Neurodiversity and language evolution: an experimental exploration of autistic individuals' language learning, use, and change

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For Ranger, Bumble, Itsy, Bitsy, Boomkin, BW, Woo, Toko, and Elza.

Abstract

Linguistic systems are shaped by those who use them; both cognitive biases and social interaction influence how language evolves. However, a common assumption in research on language change and evolution is that the ‘majority wins’, such that the linguistic features that prevail reflect the cognitive biases and social functioning of the most common (or ‘typical’) individuals. This thesis challenges this assumption, focusing on the contributions of neurodivergent, particularly autistic, language users to linguistic change. I motivate this shift through focusing on the crucial questions of *how* language change happens, and *who* does it, and argue that in order to gain a full understanding of human language, we must consider variation beyond the socially imposed norms of cognition.

To explore the relationship between neurodiversity and language change, this thesis presents a series of artificial language learning experiments, each investigating different aspects of autistic language learning, use, and change. In Chapter Three, I investigate the relationship between autistic traits, communicative efficiency, and social biases. These experiments first demonstrate that individuals with high autistic traits do adhere to the communicative efficiency trade-off between production and comprehension. Second, they show that in the presence of a social bias, people with higher autistic traits adapt their linguistic behaviour to a greater extent, retaining redundancy to meet a social goal. In Chapter Four, I present a follow-up study that sought to probe *why* people with higher autistic traits adhere more closely to social biases, and results suggest that the key mechanism driving this behaviour is autistic camouflaging. Finally, Chapter Five examines linguistic accommodation – a mechanism of language change – in mixed-neurotype interactions, extending the scope beyond autism to include ADHD. The results suggest that neurotype mixing strongly impacts linguistic behaviour in autistic people, with autistic participants accommodating most to other autistic people, least to allistic people, and intermediately to ADHD individuals.

Together, these results demonstrate that neurodivergent people can introduce changes to language not just at the lexical level, but also at the grammatical level, and that the changes introduced by neurodivergent people may differ than those introduced by neurotypical people. This highlights the need for a broader and more inclusive perspective on not just language evolution, but accounts of cognitive functioning in general that have traditionally focused on the neurotypical norm.

Lay Summary

There are over 7000 human languages spoken today. Whilst these languages may sound and look different, they also share a lot in common. Scientists think that this is because people change language over time to make it easier to learn and use. These changes can help people speak more clearly and understand each other better. We also know that different groups in society change language in different ways. For example, women may be more likely than men to start new language trends.

But one group is often left out of research on language change: neurodivergent people. These are people whose minds work in ways that are different than most others. This includes autistic people and people with ADHD. They may learn and use language differently, but we don't know how this affects the way that languages change. In this project, I take a difference-based approach to neurodiversity. That means I see neurodiversity as a natural and valuable part of human variation, and not as a problem to be fixed. It's important to include them in research to make sure that their voices are heard, and to help us better understand how language works.

In the studies for this thesis, I asked autistic people to learn small made-up languages. I then looked at how they learned these languages, and how they used them in different scenarios. First, I studied how they make language more efficient (easy to produce, but still conveying all important information). Autistic and non-autistic people both used language in a way that was considered efficient. They used either fixed word order (like in English) or case marking (like in Russian or Latin) to indicate who did the action and who it was done to, rather than using both. Next, I added a social goal. I told people to prefer a group that used both the fixed word order and case marking. We found that people with high autistic traits were more likely to keep using both of these methods of indicating who did what and to whom. In essence, they were willing to put in more effort to produce the language to meet the social goal. In follow-up work, we found that this was linked to autistic camouflaging or masking, where autistic people try and hide signs of being autistic in social settings.

Finally, we looked at how autistic, non-autistic, and people with ADHD change their language when they interact with people that they think are either autistic, non-autistic, or have ADHD. We found that autistic people adjust their language more when they interact with someone they believe to be autistic. However, people with ADHD don't change their language depending on their partner.

This research shows that neurodivergent people can also shape language, and that they might do it differently than neurotypical people. It also contributes to a new understanding of language practices, based on understanding them rather than labelling them as wrong.

Acknowledgements

Writing this sort of thing does not come particularly naturally to me, but this PhD is the culmination of all of my life's experiences up to this point. As with any other life, it is the amalgamation of thousands of small decisions and probably more people than I even recognise or remember.

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Myself and the rest of the 2020 cohort at the CDT in NLP entered our PhDs at a very strange time in the world. We weren't sure if we would be able to have in-person classes or supervision, and only weeks into the programme, restrictions were tightened again. I want to thank the CDT management who did everything they could to help us ride out those beginning rocky times, and cohort 2019, who were welcoming and valuable mentors even in trying circumstances. The CDT became a wonderfully diverse place and though I am not always good at expressing it, I hope that they know I have appreciated all of them along the way. I want to particularly thank Eddie Ungless, Anna Kapron-King, and Artemis Deligianni, and Ariadna Sanchez Cervera, who have all listened to me variously rant across the years and always provided kind voices of reason (or even, sometimes, a reciprocal rant back). From CDT management, I want to thank Sally Galloway, who kept the ship going at all times, and was always a shoulder to lean on if you needed it. And Bjorn Ross, whose unwavering commitment to pastoral work within the CDT has done the world of good across all of its cohorts, and helped me immensely at difficult times.

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Declaration

I declare that the thesis has been composed by myself and that the work has not been submitted for any other degree or professional qualification. I confirm that the work submitted is my own, except where work which has formed part of jointly-authored publications or manuscripts has been included. My contribution and those of the other authors is explicitly indicated prior to each manuscript. I confirm that appropriate credit has been given within this thesis where reference has been made to the work of others.

Lauren Fletcher

Chapter one outlines the theoretical approach taken by this thesis, referred to as the 'thesis framework', with respect to neurodiversity and autism. First, it outlines the neurodiversity paradigm and defines key terms within it. I argue that an autistic-affirming, neurodiversity paradigm based approach is essential when conducting research with autistic and otherwise neurodivergent populations. Second, I discuss the use of autism as a case study within this thesis, and how autistic perspectives were included. Third, the language choices of the thesis are exemplified and explained. Finally, I consider the methodological implications of the framework.

Chapter two forms both the introduction proper and the literature review. I introduce further relevant concepts to the thesis, particularly the use of artificial language learning (ALL) in language evolution, and relevant narratives of autism and language. This chapter partially comprises material that is to be edited and submitted as part of a special issue on Language Evolution and Diversity and Inclusion.

Chapter three presents an ALL study investigating the impact of autistic traits on communicative efficiency. Further, it considers how social biases modulate this interaction. This chapter reports the manuscript Fletcher et al. (2024) published in *Cognitive Science*. The paper demonstrates that autistic traits alone do not impact communicative efficiency; participants with higher autistic traits also balance the pressures of reducing production effort and maximising communicative accuracy. However, we find that higher autistic traits make individuals more willing to put in more production effort to meet a social goal, even though this is less efficient. We discuss implications of this finding for both language evolution and theories of autism. This chapter also includes a brief postface discussing the ramifications of the notion of communicative efficiency in the context of neurodiversity.

Chapter four follows up on chapter three by expanding the paradigm to consider a greater range of social biases and to investigate potential mechanisms behind the effect found in chapter three. Using a similar paradigm to that described in chapter three, we find that measures of autistic camouflaging are associated with an increased use of redundancy, but only for the autistic group. We find some evidence that autistic people respond to negative and positive biases differently than allistic people.

Chapter five considers the impact of neurotype mixing and matching on linguistic accommodation, and how this can impact language change. The first experiment makes three key contributions: first, that autistic adults *do* linguistically accommodate; second, that neurotype mixing reduces the amount of linguistic accommodation; and third, that the negative effect of neurotype mixing is stronger for autistic than allistic people. The second examines the impact of neuro-identity mixing with different neurominority groups (specifically, ADHD and autistic participants). We find that autistic people accommodate more to individuals with ADHD than they do to their presumably neurotypical partners, but less than they do to partners they know to be autistic. On the other hand, people with ADHD are actually less likely to accommodate when in a matched pair than a mixed pair with an autistic person. We thus discuss the importance of considering neurotype as a factor in accommodation studies beyond simple mixing and matching. In the appendices, I provide further information, such as consent, participant instructions and language background, and the analysis of some additional data: the language preferences of individuals with ADHD, national identity mixing and linguistic accommodation, and an exploratory analysis of rapport questions.

Chapter six synthesises the chapters above and provides a general discussion of findings and their application to the literature. Future avenues for research are also proposed. Finally, I give some personal reflections on doing ‘autism research’ as an autistic researcher.

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Thesis framework

“...Know that survival is not an academic skill... For the master’s tools will never dismantle the master’s house."

– Audre Lorde, 1979

1.1 Chapter outline

This chapter outlines the conceptual framework behind the thesis, providing the foundation for both the theoretical and empirical choices made throughout the thesis. It first outlines the neurodiversity paradigm and how this research situates itself within it. Next, I discuss why autism was chosen as the general ‘case study’ for this thesis, and how the research aimed to value and promote autistic perspectives. Then, I outline the various language choices used throughout the thesis and why these were chosen. Finally, I discuss some methodological implications that result from adopting a neurodiversity framework.

1.2 Neurodiversity: definitions and outline

Neurodiversity remains a controversial term that can be difficult to exactly define and has different meanings for different people and groups (see Dwyer et al., 2024, for a recent investigation on the views of autistic people and stakeholders on neurodiversity). Part of the difficulty in providing a collective definition is the fact that it is a collectively-developed term. Whilst it is oft-attributed to Singer (1999) (and her earlier thesis work), recent work by the autistic community has sought to correct the record and notes that whilst Singer may have introduced the term to the academic space, the concept was developed by the autistic community and other neurodivergent people (Dekker, 2023a,b; Botha et al., 2024). Associated terms – such as neurologically typical (now blended to ‘neurotypical’) – were also used in print before Singer (1999) by Harvey Blume (1997, 1998). Within both the literature and the writings of autistic people, various definitions have been proposed, and whilst there are many similar elements, they each place different emphasis on issues such as the social model of disability (for discussion, see Dwyer, 2022). Perhaps unsurprisingly, there thus remains a plethora of misunderstandings around the concept (den Houting, 2019; Dwyer, 2022) and many outspoken critics of it.

Nonetheless, it is important to at least have clear, working definitions of neurodiversity for the purposes of this thesis, in order to ground the work in a clear framework. As such, I adopt the influential (though by no means only, see for instance Chapman, 2020) definitions of Walker (2021) in this work. It is important to note that Walker herself also does not claim these terms as her own, and highlights the community-based nature of the development of the concept of neurodiversity. Unless otherwise cited, all definitions below are adapted from Walker (2021).

Walker (2021) argues that the term *neurodiversity* can be used in three ways. First, it simply refers to the undeniable diversity in neurocognitive functioning within the human species; it is a biological fact. Second, it can refer to the philosophical perspective of the neurodiversity *paradigm*, which asserts that neurodiversity is valuable, natural, and that there is no one 'correct' type of mind. Finally, there is the neurodiversity *movement*, which refers to social activism with the goal of the inclusion and equality for neurodivergent people. The work of this thesis primarily rests within the first two definitions of neurodiversity; it aims to demonstrate the variation in human neurocognitive functioning and how this relates to the creation and maintenance of language systems, and show that whilst there are perhaps different ways to 'do language', there is not one correct way. However, I note that I am also, informally, involved with the neurodiversity movement, and support the goals of autism activists working in this space.

Whilst neurodiversity itself describes groups (e.g. a group of individuals can be neurodiverse), other terms are required to describe individuals. The broad terms *neurodivergent*[1] and *neurotypical* are commonly used. The former refers to any individual whose neurocognitive functioning is significantly different from the social standard of 'normal'. On the other hand, neurotypical individuals' neurocognitive functioning does conform to these standards. There are very many ways to be neurodivergent, and many people are multiply neurodivergent (their neurocognitive functioning diverges in more than one way from the neurotypical norm, for instance an autistic person who also has ADHD). Some forms of neurodivergence are innate, such as autism, whilst others can be acquired, such as a neurological injury. Finally, Walker's (2021) term *neurominority* is central to later work in this thesis. A neurominority group is one where people share a similar form of innate neurodivergence and face prejudice as a result from the neurotypical community. Clear examples of neurominority groups include autism and ADHD.

As noted above, much of the groundwork for the concepts and terminology of the neurodiversity paradigm was done by autistic people. However, it is essential to note that neurodivergent and autistic are **not** synonyms (and, similarly, neurotypical and not-autistic are not synonyms). Neurodivergence is often described as an umbrella term, encompassing many different types of neurocognitive differences,

1. Walker attributes the terms neurodivergent and neurodiverse to Kassiane Asasumasu, a multiply neurodivergent autistic activist.

including (but not limited to): ADHD, dyslexia, dyscalculia, dyspraxia, plurality[2], epilepsy, obsessive compulsive disorder (OCD), tic disorders, schizophrenia, Down syndrome, dysgraphia, borderline personality disorder (BPD), and functional neurological disorder (FND). Many neurodivergent people are not autistic, but they are also clearly not neurotypical. As such, *allistic* (a neologism first used by Andrew Main, 2003) will be the term used to describe all individuals who are not autistic, whilst neurotypical is reserved for individuals who are not known to be neurodivergent.

1.3 Language choices to describe neurodivergent groups and individuals

Whilst the above section described the neurodiversity paradigm in broad terms, below I discuss more specific approaches to the language used to describe neurodivergent groups and individuals. The language choices outlined below were chosen to reflect the values and assumptions of the neurodiversity paradigm, and broadly aim to avoid pathologisation and promote the autonomy of neurodivergent individuals.

1.3.1 Guiding Principles

The key guiding principle behind deciding how one should refer to any minority group is that their preferences should take precedence. This thesis adopts this approach, and uses research with the relevant minority groups to guide language choices, as well as (where relevant) lived experience. Further, I consider the arguments of various disabled and autistic scholars on the philosophy behind various terms. For a comprehensive review of various potentially ableist terms to describe autism and suggested alternatives, see Bottema-Beutel et al. (2021). Here, I focus specifically on the terms relevant to this thesis.

1.3.2 Language choices and autism

There has been much debate amongst autistic people and stakeholders (such as parents and clinical practitioners) regarding the use of identity-first (e.g. ‘autistic person’) versus person-first (e.g. ‘person with autism’) language. This thesis adopts identity-first language. This is in line with the preferences of autistic people in large-scale studies of English-speaking (since all our participants are reported native speakers of English) populations (Botha et al., 2021; Kenny et al., 2016a; Bury et al., 2020). Additionally, ethical concerns have been raised regarding person-first language, such as the fact that it is applied unequally; e.g., a non-disabled person is much less likely to be described using person-first language than a disabled person (Gernsbacher, 2017).

2. Generally referred to in the clinical literature as Dissociative Identity Disorder (DID)/Other specified dissociative disorder (OSDD)

However, as with any group, autistic individuals' opinions are not homogeneous; whilst studies generally report identity-first language as preferred, many autistic adults do endorse terms such as 'on the autism spectrum' (Bury et al., 2020); Keating et al. (2023) estimates that 30% of a global English-speaking sample of the autistic community endorses this term. Though this is not an insignificant proportion, I have intentionally avoided the use of this phrase in the thesis. As an autistic researcher, I (and other autistic people, see Bonello (2017) for an example) find that this phrase is often used in a way that is inaccurate and unhelpful. Allistic people often suggest that it means that 'everyone' is a 'little bit autistic', minimising the autistic experience and neglecting the fact that the spectrum is instead meant to encompass the heterogeneity of autistic experiences, and not include allistic people. Further, as argued by Walker (2021), the term is unnecessarily euphemistic, and suggests a reluctance to simply call an autistic person autistic. I argue that identity-first language is more fitting with the neurodiversity paradigm, and that 'on the autism spectrum' is not the neutral linguistic choice it has sometimes been portrayed as.

When describing the recruitment protocol for this thesis, I note that (in line with their guidelines) I used the phrasing provided by Prolific for asking individuals about their autism status. Prolific's question specifically asks about 'Autism Spectrum Disorder' and 'Asperger's Syndrome'. However, unless absolutely necessary (e.g. when describing the definitions provided by the DSM), I avoid using either of these terms. For the former, autistic people reject stigmatising, medicalised language (Kenny et al., 2016a; Bury et al., 2020) such as 'disorder'-based terminology. As for the latter, as discussed by Chapple & Worsley (2021), the term is no longer accepted as an official diagnosis (American Psychiatric Association, 2013) and the autistic community has concerns about the potential elitism associated with the term (Kenny et al., 2016a; Kapp, 2020) and its relation to Hans Asperger's at-least complicit participation in the murder of disabled children (Czech, 2018; Sher, 2020).

Related to the debate about 'Asperger's Syndrome' is the issue of 'function labels', such as 'high' or 'low' functioning to describe autistic people. In lieu of the traditional ways of categorising different 'subsets' of autism – such as Asperger's, 'classical autism', and Pervasive Developmental Disorder – many practitioners have turned to the use of function labels instead. Function labels have been criticised on multiple fronts: first, the autistic community has concerns that functioning labels promote stigmatising stereotypes, are unhelpful and inconsistent, and are used to deny care (Keating et al., 2023; Keates et al., 2024); and second, the term is often used simply as a way of classifying whether an individual has an intellectual disability or not, and high intelligence is not clearly associated with better functional outcomes (Alvares et al., 2020). In this thesis, I use 'support needs' in lieu of function labels, and specify the relevant areas of need; for instance, my participants are likely to have lower support needs in terms of day-to-day communication and language. Importantly, it must be noted that having lower support needs in one area does not entail that an individual has *no* support needs. As discussed within the studies themselves, we also do not have much information on the characteristics and support needs of the autistic population on Prolific, and thus broad assumptions on support needs should be avoided.

Finally, I briefly touch upon the notion of disability. Whilst this thesis is not seeking to answer any questions regarding autism and disability, it is important to clarify this issue as it is a common debate of both proponents and critics of the neurodiversity movement. The definition of neurodiversity that I have used here does not discount the notion that autistic people are disabled[3]. Indeed, I note that I do consider myself to be disabled as a result of being autistic. The neurodiversity movement is generally associated with the social model of disability, which conceptualises disability as arising from the failure of society to accommodate an individual's needs, rather than inherent 'deficits' that are part of individuals. This notion of disability, at least in its strongest formulation, is not perfect. Whilst many autistic people relate their experience in social model terms, others argue that even in an ideal, autistic-accessible world, they would still be disabled. This thesis does not seek to take a definitive stance on the social model of disability, though it is more aligned with it than the medical model. It is likely that a social approach to disability needs to be augmented with the recognition that being disabled can and does come with negatives that are not only rooted in social oppression, such as disabilities that cause chronic pain (for discussion, see Barnes, 2016; Shakespeare, 2016).

Regardless of the exact model used, I fundamentally reject the notion that to be disabled is something *inherently* negative or something that we must always seek to cure. To be disabled does not reduce one's humanity or worth, and there is nothing wrong with saying the word 'disabled' (just as there is nothing wrong with saying the word 'autistic'). Following this logic, one might be disabled as a result of being autistic, but that does *not* mean that being autistic is inherently negative. There have always been, and will continue to be, autistic people. This thesis is built on the principle that the contributions of autistic people are worthy of attention outside of identifying 'deficits' that need to be 'fixed'.

1.4 Language choices to describe other neurodivergent groups

As noted by Grech et al. (2023), there has been little recent research on the language preferences of non-autistic neurodivergent or otherwise disabled people. It is also notable that many of the preferences described by autistic people – avoiding 'disorder' based language, using identity-first instead of person first phrases – are not followed when describing members of other neurodivergent groups, or indeed even other disabled groups in general. The clearest parallel is the terms used to describe individuals with ADHD; the term 'disorder' remains in the name, and individuals are usually referred to as 'having' or being 'with' ADHD. Anecdotally, individuals with ADHD who are closely involved with the neurodiversity movement are moving towards identity-first language such as 'ADHDer' and 'kinetic', the latter proposed by Walker & Raymaker (2021), but there has been no empirical research on the topic.

3. In line with Walker (2021), I use the terminology 'autistic people are disabled' rather than 'autism is a disability'.

In Chapter Five, I describe a study that includes people with ADHD as a second neurodivergent group alongside autistic people. In line with the guiding principles outlined above, I did not seek to impose language choices upon a group that I was not a part of, and thus we surveyed our participants to understand their preferences. These are reported in an Appendix in Chapter Five, but I note now that I use the preferences of this sample in discussing ADHD, and thus I use person-first language to describe this group throughout the thesis.

1.5 Autism as a case study and the inclusion of autistic perspectives

The relationship between autism and language has been highly studied and yet remains unclear. Whilst communication differences are a universal feature of autism, the nature of those differences is not uniform, and they are also not always immediately evident due to strategies such as autistic masking. For a full discussion of the linguistic features of autism, see Chapter Two.

What we do know, however, is that autistic people can, and have, contributed to language change. As discussed above, the terminology used in the neurodiversity movement was coined by autistic people, and it is increasingly common to see neurotypical people or other neurodivergent allistic people use this language. This is a key reason why autism was chosen as a case study for this research; there is evidence that autistic people can contribute to language change, and thus arises the question of what kinds of changes they might drive (besides the lexical changes already outlined). Despite this evidence, when autism has been engaged with in language evolution, it has only been through a deficit-based lens, built on pathologising and often dehumanising assumptions. For instance, it has been argued that autistic people represent some earlier stage in human language evolution than allistic people (Haworth, 2006) and that there are similarities between the Neanderthal brain and the autistic brain, the latter of which is somehow considered less ‘domesticated’ (Benítez-Burraco et al., 2016). Pinker (2002) directly compares autistic people to robots and chimps, supposing that they are unable to participate in cultural learning. Other neurodevelopmental conditions such as Williams Syndrome (WS) have also suffered similar fates in the language evolution literature, such as the suggestion that whilst autism is evidence of ‘failed domestication’, WS is the result of ‘over-domestication’ (Niego & Benítez-Burraco, 2019). Ultimately, it is necessary for the field to seriously engage with neurodiversity, including autism, in ways that do not reinforce the ableist ideas discussed here, both for the progression of science and for ethical reasons.

A second key reason for choosing autism as the primary case study for this thesis is that the researcher is autistic. It is important that research with minority groups, such as neurodivergent people, is done by or in close collaboration with members of said minority group, including with autistic people (Chown et al., 2017; Fletcher-Watson et al., 2019). Of course, my perspective only represents one autistic person (though I note that I have informally discussed my work with other autistic people throughout); future work in this paradigm should continue to amplify autistic voices and include more perspectives, including those of autistic people with higher support needs or who use alternative communication systems.

1.6 Methodological implications

Adopting the neurodiversity framework has several methodological implications, ranging from recruitment to statistical analysis. Below, I discuss in particular the method of recruitment for autistic participants (in this case, online) and the statistical choices made.

1.6.1 Making research accessible for autistic participants

Over the past decade or so, there has been an increase in the use of crowdsourcing online to obtain data in experimental cognitive science, and this was enhanced further by restrictions during the COVID-19 pandemic. This seismic change in how research is done has persisted since the relaxation of COVID-19 related restrictions. There has been much discussion within the literature about the impact of moving behavioural studies online, both positive and negative (Stewart et al., 2017), and whether the same results are obtained in the lab versus online. For instance, there have been concerns about data quality, due to participation being much less strictly controlled than in a lab setting (Rodd, 2024), though existing studies suggest comparable results (Krendl et al., 2024). In particular, participants on Prolific – the platform used for recruitment in this thesis – have been shown to generally produce quality data (Peer et al., 2022; Douglas et al., 2023).

One potential benefit of using online experiments is the ability to reach a much greater range of participants than was previously possible. Participants in behavioural experiments in the cognitive sciences have traditionally been rather homogeneous; they are typically white, western, and educated young people (often undergraduates taking relevant courses) (Henrich et al., 2010). Online experiments can allow a researcher access to a much richer participant pool; whilst crowdsourcing platforms also represent only a segment of the population (Paolacci & Chandler, 2014), Prolific in particular seems to have a more diverse participant pool than other options (Peer et al., 2017). Of particular relevance to this thesis, one group that might find participation online easier is neurodivergent people, particularly those with communication and social differences, such as autistic people.

Autistic people's motivations and barriers for participating in research have been investigated across a number of prior studies, which have considered a diverse range of autistic participants. Haas et al. (2016) found that autistic people are motivated by a desire to improve the lives of autistic people, but that barriers included inaccessibility, travel, and mental and physical health difficulties. Participants noted in Gowen et al. (2019) that finding and accessing university buildings can be a source of anxiety for autistic participants. Online research reduces some of these accessibility challenges; travel is not required, and participants can complete tasks in the comfort of their own spaces, rather than needing to both find and then spend significant time in unfamiliar and overwhelming environments. Many autistic people prefer communicating online rather than face-to-face (though these preferences are varied) (Howard & Sedgewick, 2021; Davidson, 2008), and may be more comfortable in the online research environment. Indeed, previous work suggests that MTurk workers have higher levels of autistic traits than a typical university subject pool (Chandler & Shapiro, 2016), perhaps reflecting the greater accessibility of these platforms compared to research in the lab.

However, concerns remain. First, whilst online experiments may be a good adjustment for some autistic people, this will not be the case for all autistic people. Second, there are concerns that not all autistic participants in these online studies are actually autistic, and that some people may be intentionally lying or acting maliciously. In the experience of collecting data for this study, it was not uncommon to find participants who had told Prolific that they identified as autistic, but answered the same question in our study saying that they did not identify as autistic. Pellicano et al. (2024) note that they believe some of the participants in their studies have been fraudulent, potentially for financial gain. A researcher working within the medical model may also note that as there is no practical way to verify diagnoses in the online crowdsourcing environment, it is possible for people to lie about their autism diagnostic status.

It is necessary to be cautious about some of these concerns. First, as Pellicano et al. (2024) do rightfully point out, measures to prevent 'scammer' participants may disproportionately impact autistic people. For instance, assuming that 'stilted' or short emails or conversations indicate the possibility of fraud, or using measures intended to detect Generative Artificial Intelligence ((Gen)AI), could lead to the exclusion of autistic people (see Gegg-Harrison & Quarterman, 2024). To give another example, requiring individuals to verify their identity by turning on their video cameras would be distressing for some autistic people. Further, an autistic person's diagnostic status is *not* indicative of their actual autism status; many autistic people are undiagnosed, and yet remain autistic. Self-identification is a necessary first step towards diagnosis, but that does not mean that autistic people must continue on to diagnosis. In fact, there are important factors that contribute to some autistic people never seeking or receiving a formal diagnosis, such as diagnostic barriers for some minority groups (R. M. Green et al., 2019; Steinbrenner et al., 2022), or the stigma resulting from diagnosis (Fletcher-Watson, 2024). Additionally, emerging research suggests that the self-diagnosed and formally diagnosed autistic populations have similar characteristics (Sturm et al., 2024).

1.6.2 Statistical analysis

Statistical analysis choices are never neutral, particularly in the context of discussing marginalised groups, including, in this case, neurominority groups. The choices made, from the overall statistical paradigm to the choice of contrast coding, comes with assumptions about said groups. For instance, using treatment coding requires setting a 'baseline' or 'reference' condition. When comparing neurotypical and neurodivergent groups – in this case, allistic and autistic – it often seems intuitive to use 'allistic' as the baseline for that comparison via treatment coding. However, this feeds into the notion that 'allistic' is the 'norm', and 'autistic' is 'other' in some way. This sets us up to assume that the *autistic* group is where the differences (and, implicitly, 'deficits') lie, rather than the fact that *both* groups are different to each other.

This sort of reasoning has been used to argue that autistic performance is somehow 'worse' than neurotypical performance, because it is statistically 'lower'. For instance, take the 'Theory of Mind' approach to autism. Many studies report that autistic people perform 'statistically significantly worse' than allistic people as a group. At worst, this has been taken to indicate that autistic people have *no* theory of mind at all. This strong conclusion is not supported by even frequentist analysis – a statistically significant difference in performance does not mean that autistic people were at the floor in performance and cannot do the task at all. However, even outwith this extreme interpretation, the results are used in narratives claiming a 'deficit' (sometimes a universal one) in autistic theory of mind. These models assume a degree of homogeneity that is not realistic for any neurotype, let alone the entire species.

The reader will notice that the statistical framework throughout this thesis, and its associated publications, changes from frequentist to Bayesian. Initial statistical analysis choices were made based on existing expertise; as with many other linguists, my statistical training was entirely frequentist, and thus this was what I knew how to apply to my data. However, as a result of both the high degree of variability within my data, and my observations of how often frequentist analysis is used to inform deficit-based narratives, I then swapped to a Bayesian framework.

1.7 Summary

This chapter has outlined the theoretical framework behind the thesis. First, it outlined and defined the neurodiversity paradigm, which informs the high-level viewpoint of this work. I argued that the neurodiversity paradigm is the correct lens through which to conduct research with neurodivergent participants, including autistic people. Second, I discussed the rationale behind the language choices employed in this thesis. I noted that this thesis uses identity-first and support needs-based language, rather than person-first and function labels. I discussed the choice not to use phases such as 'on the autism spectrum' or 'Asperger's Syndrome'. I outlined the debate around these choices, and emphasised that different autistic people prefer to be referred to in different ways. Third, I considered the choice of autism as a case study in language evolution and neurodiversity research. It argued that autistic people have very rarely been considered equally in linguistic research, and confined to discussions of language disorders and deficits. Finally, I provided reflections on how the neurodiversity paradigm influenced my research design, methods, and analysis, including issues of accessibility for autistic participants in experimental linguistics.

2

Neurodiversity and language evolution: what is the role of broader cognitive diversity in shaping language?

“Not all features of atypical human operating systems are bugs."

– Steve Silberman, 2015

2.1 The *hows* and the *whos* of language evolution

The previous chapter outlined the neurodiversity paradigm and related terms and concepts. This conceptual framework forms the central tenant of this thesis: human behaviour can only be fully understood through a lens that recognises the full spectrum of it. The area of human behaviour that this thesis explores is language use, change, and evolution.

Of the multitude of questions facing those who study language evolution, this thesis focuses on two in particular: *how* does language change happen, and *who* does it? This section explores previous research on both of these questions whilst arguing that, in order to gain a full understanding of either, it is necessary to consider the full range of human cognition. First, I discuss some mechanisms behind language change and evolution, focusing on underlying cognitive processes and biases and the ways in which these have been examined. I discuss how those various cognitive processes and biases are not homogeneous across the population, leading me to turn to the question of *who* drives language change. Whilst various sociolinguistic and cognitive factors that lead to heterogeneity in language change have been studied, the impact of neurodivergent language users remains unexplored. Here, I argue for the inclusion of neurodiversity as a vital social and cognitive variable in understanding language evolution and change. Finally, I outline relevant narratives of cognition and language amongst neurodivergent language users. I consider a range of neurotypes in brief, but focus on autistic perspectives as a case study.

The text below will be adapted as part of an invited chapter for the Oxford University Press Encyclopedia of Linguistics titled ‘Language and Neurodiversity’.

2.2 Cognitive mechanisms behind language change and evolution

Languages are undeniably diverse, as illustrated in Evans & Levinson's (2009) controversial yet widely cited demonstration of linguistic diversity (see also Levinson & Gray, 2012 and Lupyan & Dale, 2016). Yet, much linguistic study has been spent trying to demonstrate the ways in which they are similar. Indeed, whilst there are many ways for language to achieve its goals, only a subset of strategies appear to be used. Consider, for instance, the basic ordering of Subject, Object and Verb. Whilst there are six logically possible orders, SOV and SVO are wildly over-represented in the world's languages, whilst OVS and OSV are extremely under-represented, totalling only 15 languages in a sample of 1376 (Dryer, 2013b)[1]. Whilst some of this is likely driven by language contact and language relatedness (since dominant word orders, and many other features of language, do cluster geographically, cf. Ladd et al., 2015), there is a rich body of work arguing that the preference for SOV and SVO word orders also reflect underlying cognitive and learning biases, where SOV and SVO are the more cognitively 'natural' or more easily learned (Goldin-Meadow et al., 2008; Futrell et al., 2015; Tily et al., 2011; Tabullo et al., 2012).

This is not only the case for word order; cognitive biases have been appealed to to describe a wide range of statistical commonalities across language. Further, a number of different types of cognitive biases have been described. Whilst biases differ in terms of what part of cognition and language they interact with, the theoretical nature of them also differs. Historically, language 'universals' were ascribed to domain-specific, hard constraints, within the framework of Universal Grammar (Chomsky, 1965). More recently, linguists have turned away from absolute universals and considered cognitive biases that do not place absolute constraints, and are often not language-specific (though see, for instance, Schouwstra & de Swart, 2014, for a hypothesised linguistically driven bias towards agent-first word order). These biases are often described as weak biases, in contrast to the strong, innate constraints that are imposed by theories such as Universal Grammar (B. Thompson et al., 2016). These biases vary in their exact nature and purpose. Research has formulated biases that impact linguistic processing (Dye et al., 2017; Fedzechkina et al., 2018), learning (Fedzechkina et al., 2012), production (MacDonald, 2013; Ferdinand et al., 2019; Fay & Ellison, 2013; Tal et al., 2022), and communication (Gibson et al., 2013; T. H. Clark et al., 2023; Fedzechkina et al., 2022; Fedzechkina & Roberts, 2020). Some biases involve more than one of these processes at a time (e.g. the bias for communicative efficiency, which is a trade-off between reducing production effort and maximising information transfer (Gibson et al., 2019; Levshina & Moran, 2021), whilst different types of biases have been shown to interact differently with certain linguistic features (Keogh et al., 2024).

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1. Though many typological studies treat dominant word order as categorical, and for the purposes of discussion here I do also, see Levshina et al. (2023) for a recent discussion on why word order may be better conceptualised as a gradient phenomenon that is by default variable.

Importantly, these weak biases are amplified through a process of cultural learning, whereby individuals learn language from the existing language users of their community (Kirby et al., 2015, 2014; Smith, 2011). Given the pressures for learning and communication in culturally transmitted systems, structures that are easier for learners to learn (or for producers to produce, or for listeners to understand) are more likely to persist across generations. In other words, iterated learning allows small, individual-level changes to cumulatively impact the population over time (B. Thompson et al., 2016).

2.2.1 Probing cognitive biases

Much of the evidence I provided above to support the notion of cognitive biases driving cross-linguistic tendencies is based on experiments using a paradigm known as Artificial Language Learning (ALL)[2]. ALL has its roots in Artificial Grammar Learning (cf. Reber, 1967), which as a paradigm has been used to answer questions about implicit versus explicit learning (Pothos, 2007), transfer effects across different grammars (Gomez et al., 2000; Ziori & Pothos, 2015), and the capacity of both human and non-human animals to learn grammars of different computational complexities (Fitch, 2018; Zuberbühler, 2019). Where AGL targets specific syntactic complexities of grammars (cf. the Chomsky Hierarchy, Chomsky, 1956) through relatively simple grammars lacking semantic content (with exceptions, such as the BROCANTO paradigm used by Friederici et al., 2002), ALL experiments are richer, implementing semantics and often communication-like pressures.

In essence, an ALL experiment involves teaching participants a 'mini' artificial language in the lab, that has some feature of natural language that the researcher wishes to test. Importantly, ALL experiments are built on observations from natural language data. For instance, the work arguing for a cognitive bias of some sort driving the typological patterns in the basic word order of the clause uses ALL experiments to directly test these already observed patterns, e.g.,Tabullo et al. (2012), who directly test the idea that less frequent word orders are harder to learn, i.e. a cognitive learnability bias. Notably, ALL experiments allow us to not only ask if there is a bias, but also what the nature of that bias might be. Take, for instance, the typological observation that plurals tend to be marked, whilst singulars are unmarked (Haspelmath, 2021; Dryer, 2013a). As described by Kurumada & Grimm (2019), this has often been attributed to markedness, but the exact nature of markedness is unclear; one argument suggests that that concept of plural is more complex than the concept of singular, whilst another suggests that singular is more predictable, and thus 'default', than plural. Kurumada & Grimm's (2019) artificial language learning experiment allows them to directly manipulate and test this predictability hypothesis, as natural language data alone does not give us clear information about predicability. They find that participants are more likely to produce plurals for nouns in categories that are often singular, and less likely to produce plurals for nouns in categories that are often plural, in line with the predicability hypothesis. To give another example, consider Differential Object Marking (DOM), where languages only require case marking on some objects, and not others (Haspelmath, 2021, 2019; Iemmolo, 2010). Generally

2. Similar paradigms are also sometimes referred to as experimental semiotics (Galantucci et al., 2012); the two terms have a good deal of overlap in the literature, though experimental semiotics generally focuses more on communication and the emergence of entirely novel communication systems.

speaking, DOM appears to rely on the semantic or pragmatic function of the object in question, but the exact mechanism remains a matter of debate. Again, ALL allows us to test particular hypotheses about DOM; Fedzechkina et al. (2012) find that DOM is conditioned on animacy (i.e. animate objects are marked, as they are less typical than animate subjects/inanimate objects), whilst Tal et al. (2022) recently found that information structure indirectly contributed to DOM.

Whilst ALL cannot work on its own and must be interpreted alongside natural language data, it is a powerful tool that allows us to test *causal* hypotheses about why languages look the way they do (Fedzechkina et al., 2016b). Whilst the exact nature of ALL experiments differs, with factors such as widely varying vocabulary sizes and whether vocabulary is fully novel to the learner or similar to the phonotactics of their native language, they offer a controlled environment, and have been shown to parallel real-world L2 learning (Wonnacott et al., 2008; Ettlinger et al., 2016) and activate similar areas of the brain as natural language learning (Friederici et al., 2002) and processing (Verhoef et al., 2024; Malik-Moraleda et al., 2025). ALL can also be used across a range of modalities, going beyond typical spoken and written language to include silent gestures (e.g. Motamedi et al., 2019) and even non-linguistic stimuli (e.g. Stevens & Roberts, 2019; Theisen et al., 2010; Culbertson et al., 2024). ALL studies have been used across a wide domain of linguistic phenomena beyond those already discussed, such as syntax (e.g. Culbertson & Newport, 2015), morphology (e.g. Saldana et al., 2021), phonology (e.g. White, 2014; Martin & Peperkamp, 2020), and semantics (e.g. Chemla et al., 2019a) (see Culbertson, 2023, for a recent review of ALL experiments, particularly with respect to syntax).

In this thesis, I present a series of ALL experiments with neurodivergent (primarily autistic) people. I chose this method given the attributes described above; it is controlled and allows us to test specific features in absence of confounding factors. Furthermore, its ability to test causal hypotheses allowed us to test whether specific aspects of autism, such as camouflaging or attention to detail, were related to specific linguistic behaviours. As with all ALL experiments, however, it must be supplemented with real-world language data. In Chapter Six, I return to this point and argue that there is a need for the ethical collection of naturally-occurring autistic language data. For now, I focus on what these controlled experiments can reveal about how autistic cognitive traits may shape language use.

2.3 Variation in language change

Above, I focused on the question of *how* language changes, particularly with respect to the role of individual cognitive biases and how they cumulatively can lead to population-level changes. Now, I turn to the second foundational component of this thesis, which is *who* drives language change. I begin by considering the social factors that impact language change at the macro-level, such as the impact of overall community size and makeup. Then, I turn to variationist sociolinguistics, and consider the impact of social identity on language change.

First, within the language evolution literature, a substantial amount of work has considered the impact of various cultural and environmental factors on language change. Termed sociolinguistic typology (Trudgill, 2017, 2011), one school of thought considers the relationship between factors such as community size and the proportion of L2 learners on linguistic complexity. Wray & Grace (2007) hypothesised that languages used in insular communities tend to be more complex, whilst languages that are used for more inter-group communication are simpler and more regular. Along similar lines, others have argued that that smaller communities have more complex languages than those used in larger communities, as a consequence of differences in preferences between L1 learners in small populations, and L2 learners in larger, less insular populations (known as the Linguistic Niche Hypothesis, Dale & Lupyan, 2012) (Lupyan & Dale, 2010; Nettle, 2012; Bentz et al., 2015, 2018). Josserand, Allassonnière-Tang, et al. (2024) take a more nuanced approach, considering factors beyond simple community size, and find that variation occurs when individuals are less well connected to each other. Work in the lab also tentatively supports these ideas, with Raviv et al. (2020) finding that languages emerging in small social networks show the greatest variation in linguistic behaviours. This theory is not without its criticism, with Koplenig et al. (2023) finding that larger populations have languages with higher complexity, and Shcherbakova et al. (2023) finding no correlation between complexity and sociodemographic factors. These conflicting results found when examining large samples of the world's languages are likely driven, at least in part, by different measurement and database choices (Lupyan & Raviv, 2024). Taken as a whole, however, the evidence thus far suggests that high-level social factors such as community size can have an impact on language, though the exact nature and extent remains to be determined.

Whilst macro-level factors such as community size can provide valuable insight into broad patterns of language variation, this thesis focuses on a more fine-grained perspective, looking at variation within and between specific languages and groups. This approach aligns with variationist sociolinguistics, which argues that variation both reflects and constructs social meaning in the form of various identities (such as age, gender, class, or even more specific identities like 'jock' or 'goth'[3]) (Eckert, 2008, 2012).

Notably for the purposes of this thesis, variationist sociolinguistics highlights that innovation in language often comes from marginalised groups; for instance, it is commonly argued that women are the main drivers of language change (Labov, 1990, 2001; Tagliamonte & D'Arcy, 2009). Marginalised groups driving language change can also be seen on modern social media platforms; for instance, the use of 'algospeak' (where users creatively alter words and phrases to avoid content moderation policies) is common amongst marginalised people online (Steen et al., 2023), and phrases such as 'unalive' are becoming ubiquitous both on and offline amongst young people (McArthur, 2024). Many terms that originated in African American Vernacular English (AAVE) are now commonplace in everyday

3. Though not extensively considered by this thesis, it is important to remember that sociolinguistic categories are not fixed nor easily defined. The use of fixed categorical variables, such as black or white and male or female, does not reflect diverse social reality. This is also the case when considering neurodivergent identity; many neurodivergent people are multiply neurodivergent, some have a stronger sense of neurodivergent identity than others, and some never know that they are neurodivergent.

vernacular (S. Thompson, 2021); for instance, the term ‘woke’ is common across British media (albeit in an often negative way, see Cammaerts, 2022). To give a relevant example oft-cited in this thesis, tone markers (e.g. /s for sarcasm) have widespread usage online, and their origin is often attributed to autistic people (Marcus & O’Neill, 2020).

Social meaning thus has a crucial role to play in language change, but much of the work done on social variation and language evolution focuses on the macro-level factors outlined above, rather than more specific social identities[4]. However, considering the role of social variation on language evolution on a broader scale is more difficult with traditional variationist sociolinguistic methods. Empirical data collection in sociolinguistics is time-intensive, and often conducted in specific speech communities, whose language is shaped by a wide range of cumulative factors, making it difficult to identify a single factor that might drive a linguistic feature or eliminate confounding variables (cf. Hernández-Campoy, 2015; Sharma, 2025). Whilst computational sociolinguistics, driven by access to large-scale data, is able to benefit from much faster and easier data collection (for review, see Nguyen et al., 2016), online language does not necessarily reflect offline language (though the two are certainly interlinked, see Ilbury, 2025, for a recent discussion).

G. Roberts & Sneller (2020) argue that sociolinguistics would benefit from experimental paradigms that are currently used by those working in language evolution, such as ALL (and indeed, that those working in language evolution would be benefitted by working more closely with their sociolinguist colleagues). They note that whilst the two fields are parallel, innovations within one are often not communicated to the other, and a clear example of this is the use of ALL paradigms. These are now widespread within language evolution, but are not commonly used by sociolinguists. There is some work that has explicitly connected ideas from language evolution and sociolinguistics in ALL experiments. Ongoing work considers the impact of gender, other social constructs, and personality traits on change driven by linguistic accommodation, with preliminary results suggesting that women are more likely to change their grammar to be more like their partner’s *after* interaction (Cheung et al., 2024). Sneller & Roberts (2018) consider the impact of the social perception of different groups (specifically, one group is perceived as weak, whilst the other as strong), and find that participants are driven to using the linguistic traits of the socially desirable group. Though not directly related to any real-world sociological category, G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) find that biases towards certain groups lead language learners to increase redundancy in language, and even become less informative. However, it is clear that there is great scope for ALL to provide a controlled environment to test sociolinguistic hypotheses relating to social identity.

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4. Sociolinguistics undoubtedly also places importance on the macro-level social factors that language evolution researchers have examined (see Mühlenbernd & Quinley, 2017, for discussion of network structure and variationist sociolinguistics), but here I instead focus on what sociolinguistics has to say about specific social identities.

However, to date, sociolinguistics has not considered neurodiversity as a driver of linguistic variation. This may be due to the fact that it is only relatively recently recognised that being neurodivergent can be as much a social identity as it is an instance of cognitive variation. For instance, many autistic people consider themselves to have an autistic identity and to be a part of the autistic community (Botha & Gillespie-Lynch, 2022; Cohen et al., 2022; Davies et al., 2024; Øverland et al., 2024; Silberman, 2015). Language is a powerful tool that both reflects and builds identity (Bucholtz & Hall, 2005; Eckert, 2012, 2008), and it is thus intuitive that neurodivergent people may also use language to build their identities as neurodivergent people. Previous work has shown that autistic people both construct and deconstruct narratives online in the process of developing autistic identity (Egner, 2022), though not much attention has been paid to how they might use specific language features to do that. For a closer example, Guntuku et al.'s (2019) find differences in the language of social media users with ADHD compared to a control group, though the focus of this paper was on the 'detection' of ADHD using machine learning, rather than how people with ADHD build their ADHD identity.

The recent recognition of neurodiversity as a social identity cannot, however, be the only reason behind this prior lack of attention. Sociolinguistics has long acknowledged the role of cognitive factors in language change, even if they have not always been foregrounded. For instance, the third volume of Labov's seminal Principles of Linguistic Change is explicitly titled "Cultural and Cognitive factors" (Labov, 2010). Labov characterises cognitive factors in language change as "factors that influence the acquisition of the linguistic system" (Labov, 2010, p.2), and many neurodivergent conditions certainly fall under this description. Tamminga et al. (2016) also highlight the importance of psychological and cognitive factors in shaping linguistic variation. On this basis, neurodiversity should fall within the remit of research on language change and variation. Yet, the study of neurodivergent language has generally been confined to specific studies of language 'disorders'. I suggest that this disparity is best understood in light of historically ableist assumptions within both the field and society as a whole, which – implicitly or explicitly – positioned neurodivergent language practices as 'deviant' or 'uninformative', and therefore not worthy of systematic sociolinguistic variation.

This section has demonstrated that language change is not just a cognitive process, but also a social one. Marginalised groups tend to drive innovation, and language is used in ways that both reflects and creates identity. However, this work has not yet considered the importance of neurodivergence as an axis of variation that could contribute to language change.

2.4 Bringing neurodiversity into language evolution

Thus far, this chapter has argued that both cognition and social identity impact language change and variation; both elements contribute to *how* language changes and *who* does it. I have also argued that neurodiversity represents the intersection of both the cognitive and the social; neurodivergent people have cognitive differences, and may also form neurodivergent social identities. Despite neurodiversity overlapping both of these crucial elements, very little work to date has explicitly considered its role in language change and variation.

Below, I advocate for explicitly considering neurodiversity in the study of language evolution. First, I provide commentary on some previous research that has linked neurodiversity to language evolution, and argue that the approach taken by this research is often built on ableist assumptions and has the potential to be harmful. Then, I turn to recent considerations within the field of how 'individual differences' in cognition may contribute to language learning and change. Finally, I argue that we must go beyond differences within the neurotypical range, and consider the full range of human cognition.

Before turning to these arguments, I first note here that there are several ways of conceptualising the claim that neurodivergent people might contribute to language change. One possibility is that neurodivergent individuals, like the wider population, participate in ongoing linguistic change by adopting and propagating emerging variants. In this sense, neurodivergent people may not be the source of any distinctive innovations arising from neurodivergent cognition or social identity, but instead contribute to language change in the same way that most speakers do. This position follows naturally from the observation that most neurodivergent people are fully embedded in their language communities and adapt their linguistic behaviour as those communities change. Despite this, such participation is rarely made explicit in literature examining language variation and change.

A second way of approaching this question is to ask whether neurodivergent people might introduce particular innovations as a result of differences in cognitive processing, social organisation, or a combination of the two. This is the interpretation that this thesis primarily addresses. Specifically, I examine whether neurodivergent and neurotypical individuals differ in their use of linguistic features under certain conditions, and how such differences might scale up to affect population-level language patterns. I also consider whether the distribution and interaction of neurodivergent and neurotypical cognition within a speech community influences the types of changes that occur and their eventual outcomes. This thesis is therefore concerned not with whether neurodivergent people participate in language change per se, but with whether and how neurodivergent cognition and sociality might shape the trajectory of language change.

2.4.1 Previous accounts of neurodiversity and language evolution

Previous accounts of neurodiversity in language evolution have primarily focused on William's Syndrome, schizophrenia, and autism. For instance, some accounts consider whether the genetics of autism and other language disabilities could help us understand the genetic basis of language, and by extension its evolution (Fitch et al., 2010). This line of inquiry does, however, raise significant ethical concerns. Some autistic people argue that such studies do not reflect the research priorities of autistic people, who instead want research to focus on improving social conditions and quality of life (O'Dell et al., 2016; Roche et al., 2021), whilst others argue that such data could be misused in efforts to 'cure' or even 'eradicate' autism (Sanderson, 2021). Moreover, given the large heterogeneity of autism and the thousands of genes that have been claimed to be involved and interact with each other in autism (Iakoucheva et al., 2019), it is unlikely that such research would provide any answers into the evolution of language any time soon.

However, other proposals within the literature are much more problematic, and often risk actively dehumanising neurodivergent people based on untrue, sweeping assumptions about neurodivergent behaviour and motivations. One line of research directly compares autistic people to non-human hominids; Tomasello et al. (2005) claim that autistic children – *like apes* – do not have 'the motivation or capacity to share things psychologically with others'; directly comparing autistic people to apes is inherently problematic, but this idea also assumes that all autistic people neither can nor want to be social, a proposal that has recently been debunked (Jaswal & Akhtar, 2019a). Similarly, Pinker (2002) compares autistic people to robots (and again apes), stating that we remind him 'that cultural learning is possible only because neurologically normal people have innate equipment to accomplish it'. It has been argued that autistic people somehow represent an earlier stage in human evolution than allistic people (Haworth, 2006), and that there are greater similarities between the Neanderthal brain and the autistic brain than the allistic brain (Benítez-Burraco & Murphy, 2016). The notion that autistic people are 'less evolved' is troubling both ethically and scientifically, as there is *no such thing* as any species, or part of a species, being 'less' or 'more' evolved than others. Such arguments bear similarity to scientific racism, which has a long history of claiming that Black people are somehow closer to apes than White people, a pervasive myth that still persists today (Goff et al., 2008; Chisango et al., 2023).

Some have compared art by autistic people to that of pre-modern humans (Folgerø et al., 2021), and from this claimed that supposed 'superior' visual perception, as present in autism, is the 'price' of language, as autistic people supposedly cannot have *both* 'superior' visual perception and language (Johansson & Folgerø, 2022). Whether autistic people truly do have 'superior' visual perception or not remains an open question regardless, with many authors actually claiming that autistic people's visual perception is 'deficient' (e.g. Thye et al., 2018; Takarae et al., 2008). Similarly, Crow (1997) suggests that schizophrenia is 'the price' of language, arguing that 'language and psychosis have a common evolutionary origin'.

Self-domestication has been argued to be crucial in the evolution of language as a means by which traits essential to cultural transmission emerge (Thomas & Kirby, 2018). Benitez-Burraco and colleagues have argued that conditions that fall under the neurodiversity umbrella such as autism, schizophrenia, Tourette's syndrome, William's Syndrome, and even synaesthesia represent either a 'failure' of human self-domestication, or a 'hyper-domesticated' human phenotype (Benítez-Burraco et al., 2016; Benítez-Burraco & Progovac, 2021; Niego & Benítez-Burraco, 2019). This framing is deeply problematic and dehumanising, framing neurodivergent people as a 'failed' product of an evolutionary process, and implying an evolutionary hierarchy.

As a whole, previous accounts of neurodiversity in language evolution are insufficient, outdated, and potentially harmful. A better understanding is needed, one which incorporates the perspective of neurodivergent people and the neurodiversity paradigm. In this thesis, I hope to provide a starting point for a more inclusive study of language evolution, that values rather than dehumanises neurodivergent people.

2.4.2 Individual differences in language evolution

The study of 'individual differences' in cognitive science refers to examining the impact of inter-individual variation in various cognitive functions, and how this impacts behaviour and processing. Individual differences have been studied in a wide range of domains, such as first language acquisition (Kidd & Donnelly, 2020), executive functioning (N. P. Friedman & Miyake, 2017), phoneme categorisation (Kapnoula et al., 2017; Kapnoula & McMurray, 2021), social perception (Aquino et al., 2016), and visual perception (Tulver et al., 2019).

Studies of language evolution have recently begun to acknowledge and examine the role of individual differences in language evolution. Whilst the prevailing view in language evolution has often been that the 'majority wins' (cf. Josserand et al., 2021), recent work suggests that the minority can meaningfully impact the population-level language. Navarro et al. (2018) find that simulated agents with extreme individual differences (i.e. some agents have stronger biases than others) can drive unbiased agents towards more extreme behaviours, and when there are competing biases within the population, both seem to play a part in the final population-level grammar, which does not easily reflect the average of both group's priors. Similarly, and also using simulated agents, Josserand et al. (2021) find that minority biases are resilient, and that the language of the majority is impacted by the biases of the minority.

Turning to experimental paradigms rather than computational simulations, Josserand, Pellegrino, et al. (2024) use a paradigm where 4 participants form 'micro-societies' and interact using an artificial language via typing. Interestingly, the authors simulate something akin to a speech disability by giving 1 participant access to only a subset of the full keyboard input given to the other participants, meaning that they are physically unable to produce the full range of letters used in the artificial language. In these heterogeneous groups, the whole group adapts to the biased participant, even when not directly interacting with them, increasing overall linguistic diversity and reducing the use of the letters that the biased participants are unable to use. Whilst this last experiment does not account for 'real-world' neurodiversity, the parallels to it are easy to draw, and it provides promising evidence that the majority population does not simply dismiss the linguistic input of the minority population, but rather adapts to it and incorporates it.

Some work has also considered specific aspects of cognition in which participants might differ, and how this could interact with language learning and use. For instance, Keogh & Lupyan (2024) find that participants show different preferences for linguistic cues to noun class membership; whilst most participants prefer one cue, a good proportion of participants still prefer the other. Additionally, they find that redundancy in the language was helpful to some (but not all) learners. Palma et al. (2023) find that individual differences in bilingual experiences (e.g. which language participants use more in day-to-day life) impact the creation of linguistic structure.

Previous accounts of neurodiversity and language evolution are, I have argued, insufficient and often take an ableist and even harmful turn. It is clear, however, that the field is beginning to recognise the implications of variation in cognitive functioning on language evolution. Recent work on individual differences and language evolution represents a meaningful step forward towards counting for a broader range of human cognition, but it is still constrained to variation within an arbitrary 'norm'. I argue that we need to take another step forward, and account for the full range of neurodiversity.

2.4.3 Accounting for full neurodiversity

Taken together, the work outlined above demonstrates two fundamental ideas behind this thesis: first, that minority variation in cognition (including linguistic biases) is not overruled by the majority and has a role in shaping language; second, that social variation and identity also impact language use and change.

Now, I turn to why considering neurodiversity with respect to both of these aspects is crucial. First, I consider the impact of cognitive variation. Cognitive differences are often not explicitly considered in experimental studies of language evolution, and their impact is often constrained to error terms. As argued by Josserand, Pellegrino, et al. (2024), there is usually a focus on group-level preferences within studies of how cognition impacts language, and common statistical techniques average across data and treat variation as 'error' or exclude it as 'outliers' (cf. Yu & Zellou, 2019, for a discussion of these issues with respect to variation in phonological processing). Consider Fedzechkina et al. (2016a), a foundational paper for future work in this thesis; whilst there are clearly strong trends in the behaviour of participants, there is also considerable between-individual variation (as noted by the authors themselves), with participants differing with respect to whether they prioritised increasing informativity or reducing effort.

Second, when individual variation is considered, it is done so only within a restricted range of possible differences. This is partly due to the fact that this is an emerging field, and research has simply not yet covered a broader range of ground. But it also reflects a more general problem in cognitive science, which is that it typically only considers variation *within the established norm* (Manalili et al., 2023a). In other words, the individual differences paradigm entails working with neurodiversity, but only neurodiversity within neurotypicals, and not across the whole species.

This reinforces the notion that only some human minds represent natural human diversity. It also reflects a difference in attitudes towards different types of diversity. When we study individual differences, we are not attempting to 'cure' neurotypical individuals of these differences; we rightly recognise the value in that diversity, and seek to understand its impact on language and other behaviours. However, when we study diversity beyond that norm, the focus is almost always on deficit and cure, suggesting that there is something 'unnatural' or 'wrong' about this variation. This reflects the broader view that, whilst some variation is allowed, there is ultimately a 'right' type of mind. It is crucial to the neurodiversity paradigm that much of the variation that we have previously pathologised should not be[5]. By always pathologising variation beyond the socially acceptable norm, the field to not only do a disservice to neurodivergent people, but also to itself, as it fails to meaningfully engage with the true range of variation in human minds (see also Manalili et al., 2023a). This thesis encourages language evolution, and cognitive science as a whole, to recognise the value in neurodiversity beyond the social standard.

On the other hand, turning back to identity and social variation, existing work on language and neurodiversity has failed to recognise that being neurodivergent often entails not just cognitive differences, but also a minority identity, both at the individual and social level (Davies et al., 2024; Beck, 2024; Cooper et al., 2021; Love et al., 2023; Leveille, 2024; McCracken, 2021; Shmulsky et al., 2021). Autistic scholars such as Radulski (2022a) have also linked aspects of behaviour by some autistic people, such as camouflaging, to autistic people's status as a minority identity (see section 2.6.3 for further discussion of camouflaging). Various work has drawn parallels between autistic identity and other sociolinguistic identities such as sexuality, gender, and race (e.g. Radulski, 2022a; Walker, 2021; Rivera & Bennetto, 2023; Ai et al., 2022; M. R. Yergeau, 2018), linking them through theories such as minority stress (Meyer, 2003), which describes the mental health difficulties that can emerge as a result of recurrent stigma and discrimination. Further, the intersection between neurodivergent identity and other marginalised identities (particularly racial and gender minorities) has been the subject of some study, generally demonstrating that, like with other points of intersectionality, being both neurodivergent and of another minority group compounds stigma and discrimination (Botha & Gillespie-Lynch, 2022; Davis et al., 2024; Udonsi, 2022; Gottardello et al., 2025; Maroney & Horne, 2022; Moore et al., 2022). Yet, as discussed above, the social identity aspect of neurodivergent has not been studied in any detail.

5. It is important to note that the neurodiversity paradigm recognises that some forms of neurodiversity that are not intrinsic to self, such as epilepsy or FND, can be pathologised and consensually cured.

Finally, I argue that there already exists good evidence that neurodivergent people can, and do, drive language change. For instance, the terms used by the neurodiversity movement were originated by autistic and otherwise neurodivergent people (Walker & Raymaker, 2021). Further, consider the example of tone indicators, which are used in online discourse to convey tone that may be difficult to infer from written speech (Marcus & O'Neill, 2020). Whilst no academic research has been conducted into tone indicators, their origins are often attributed to neurodivergent people who might have more difficulty inferring tone, and yet they are now used widely across the internet by both neurodivergent and neurotypical people alike.

Further, parallels can be clearly drawn between the autistic and the Deaf communities (Friedner & and Block, 2017); both groups' language usage has traditionally been medicalised, and both groups often consider being Deaf or being autistic to be core cultural and social identities. Whilst the role of autistic or otherwise neurodivergent people in language variation has not been examined, the influence of Deaf communities has been more widely documented. For instance, consider the case of emerging village sign languages, such as Al-Sayyid Bedouin Sign Language (ABSL) (Senghas, 2005; Sandler et al., 2005), Central Taurus Sign Language (CTSL) (Brentari et al., 2021), or Kata Kolok (De Vos, 2012). These languages are created where there is a higher than usual number of Deaf people in a community, though notably still only a small proportion (often cited to be around 2-5%), and are used by both the Deaf and hearing members of the population. Josserand (2024) argues that examples such of these highlight the role of individual variation in shaping new linguistic systems. Here, I extend this directly to neurodiversity and disability more broadly. Whilst the comparison is not exact, this nevertheless lends credence to the idea that people whose communicative practices diverge from normative expectations and have traditionally been conceived as pathological can impact the population-level language.

Building on these foundational points, the rest of this chapter takes a deeper look into neurodivergent – particularly autistic – cognition and language use. First, I broadly consider just some of the cognitive and linguistic variation amongst neurodivergent people that could be relevant to language change. Then, I turn to autistic people specifically, considering relevant theories of autism with respect to cognition, language, and identity.

2.5 Language amongst neurodivergent language users

Differences in language are commonly associated with various neurodivergent neurotypes. Below, I discuss this with respect to autism in depth, as it is the primary case study of this thesis. However, I first provide a broad overview of some other neurotypes and how they interact with language.

The form of neurodiversity that instantly comes to mind when considering language is dyslexia. Dyslexia is characterised by differences in word reading ability (Elliott & Grigorenko, 2024), and is often (but not always) accompanied by differences in phonological processing (Dębska et al., 2022; Mundy & Hannant, 2020; Perfetti et al., 2019), morphological understanding (Duranovic et al., 2014; Rothou &

Padeliadu, 2019), and spoken language production (Wiseheart & Altmann, 2018; Smith-Spark et al., 2017). People with dyslexia may find learning a second language more difficult (Betta & Romani, 2006; Pérez-Litago et al., 2025; Venagli & Kupisch, 2024). Dyslexia is one of the most common neurodevelopmental conditions, with UK-based organisations such as the NHS and the British Dyslexia Association estimating that around 10% of people in the UK are dyslexic (British Dyslexia Association, 2025). Despite how common dyslexia is, its potential impact on language change has not been considered, perhaps due to the prevailing belief that primarily relates to reading, rather than to language as a whole.

Like dyslexia, DLD has a strong relationship with language. DLD is associated with a variety of differences in grammar, with the most prototypical in many (but not all) languages being not using inflection on verb stems where it is conventionally expected (Leonard, 2015). Whilst there is little evidence regarding the long-term linguistic profile of people with DLD, with most studies focusing on childhood, the research that does exist suggests that at least some people with DLD continue to show linguistic differences throughout their lives (Clegg et al., 2005; Botting, 2020). Like dyslexia, DLD is also very common, with the American National Institute on Deafness and Other Communication Disorders estimating that 1 in 14 children have DLD (National Institute on Deafness and Other Communication Disorders, 2023). DLD is particularly interesting when considering broad questions around language change and evolution, for two key reasons. First, children with DLD commonly show creativity in their morpheme use; for instance, in English, they may use regular verb morphology where irregular morphology is more common (e.g. *throwed* instead of *threw*), which links to more general theories of language change and productive morphology (cf. Plag, 2018, but also see discussion of similar productions by autistic people below). Second, the manifestation of DLD differs significantly cross-linguistically (Leonard, 2022). For instance, in languages that do not permit bare stems at all, children with DLD are much less likely to use them than they are in languages that do permit bare stems (Leonard, 2022). This clearly demonstrates that typology and language structure impact neurodivergent language use, but the opposite direction of effect – do neurodivergent people impact language structure and typology? – is as yet unexplored.

Other neurodivergent neurotypes, which are not necessarily obviously associated with language, can also be linked to linguistic differences. For instance, schizophrenia is associated with a range of language differences, to the point where it has been suggested that language could be used as a diagnostic biomarker for schizophrenia (J. N. de Boer et al., 2020). People with schizophrenia show differences in pragmatics, such as in metaphor interpretation (Champagne-Lavau & Stip, 2010; Daud et al., 2020), as well as at the structural and lexical levels (Stephane et al., 2014). People with ADHD also commonly show differences in structural (Hawkins et al., 2016; Parks et al., 2023) and pragmatic language (Carruthers et al., 2022; P. B. Kessler & Ikuta, 2023). Interestingly, as mentioned above, there is also emerging evidence of a sociolinguistic style in the discourse of people with ADHD online, with features such as hedging, negation, and swear words being more common in users with ADHD (Guntuku et al., 2019), though much more work is needed in this area.

Overall, it is clear that neurodiversity has significant implications for how people use language beyond individual differences. Throughout the lifespan, people of various neurotypes use language differently within their language communities. Therefore, that they may have a role in shaping language is clear, but in what areas they may have exerted an influence remains unexplored.

2.6 Relevant theories of autism

As discussed in the thesis framework, the primary case study for this thesis is autism. Below, I describe the key cognitive, social, and linguistic differences in autistic individuals, to provide a specific foundation for the studies in this thesis. I also discuss the previous research with comparable paradigms to mine in autistic individuals, focusing on artificial grammar learning.

2.6.1 Cognitive differences in autistic individuals

I have outlined above how language evolution has argued that various aspects of cognitive functioning impact language. For instance, some claim that our cognitive bias for animate agents drives subject-first word orders (I. Meir et al., 2017). At the same time, autistic and otherwise neurodivergent people people display a range of cognitive differences (though the exact nature and validity of some of these differences remains a matter of debate, see the discussion of Theory of Mind below). It is thus intuitive that these cognitive differences could impact language. Here, I discuss a selection of cognitive differences in autistic people that could relate to existing theories of language evolution. I focus on social cognition, executive function, and perception.

Work on language evolution (and cultural evolution in humans in general) has focused on the reciprocal relationship between theory of mind (ToM) and language as crucial to the development of both (Heyes & Frith, 2014; Herrmann et al., 2007). As such, the relationship between autism and ToM seems immediately relevant to the study of language evolution. This is particularly so considering the long history of research on autistic ToM. Since 1985 (Baron-Cohen et al., 1985), Baron-Cohen and colleagues (as well as others) have argued that the core defining feature of autism is that autistic people lack ToM. This is based on research demonstrating that autistic people (usually autistic children) fail ToM tasks, ranging from the classical Sally Anne task (Baron-Cohen et al., 1985) to more complex tasks such as Happé's (1994) Strange Stories.

However, whilst the idea that autistic people lack ToM has been pervasive (e.g. Baron-Cohen et al., 1985; Frith, 2001), there are a variety of failures in this claim (Gernsbacher & Yergeau, 2019a); differences in ToM tasks are not unique to autism, nor are they present in all autistic people, easily replicated, or clearly differentiated from spoken language abilities. Additionally, as also pointed out by Gernsbacher & Yergeau (2019a), in non-traditional ToM tasks, particularly those that do not require verbal skills, research consistently finds that autistic people can infer the mental states of others (Kerr & Durkin, 2004; Vivanti et al., 2011; Cole et al., 2018).

Nonetheless, what is clear is that autistic sociality is in some way different to allistic sociality (e.g. Dawson & Cowen, 2019). One alternative to inherent deficit accounts, such as the claim that autistic people lack ToM, is intersubjective accounts, such as the Double Empathy Theory, which is discussed below in Section 2.6.3.

Turning away from sociality for now, there are a variety of other cognitive differences in autistic people that could be relevant to language. For instance, executive functioning (which encompasses elements such as working memory, planning, and inhibition Diamond (2013)) has been found to be different in autism, based both on experimental evidence (e.g. Johnston et al., 2019; Sankalaite et al., 2025) and the reports of autistic people themselves (Kenny et al., 2024; Roestorf et al., 2025).

There are also a range of theories regarding information and perceptual processing in autism. One such account is the ‘weak central coherence’ theory, which argues that autistic people have a detail-focused processing style; in other words, they pay attention to small details, but they find it more effortful to integrate these details into global meaning (Happé & Frith, 2006). Work in this area has found evidence of both slower global processing (Van der Hallen et al., 2015) and that autistic people find it more effortful to do so (Booth & Happé, 2018).

Relatedly, the relationship between autism and the visual perception of various kinds of stimuli has been examined extensively. Indeed, general sensory differences are reported to be extremely common amongst autistic people (Hazen et al., 2014; Ben-Sasson et al., 2019). For example, autistic people may perceive colours (Franklin et al., 2010; Zachi et al., 2017) and faces (Morin et al., 2015) differently. They may be better at detecting targets in complex scenes (Gonzalez et al., 2013). Autistic people themselves report differences in visual sensory processing, such as hypersensitivity to light and colour, enhanced perceptual processing, and differences with respect to eye contact and face recognition. Indeed, some theories of autism frame it with respect to sensory and motor differences, rather than the traditional characterisation based on social ‘deficit’ (Donnellan et al., 2013; Kapp, 2025).

2.6.2 Language and autism

Given the relationship between communication and language and autism in its diagnostic definition, language has been studied extensively in autistic individuals at all linguistic levels. I note here first that much research on language and autism is done within a deficit-based model (Ferreira et al., 2024), and the goal has often been to identify ‘deviant’ behaviours and eliminate them (e.g. J. M. A. Roberts, 2014). Differences in linguistic behaviour by autistic people has often been framed in a dehumanising way; consider, for instance, Mizuno et al.’s (2011) assertion that “pronoun reversals in autism may reflect a *disturbed processing of understanding of self and other* in the reciprocal relationship" (emphasis added). As noted by Ferreira et al. (2024), autistic language is often described with terms such as ‘deficient’, ‘bizarre’, or even ‘aberrant’. In the description of autistic language below, I re-frame features of autistic language as differences rather than deficit, but there is a clear need for a general reconsideration of how autism and language are treated in the literature (Ferreira et al., 2024).

It is also important to note that, as with all aspects of autism, the language experience of autistic people is highly heterogeneous. In particular, a good proportion of autistic people (estimated to be around 30%, see Tager-Flusberg & Kasari, 2013) are minimally or non-speaking[6] and use Augmentative and Alternative Communication (AAC) methods to help them communicate, such as gestures or electronic softwares. Additionally, language acquisition often takes an atypical path (Kissine et al., 2023) and in some cases, language skills are apparently lost (R. Luyster et al., 2005; Prescott & Ellis Weismer, 2022). Not all autistic people will display features that are considered prototypical of language in autism; for instance, in Szatmari et al.'s (1995) sample of autistic children, only 26% showed evidence of pronoun reversal, and only 10.7% of using neologisms. Ultimately, there is no singular autistic language profile, and it is difficult to define different language profiles within autism due to the large degree of heterogeneity (Schaeffer et al., 2023). Further, whilst there is a wealth of literature examining language in autistic children, there is relatively little considering the linguistic profiles of autistic adults (such as our participants in the studies that comprise this thesis). Research suggests that there may be less heterogeneity amongst autistic adults (Manenti et al., 2024), but as mentioned above, further work is needed to fully understand the language profile of autistic adults.

The key linguistic differences associated with autism relate to either the pragmatic or lexical/semantic domain, but I first consider evidence with respect to syntactic differences in autistic people. Whether morphosyntax is different in autism is a hotly contested issue; whilst Naigles & Tek (2017) suggest that 'form-based' aspects of language such as morphosyntax are typical in autism, Eigsti et al. (2007) argues that autistic children do show differences in morphosyntax, producing 'less complex' language than their typically developing peers and following an atypical development pathway. It is often also difficult to test morphosyntax in a way that does not also include some pragmatic dimension, and differences in performance on standardised tests are not necessarily attributable to differences in morphosyntax alone (Sukenik & Friedmann, 2018). For instance, autistic children are often said to interpret (e.g., Overweg et al., 2018) or produce (e.g., Mazzaggio & Shield, 2020) pronouns in ways that differ from allistic children (though note conflicting evidence on this phenomenon, which does not appear to be universal in autism, e.g., Noterdaeme et al., 2010; Shield et al., 2015), but it is difficult to disentangle whether this is related to syntax or more general pragmatic knowledge.

In general, where studies do find a difference between autistic and allistic children in morphosyntax, they tend to relate to structures with syntactic dependencies and multiple clauses, similar to children with DLD (N. Meir & Novogrodsky, 2020) (see also Schaeffer et al., 2023, for a recent review). In this thesis, the investigations of morphosyntax focus on the interplay of word order and morphological cues in indicating the role of subject and object. Some prior research has considered this particular phenomenon in autism; Su & Naigles (2019) and Xu et al. (2022) suggest that autistic children, like their allistic peers, use word-order cues to assign grammatical role. Interestingly, however, Zhou et al. (2017) find that autistic children preferred word order cues than morphosyntactic cues for sentence

6. I use these terms, as opposed to other terms such as "non-verbal", as per the preferences of minimally speaking autistic people who use AAC methods (Zimmerman, 2022; Zisk & Konyn, 2025; Bottema-Beutel et al., 2025)

comprehension and that when word order and morphology provide conflicting cues to grammatical role, autistic children were more likely to assign thematic role based on the word order than the morphology. This suggests that autistic people may weigh syntactic cues differently in comprehension, and will be considered in this thesis in more detail.

One of the most commonly cited ‘features of autistic language’ is echolalia. Echolalia is defined as the ‘immediate or delayed repetition of the speech of another’ (J. M. A. Roberts, 2014). It is done more often by autistic children than allistic children or children with DLD (van Santen et al., 2013), and is also observed in signing autistic children (Shield, 2014). Echolalia is a common subject for ‘corrective’ therapy in autism, with the goal to reduce or eliminate the behaviour entirely (for a review of such therapies, see Neely et al., 2016), as echolalia is often seen as an ‘empty’ behaviour that can lead to communicative breakdowns (Neely et al., 2016) and even disrupt language development (Valentino et al., 2012). However, even early work on echolalia has shown that it has a variety of communicative functions (Prizant & Rydell, 1984; Prizant & Duchan, 1981), such as turn-taking, answering questions, and making requests, and more recent work has continued to demonstrate this (Sterponi & Shankey, 2014; Jaswal & Akhtar, 2019a). Echolalia can be considered a stepping stone towards productive use in autism (Gernsbacher et al., 2016) (and indeed, also in allistic children, e.g., Lieven et al., 1992). Whilst echolalia itself is not central to this thesis, it provides an important example of how autistic language has been pathologised and misunderstood, despite its often communicative intentions.

Autistic people can also show substantial differences in their lexical profiles compared to allistic people. Whilst the evidence in the literature as to whether lexical and semantic abilities are similar to allistic people is considerably mixed (Sukenik & Tuller, 2023), lexical knowledge is actually often seen as a strength of autistic people (Naigles & Tek, 2017). A substantial proportion of autistic people are hyperlexic, and are able to read texts considered very advanced for their age (Ostrolenk, Forgeot d’Arc, et al., 2017). Autistic people report enjoyment from using rare words (R. J. Luyster et al., 2022), but this preference often leads to their speech being described as ‘pedantic’, as it is ‘more factual, accurate, specific, or technical’ than required in the relevant context (de Villiers et al., 2007). This tendency to use precise or unusual lexical items has notably been linked to communicative efficiency, a crucial concept in Chapters Three and Four of this thesis; R. J. Luyster et al. (2022) report that at the Consortium on Autism and Sign Language in 2015, panel members discussed the possibility that autistic people prioritise specificity and informative accuracy above reducing production effort. This is supported by the accounts of autistic speakers using so-called ‘pedantic’ language, but will be examined more precisely in relation to communicative efficiency below.

Autistic lexical production has been previously described as ‘idiosyncratic’, producing neologisms and unconventional phrases (Volden & Lord, 1991), often to describe concepts that are not accessible with conventional forms (R. J. Luyster et al., 2022). This behaviour is also seen in signing autistic children, who have been reported to invent new signs (Shield, 2014). Interestingly in the context of this thesis, these neologisms are usually productive; that is, they make use of existing lexical items and morphemes to create new words (Volden & Lord, 1991; Werth et al., 2001). This is parallel to processes of language change, where productive morphemes are commonly used to create new words or to create new forms of neologisms (Plag, 2018), with many new words in the Oxford English Dictionary reflecting these processes, e.g. ‘clown-*y*’, ‘*un*-follow’. The creative neologisms used by autistic people are typically contextually meaningful and interpretable, and show that autistic language can be a site of innovation and variation.

Finally, I turn briefly to evidence with respect to AGL learning in autism. Studies on AGL in autism generally show comparable performance by autistic people to allistic people (Brown et al., 2010; Mayo & Eigsti, 2012; Ziva & Ziori, 2024). These results have been used to suggest that statistical learning is not a weakness in autism, and is unlikely to be the source of autistic differences, including in language Obeid et al. (2016). Whilst AGL is not exactly comparable to ALL, there are no existing studies on ALL in autism outside of this thesis that I am aware of, and the evidence with AGL provides good reason to believe that autistic people will be able to approach ALL tasks as used in this thesis.

To summarise, this section shows that whilst autistic language has often been treated as deficient, and only considered in comparison to ‘typical’ allistic language, it is evident that autistic language is both diverse and creative in ways that could relate to language change and evolution. This emphasises the importance of considering autistic language – and indeed, neurodivergent language in general – when considering why and how languages look the way that they do. Comprehensive theories of language use and change must account for the linguistic heterogeneity introduced by neurodivergent populations. Finally, I discussed some existing work on AGL/ALL with autistic people, providing a foundation for the experimental work in this thesis.

2.6.3 Social Differences in autistic individuals

In this section, I consider two key theories that underpin the empirical work in this thesis, the Double Empathy Problem (D. Milton, 2012b) and autistic camouflaging (e.g. Hull, Petrides, Allison, Smith, Baron-Cohen, et al., 2017). These are alternative theories of autistic social differences and motivation, which move away from deficit-based accounts such as ToM or the idea that autistic people lack social motivation.

Turning away from traditional theories of social ‘deficits’ in autism: The Double Empathy Problem

Theories of conversation have long emphasised the importance of both speaker and hearer. Consider, for instance, Grice’s cooperative principle, which is built on the notion that speakers and hearers work together to reach mutual understanding: “Our talk exchanges... are characteristically, to some degree at least, cooperative efforts; and each participant recognises in them, to some extent, a common purpose or set of purposes" (Grice, 1989, p. 26). In any communicative scenario, (at least) two individuals are continually involved in negotiating the context and structure of the interaction. Despite this, autistic social differences have consistently been conceived as a one-sided deficit on behalf of the autistic individual. The DSM-5 diagnostic criteria for autism requires “persistent deficits in social communication and social interaction across multiple contexts" (American Psychiatric Association, 2013).

What such conceptualisations of autism do not account for is the potential misunderstandings and difficulties caused by the allistic, rather than the autistic, person, as a result of the significant differences between autistic and allistic people. For instance, as seen above, autistic people have often been described as lacking social motivation, often based on behaviours such as avoiding eye contact, using echolalia, and reduced pointing compared to allistic people (for review, see Jaswal & Akhtar, 2019a). Whilst it is likely that some autistic people experience different or even reduced social motivation compared to allistic people, and it is important that we do not dehumanise autistic individuals on this basis (Fletcher-Watson & Crompton, 2019), recent work has made it increasingly clear that a lack of social motivation is not a universal feature of autism, despite what may be perceived (Jaswal & Akhtar, 2019a). The question then becomes *why* are these particular features of autism viewed as entailing a lack of social motivation, and in answer to this, I turn to the Double Empathy Problem.

In the past decade or so of autism research, the Double Empathy Problem (DEP) (D. Milton, 2012a; D. Milton et al., 2022) has highlighted this imbalance in the attribution of blame onto the autistic rather than the allistic person. The DEP states that there is a disjuncture of reciprocity between social actors who are differently disposed; in other words, autistic and allistic people come to the table with such different cognitive experiences and expectations that it can be difficult for either side to have full insight into the other (D. Milton, 2012a). Other accounts of autism, similar to the DEP, have also emerged, such as the Dialectal Misattunement Hypothesis (Bolis et al., 2021), which uses a Bayesian framework to argue that various neurodevelopmental conditions, including autism, which are characterised by commmunication differences compared to neurotypical people, are driven by repeated misalignments in interpersonal interactions, perhaps as a result of different cognitive styles. This is likely at least part of the reason as to why autistic people are seen as less socially motivated; if allistic people themselves associate an action with times in which they are not socially motivated, then they may interpret that same action in an autistic person as also indicating a lack of social interest, even though for them that is not the correct interpretation.

The DEP was originally conceived as a way to push back against the notions that autistic people lack ToM and/or empathy, and that this is the source of difficulties in autistic-allistic communication (D. Milton, 2012a; D. Milton et al., 2022). Emerging empirical research using a variety of methods, including qualitative interviews, natural interactions, and structured experiments, has supported the general claims of the DEP. With respect to empathy and ToM, Sheppard et al. (2016) find that, despite the fact that autistic people are as expressive as allistic people, allistic people struggle to interpret the behaviour and mental states of autistic people. Allistic people show less emphatic accuracy when viewing accounts of emotional events from autistic people than they do from allistic people, particularly when it comes to identifying whether the speaker is sad or happy (Cheang et al., 2024). Although not explicitly framed within DEP theory, Edey et al. (2016) also provide relevant evidence: both autistic and allistic participants were required to create moving animations to represent mental states, and allistic people had greater trouble interpreting autistic emotions compared to allistic emotions. From the opposite perspective, Sheppard et al. (2023) find that autistic people only report difficulties in mindreading with allistic people, and both autistic and allistic people are better at mindreading in matched rather than mixed neurotype interactions. Qualitative accounts also support that mindreading is a point of difference in autistic-allistic interactions; Marocchini & Baldin's (2024) autistic participants report that allistic people have difficulty interpreting autistic ToM, and that in fact they tend to over-interpret what autistic people say. The difficulty allistic people have in interpreting the mental states of autistic people likely has real-world consequences, as demonstrated by Szechy et al. (2024), who find that allistic people do not accurately interpret the behaviour of autistic employees.

More broadly, research has consistently shown that allistic people have less rapport with autistic people, and rate interactions with autistic people less favourably than interactions with allistic people (Morrison et al., 2020; Alkhaldi et al., 2021, 2019; DeBrabander et al., 2019). Notably, as highlighted by Sasson et al. (2017a), negative impressions of autistic people are formed quickly and are enduring, and seem to relate to substance rather than style. Similar results have been found for the first-impressions of autistic children by both allistic children (Q. Chen et al., 2024) and allistic adults (Boucher et al., 2023). Across studies, autistic people are frequently rated as more awkward and lacking empathy (Alkhaldi et al., 2021; Sasson et al., 2017a), and are even perceived as being less successful and less happy (Alhusayni et al., 2024). Allistic people also over-estimate how helpful they are to autistic people in a collaborative task (Heasman & Gillespie, 2019). As for autistic people, research suggests that they have higher rapport with other autistic people than with allistic people (Crompton, Sharp, et al., 2020; Foster et al., 2025).

The difficulties in communication between autistic and allistic people is perhaps unsurprising, considering the oft-proposed bidirectional relationship between ToM and language (e.g. de Villiers, 2007). In essence, if autistic and allistic people find it difficult to infer each other's mental states, this will likely make conversation more difficult. However, I note that the existing experimental studies on mixed and matched-neurotype interactions do not explicitly consider elements of ToM (such as behaviour inference) in tandem with measures of communicative success, so we cannot be sure that this is a causal relationship. Some of the studies do consider rapport, but findings differ; Crompton, Ropar, Evans-Williams, et al.'s (2020) mixed pairs report the lowest rapport, whilst Oates et al. (2024) find that matched autistic pairs have the lowest rapport.

Crucially for this thesis, these bidirectional differences go beyond first impressions and the ability to infer mental states and behaviour; they also impact communication in a variety of different ways. Crompton, Ropar, Evans-Williams, et al. (2020) find that mixed-neurotype diffusion chains (where participants relay information to another participant, and that participant to the next, etc.) are much less efficient at transferring information than matched neurotype chains. Importantly, they do not find a difference between the autistic-autistic and the allistic-allistic chains, indicating that autistic people are just as effective at transferring information with each other as allistic people are. In expository contexts, Oates et al. (2024) similarly find that matched neurotype pairs are better at more accurately conveying information (in this case, giving directions) than mixed pairs. Notably, recent work also suggests that autistic people specifically change their linguistic behaviours in mixed interactions, becoming more verbose in a director-matcher task when directing allistic matchers (Geelhand et al., 2024).

There are also reported qualitative differences between mixed and matched neurotype interactions; Y.-L. Chen et al. (2021) find qualitative differences between autistic-autistic and autistic-allistic interactions, with the former being more relational rather than functional, more reciprocal, and more likely to involve sharing thoughts and experiences. Additionally, their work suggests that, over time, both autistic and allistic people are more likely to continue to interact with others of their own neurotype. Autistic people often report that autistic-autistic interactions are fundamentally different than autistic-allistic interactions, due to differences in communication styles (e.g. allistic people are less direct and use more small talk) (Marocchini & Baldin, 2024), and that autistic-autistic interactions can help improve wellbeing and be a source of happiness and validation (Crompton, Hallett, et al., 2020). Evidence for qualitative differences between neurotype mixed and matched interactions are not limited to the reports of autistic people themselves; Jones et al. (2024) find that allistic observers rate mixed neurotype interactions as less successful than matched interactions, and that autistic-autistic interactions are rated comparably to allistic-allistic interactions. G. L. Williams et al. (2021), using a Relevance Theory framework, conduct an ethnographic study of autistic participants engaged in natural conversation, and find that autistic-autistic communication has better flow, rapport, and intersubjective attunement. Allistic people themselves also recognise the bidirectional difficulty of autistic-allistic interactions (Rachanska, 2025).

Taken together, findings from within the DEP framework are foundational to this thesis, as they demonstrate that autistic communication should not be treated as inherently deficient, but rather an example of natural linguistic and communicative variation. Ethically, these findings highlight the need for more systematic investigation of autistic communication that does *not* assume a deficit in comparison to allistic people. Theoretically, turning back to language evolution, it also suggests that autistic and allistic people may have different communicative goals and use different linguistic devices, and such variation could have a role in shaping language.

Autistic camouflaging, language, and code-switching

Autistic camouflaging, also referred to as autistic masking, refers to a set of behaviours which autistic people employ to appear 'less autistic' by managing autistic social differences and fitting in with neurotypical others (e.g. Hull, Mandy, Lai, Baron-Cohen, et al., 2019; Cook et al., 2021, 2022; Ai et al., 2022; Radulski, 2022a). Much attention has been given to the conceptualisation and measurement of autistic camouflaging in recent autism research, and it is consistently reported by autistic people with a variety of cognitive profiles (Hull, Petrides, & Mandy, 2021).[7]

Autistic camouflaging has been conceptualised as a form of general impression management (Ai et al., 2022; Robinson et al., 2020; Schneid & Raz, 2020; Hull, Mandy, Lai, Baron-Cohen, et al., 2019; Jorgenson et al., 2020), which refers to behaviours employed across the general population to create an appropriate public self for others in social interaction (Goffman, 1959; Leary & Kowalski, 1990). Importantly, whilst impression management is common across the population, it is often non-optional in marginalised groups, including autistic people, in order to avoid stigma and negative repercussions (Ai et al., 2022; Pearson & Rose, 2021). For instance, autistic people report the need to camouflage in high-pressure situations such as job interviews (Finn et al., 2023), and generally note that camouflaging is done to be safe and functional in society (Hull, Petrides, Allison, Smith, Baron-Cohen, et al., 2017). Whilst allistic people report that they camouflage to form friendships and gain opportunities, autistic people report camouflaging to avoid negative experiences (Bernardin, Lewis, et al., 2021). There are also components to autistic camouflaging that appear to be unique to autism, rather than also part of general impression management, such as hiding sensory differences (Miller et al., 2021a). Camouflaging – in both autistic and allistic people of various ages – is associated with poor mental health outcomes (Bernardin, Lewis, et al., 2021; Ai et al., 2024a; Cage et al., 2018; Cage & Troxell-Whitman, 2019; Hull, Levy, et al., 2021; Somerville et al., 2024), and the trend holds cross-culturally (Tamura et al., 2024; Keating et al., 2024), likely reflecting both the cognitive load of camouflaging (Funawatari, Sumiya, Iwabuchi, & Senju, 2024) and the often forced nature of it (Pearson & Rose, 2021). Notably, camouflaging does not seem to be unique to autism amongst neurodivergent people; whilst existing research is limited, there is evidence of camouflaging in people with ADHD (van der Putten et al., 2024) and DLD (Hobson & Lee, 2023).

For the purposes of this thesis, I conceptualise the mechanisms of autistic camouflaging in line with Hull, Petrides, Allison, Smith, Baron-Cohen, et al. (2017) and Hull, Mandy, Lai, Baron-Cohen, et al. (2019). Hull and colleagues argue that camouflaging can be categorised across three dimensions: compensation (compensating for social differences), masking (hiding autistic traits), and assimilation (fitting in in difficult social situations) (see Chapter Four for a longer discussion on the different dimensions of camouflaging). However, a broad range of camouflaging behaviours are reported by autistic people. Here, I focus on behaviours that relate to language use, as these most clearly link to

7. Whilst autism practitioners anecdotally report camouflaging in autistic individuals with intellectual disability, and arguably, therapies targeted to autistic people with higher support needs are essentially taught camouflaging, there is a critical need for further research on autistic camouflaging with this population (Gibbs et al., 2024; Petrolini et al., 2023).

the overall questions of this thesis. Whilst camouflaging research has not systematically focused on only linguistic behaviours, evidence that they are used as part of camouflaging is rife throughout the qualitative literature. Cook et al.'s (2022) participants report mirroring other people's verbal behaviours, self-monitoring speech intonation, and increasing the clarity of their verbal communication. Similarly, participants in Hull, Petrides, Allison, Smith, Baron-Cohen, et al. (2017) and Miller et al. (2021a) report copying/imitating the speech of others. Using learnt social scripts (Hill, 2024) and the 'right kinds of expressions' (Hull, Petrides, Allison, Smith, Baron-Cohen, et al., 2017) are also reported. In the only existing study that considers a more specific aspect of linguistic behaviour in relation to camouflaging, Parish-Morris et al. (2017) find that autistic girls' pattern of difluencies is similar to allistic girls, using less 'uh' and more 'um' in order to appear more socially sophisticated. Like autistic people, people with DLD also camouflage linguistically (Hobson & Lee, 2023), again using scripts and pre-established phrases to help them communicate.

To date, no known research has considered whether more specific grammatical or lexical features are employed in autistic masking. However, work on other marginalised groups has demonstrated that people do alter these and other aspects of their linguistic behaviour to manage other's perceptions of them. Code-switching[8] refers to alternating between two or more languages, or different varieties of a single language, dependent on the social context (Gumperz, 1977). Most relevant to this thesis is the idea of code-switching between different dialects. Whilst code-switching itself is a neutral linguistic practise (cf. D. G. Johnson et al., 2021), in marginalised groups it is often employed as a form of compulsory impression management.

Code-switching by marginalised people is most widely studied in the context of African American English (AAE), with black Americans often required to use 'standard' White American English rather than AAE in predominantly white spaces (Mills & Washington, 2015; McCluney et al., 2021). Like camouflaging, this is associated with negative mental health outcomes (D. G. Johnson et al., 2021; Hewlin, 2009). However, code-switching to avoid prejudice is by no means limited to this population, and is also employed by LGBTQ+ people (Khoo & Ilbury, 2024; Gratton, 2016), and at the intersection of different identities (e.g., black women, Rosenboom & Joseph, 2024). Code-switching in these communities has been likened to the camouflaging behaviours of autistic people by both scholars and autistic people themselves (J. Roberts, 2024; McCracken, 2021), but has not yet been the subject of any systematic investigation. Whilst the work in this thesis is not specifically designed to understand code-switching, it does provide a foundation for considering how autistic people may change their language in response to different social situations.

8. For some groups discussed, code-switching is also referred to as style-shifting, which traditionally refers to how speakers switch between registers of different formalities.

2.7 Interpreting the statistical analyses used in the thesis

As mentioned in the framework, the statistical choices change throughout the thesis. Chapter 3 uses frequentist analysis, whilst Chapter 4 uses a standard Bayesian approach. Chapter 5 also uses a Bayesian approach, but it is slightly less orthodox, presenting models without their usual intercept terms. Here, I provide a short explanation on how to interpret the Bayesian analysis in Chapters 4 and 5, as this statistical framework is likely less well known to readers than the traditional frequentist approach. This is only a brief overview, and for more extensive writing on the differences between and advantages of the Bayesian approach, including in the language sciences, see Vasishth et al. (2018); Kruschke & Liddell (2018); Vasishth & Gelman (2021).

Whilst classical frequentist approaches focus on null hypothesis significance testing (NHST) (evaluating how likely the observed data would be if the null hypothesis were true), Bayesian methods instead quantify uncertainty around parameter estimates. In the Bayesian framework, we estimate the posterior distribution of each parameter. This probability distribution describes how plausible different values of an effect are given the data and the model (which can include prior knowledge). This approach is particularly useful in the context of this thesis, as much about language and neurodiversity remains unknown, and population parameters cannot be assumed, as they must be in frequentist analysis.

Throughout the Bayesian analysis, I report Credible Intervals (CrIs), typically the 95% CrI. A 95% CrI represents the range within which the model estimates that the true value of a parameter lies with 95% probability. Importantly, these intervals should not be interpreted as indicators of “significance" in the frequentist sense. Whilst a 95% CrI that does not include 0 suggests that most of the posterior distribution lies on one side of zero (indicating the likelihood of either a positive or negative effect), no alternative hypothesis has been rejected, as is the case in frequentist NHST. Additionally, a 95% CrI that *does* include 0 is not an indication that the effect is non-significant. Rather, it indicates that there is greater uncertainty about the effect's direction, and we can still often make inferences about its possible direction. In all cases, the focus is on assessing the magnitude and direction of effects and the degree of certainty the model assigns to possible values, rather than significance.

In Chapter 5, I specify the model without the usual intercept term. This approach is advocated for by McElreath (2020), who notes that this allows the uncertainty to be evenly distributed across the categorical predictors. However, it does require calculation of the contrasts between the predictors after model estimation. The interpretation remains largely the same, with the key difference being that the predictors are directly compared against each other, rather than against, for example, the grand mean (as would be the case in a sum-coded model with an intercept). Contrasts are summarised by their posterior distributions and CrIs, which indicate how probable different effect sizes are. These results should, as in Chapter 4, be interpreted using probabilistic statements, rather than binary accept/reject hypothesis decisions.

I note that one of the key advantages of the Bayesian framework is the ability to include prior knowledge about the world into the model. For instance, if prior experimental work has consistently provided evidence that the effect should go in a particular direction, this can be directly incorporated into the model (and, importantly, data is able to override those priors if they do not align). However, here, I have used what are known as weakly-regularising priors. These keep the parameter estimates within a reasonable range, preventing extreme values, but they do not dominate the data. They reflect the a priori uncertainty about possible effects, as we do not have much prior knowledge about how the tested elements of language and neurodiversity interact. The prior I usually use is normal(0,1.5), which provides a relatively uniform distribution in probability space, allowing any outcome to be equally plausible.

2.8 Summary

In this chapter, I have outlined my argument that language evolution must account for full human neurodiversity in order to gain a full understanding both of *how* language changes, and *who* does it. I discussed the cognitive mechanisms behind language evolution, focusing on weak cognitive biases that can be amplified by processes of cultural learning. Then, I turned to how sociolinguistic variation drives language change, and argued that marginalised groups are often the leaders of linguistic innovation. I then brought these two aspects together to argue that neurodiversity reflects both of these domains: first, it entails differences in cognition that may affect the structure of language; second, being neurodivergent often constitutes a specific identity, yet the role of neurodivergent identity in sociolinguistic variation is as yet unexplored. I outlined previous accounts of neurodiversity and individual differences in language evolution, and argued that they do not adequately capture true neurodiversity. Finally, I turned to specific linguistic and socio-cognitive differences in autistic and otherwise neurodivergent people to establish that these groups already show broad variation in linguistic practices that could impact the overall picture of language.

Having established the need for a neurodiversity-inclusive approach to language evolution, this thesis now turns to empirical exploration of what the relationship between neurodiversity and language change might look like. Focusing on autism as a case study, the next two chapters examine the impact of neurodiversity on communicative efficiency and its relation to social biases. In Chapter Five, I investigate the Double Empathy Problem and how it might impact linguistic variation. After these main content chapters, I return to broader questions about the implication of my results for neurodiversity and language evolution in Chapter Six, the general discussion.

3

Autistic traits, communicative efficiency, and social biases

"In cyberspace, many of the nation's autistics are doing the very thing the syndrome supposedly deters them from doing – communicating..."

– Harvey Blume, 1997

3.1 Preface: chapter one

The manuscript that forms the bulk of this chapter reports on the first ALL experiments that, as far as we are aware of, were explicitly conducted with the autistic population. ALL, as described above, is the methodology that this thesis uses in order to explore various cognitive and social biases that might differ in autistic people. However, since there were no prior studies utilising this paradigm with an explicitly autistic population, we had no prior understanding of how autistic people would behave in such experiments.

Therefore, we first aimed to establish a baseline of behaviour by autistic people in ALL experiments. We selected communicative efficiency as behaviours reflecting it are robustly found in ALL; consistently, participants rearrange languages to be more efficient. Experiment one allowed us to explore if this behaviour is also present in autistic people.

Importantly, however, this baseline also allowed us to move to more complex phenomena. Specifically, recent work shows that social biases impact the communicative efficiency trade-off, and experiment two introduces this social bias to the paradigm in experiment one. This social element seemed to be a natural place to start when considering the role of autistic people in language evolution, considering that structural language differences vary wildly within the autistic population, but differences in social situations are robustly found. That said, the prevailing narrative of autism in the literature is that of a social deficit. Such a theory would predict that autistic people are less (or not at all) sensitive to social biases. Under the neurodiversity-affirming approach of this thesis, however, we believed it was possible that autistic people might adhere *more* to a social bias, and that is indeed what we found.

It should be noted that the statistical method used in this chapter is frequentist. The key findings are based on tests of statistical significance and generalised linear mixed models. However, the reader will likely notice that the following two empirical chapters both employ Bayesian analysis. The change to a Bayesian approach will be discussed in more detail in the preface to Chapter Five, but, briefly, this was in response to both the high variability within our data, and the fact that a Bayesian analysis allows us to be more nuanced when describing the behaviour of neurodivergent groups. Furthermore, there is significant historical baggage associated with the psychological sciences, autistic populations, and frequentist analysis. Traditional tests of statistical significance have been extensively used to 'prove' deficits in the autistic population, and do not recognise the high heterogeneity amongst autistic people. A Bayesian approach is thus both practically more appropriate, and fits better with the neurodiversity-affirming framework that this thesis adopts.

In the postface of this chapter, I discuss, inspired by an insightful reviewer comment, whether a neurodiversity paradigm approach and the notion of 'communicative efficiency' are compatible with each other. This is briefly mentioned in the manuscript proper, but for reasons of space is not much elaborated on. I consider it to be an issue that is important to discuss, however, in the context of considering the impact of neurodivergent populations on language evolution.

In the appendices, I present supplementary materials and analysis for Experiments 1 and 2. I provide the instructions and consent information that were given to participants, as well as some further information about participant demographics. In line with the other chapters of the thesis, I also present a Bayesian analysis of the data used for this manuscript, to supplement the frequentist analysis already present and make the presentation of results consistent with the rest of the thesis.

3.2 Fletcher et al. (2024): author contributions

The following manuscript was published by *Cognitive Science* as *Autistic Traits, Communicative Efficiency, and Social Biases Shape Language Learning in Autistic and Allistic Learners* in October 2024. The paper was co-authored by myself and my supervisors, Hugh Rabagliati and Jennifer Culbertson. The development of the experimental design, hypotheses, and approach for analysis was developed during supervision meetings by all three authors. I conducted the data collection and analysis, with feedback and support from my co-authors. I also wrote the manuscript itself, with feedback from both co-authors. Major and minor revisions were made in response to reviewer feedback, and were signed off by all authors. The manuscript has been re-formatted in line with the format of this thesis, but can be found in its published form here: https://doi.org/10.1111/cogs.70007.

3.3 Abstract

There is ample evidence that individual-level cognitive mechanisms active during language learning and use can contribute to the evolution of language. For example, experimental work suggests that learners will reduce case marking in a language where grammatical roles are reliably indicated by fixed word (Fedzechkina & Jaeger, 2020), a correlation found robustly in the languages of the world. However, such research often assumes homogeneity amongst language learners and users, or at least does not dig into individual differences in behavior. Yet, it is increasingly clear that language users vary in a large number of ways: in culture, in demographics, and – critically for present purposes – in terms of cognitive diversity. Here, we explore how neurodiversity impacts behavior in an experimental task similar to the one summarised above, and how this behavior interacts with social pressures (e.g. as in G. Roberts & Fedzechkina, 2018). We find both similarities and differences between autistic and non-autistic English-speaking individuals, suggesting that neurodiversity can impact language change in the lab. This in turn highlights the potential for future research on the role of neurodivergent populations in language evolution more generally.

3.4 Introduction

3.4.1 Neurodiversity, autism, and language evolution

Neurodiversity describes both a concept and a movement designed to highlight ways in which people's neurocognitive functioning differs from 'the dominant societal standards of "normal"' (Walker, 2021). People who identify as neurodivergent include those who are dyslexic, dyspraxic, plural, ADHD, intellectually disabled, who have mental health conditions such as depression, as well as those who are autistic. Indeed, the increasing recognition that autism is a neurocognitive style, rather than a neurodevelopmental 'disorder', has been a key driver in our understanding of neurodiversity, as have autistic people and activists (Walker, 2021).

Importantly, there are reasons to believe that neurodiversity and neurodivergent individuals may influence language evolution, based not only upon theoretical and empirical analyses of the cognitive and interactional skills of neurodivergent people, but also upon evidence for actual language change. We return to these below, after a brief review of relevant narratives of autism.

While the American Psychiatric Association (2013) medically characterises autism as a highly hetereogeneous neurodevelopmental social-communicative disorder, the neurodiversity paradigm recasts autism as a neurocognitive style. That is, autistic people differ from the dominant social standard in their cognitive functioning (Walker, 2021). Autistic people experience the world and social situations differently to allistic (non-autistic) people. Autistic people typically do not prefer person-first language, such as 'person with autism' (Botha et al., 2021; Kenny et al., 2016a; Bury et al., 2020). As such, 'autistic people' and 'autistic individuals' will be the preferred terms in this paper. Epidemiological studies on autism usually focus on the 'prevalence' of diagnosed autism within child populations. For instance, a recent study suggests that 1/57 children are diagnosed autistic in England (Roman-Urrestarazu et al., 2021). However, we note both that autistic children become autistic adults, and that many autistic people of all ages are not formally diagnosed as autistic for a variety of reasons. Certain demographics of autistics are less likely to be diagnosed, such as older adults (Stagg & Belcher, 2019), women (R. M. Green et al., 2019), and people of colour (Steinbrenner et al., 2022; Imm et al., 2019). Further, autistic people may not seek diagnosis due to either the prohibitive cost in many parts of the world, or the possibility of discrimination as a result of a diagnosis, (for discussion of discrimination faced by autistic people, see Aylward, Gal-Szabo, & Taraman, 2021; Shkedy et al., 2021; Griffiths et al., 2019; Nicolaidis et al., 2015; Romualdez et al., 2021; Jury et al., 2021). Importantly, however, a recent study found no significant differences between self-diagnosed and formally diagnosed participants in self-report measures of autistic traits (Sturm et al., 2024). Thus, in this study, we treat autism as a highly heterogeneous cognitive experience, and do not seek to medicalise it.

Structural language abilities in autistic people, such as (morpho)syntax, phonology, and lexis, are generally typical when not accompanied by a co-occurring language disability (see Schaeffer et al. (2023) for a recent review of language profiles in autism). Differences may be observed in acquisition, including delay in production beyond typical expectations (e.g. Mitchell et al., 2006). However, some autistic people's language abilities are precocious, at least in certain areas; for instance, hyperlexia is highly correlated with autism (for a review on hyperlexia and its relation to neurocognitive functioning see Ostrolenk, d'Arc, et al. (2017)). On the other hand, autistic individuals are often perceived to struggle with pragmatic aspects of language and communication (Eigsti et al., 2011), which can have a significant impact on quality of life (Cummins et al., 2020; Oakley et al., 2021; Jennes-Coussens et al., 2006). Indeed, these pragmatic differences are a core diagnostic criteria for autism (American Psychiatric Association, 2013), though how they manifest differs between autistic individuals. One potential explanation for the differences between communication in autistic and allistic individuals is the Double Empathy Problem (D. Milton, 2012a), which argues that there is nothing inherently 'wrong' with autistic communication, but rather it is misunderstandings on behalf of both the allistic and autistic communicators, caused by different neurocognitive functioning, that lead to mutual pragmatic misunderstandings (G. L. Williams et al., 2021). Supporting this are findings that autistic-autistic communication is more successful than autistic-allistic communication (Crompton, Ropar, Evans-Williams, et al., 2020).

Many autistic people are engaged with their language communities, and use language day-to-day as allistic people do. Further, recent evidence suggests that autistic people drive language change. Beyond the introduction of the terms used in the neurodiversity movement (including many used in this paper), tone indicators are a written expression of paralinguistic features such as sarcasm (/s) and genuineness of questions (/genq). The origin of tone indicators is often attributed to autistic people's communicative needs (e.g. Marcus & O'Neill, 2020). But importantly, they are now used widely by neurotypical and neurodivergent people alike, supporting the claim that neurodivergent people can be the drivers of language change both within and outside of their communities. Notably, language evolution research has recently shown that small group-level and individual-level language variations can indeed disseminate throughout a population and impact language evolution (Josserand, Pellegrino, et al., 2024; Josserand et al., 2021; Rita et al., 2022; Navarro et al., 2018).

The potential role of neurodivergent people in language evolution is therefore ripe for examination, yet to date we are aware of no research that considers the specific role of neurodiversity in language evolution. In many studies, neurodivergent individuals are explicitly excluded as a control measure. In others, there is an implicit assumption that the set of participants have a homogeneous neurotype. When individual differences are considered, the scope has typically been limited to variation within (assumed to be) neurotypical individuals (e.g. T. Johnson et al., 2020; Manalili et al., 2023b). When autistic people have been considered, it has only been through theoretical proposals that incorporate arguments that read as ableist, such as the idea that autistic people represent some earlier stage in human language than allistic people (Haworth, 2006), or that there are similarities between the Neanderthal brain and the autistic brain that relate to language evolution (Benítez-Burraco & Murphy, 2016), or that autistic individuals cannot perform cultural learning: "together with robots and chimpanzees, people with autism remind us that cultural learning is possible only because neurologically normal people have innate equipment to accomplish it" (Pinker, 2002). We believe that these arguments are outdated and outmoded with respect to modern conceptions of neurodiversity and autism, and that a better understanding is necessary.

The problem of not sufficiently considering neurodiveristy is not limited to language evolution research; throughout cognitive science, neurodivergent individuals are typically only engaged with to the extent of examining specific ‘deficits’ or ‘deviations’, with the motive often being to ‘fix’ such ‘deficits’ and make a neurodivergent person appear more neurotypical (Bertilsdotter-Rosqvist et al., 2023; M. Yergeau, 2013). As discussed by Manalili et al. (2023b), this presents both scientific and ethical challenges for cognitive science. Insisting on deficit-based models can ultimately lead to monolithic claims that ignore the heterogeneous nature of cognitive processing (see, for instance, the empirical unsoundness of the Theory of Mind ‘deficit’ theory of autism, and the harms it can cause to autistic people (Gernsbacher & Yergeau, 2019b). Further, cognitive science cannot account for true cognitive diversity without considering neurodiversity.

In summary, there are reasons to believe not only that autistic individuals can contribute to language evolution and change, but that they have already done so. Further, examining their role in language evolution helps make cognitive science more inclusive and consider the full spectrum of cognitive diversity. Thus, we turn to the question of *how* autistic people can cause and impact language change, with the goal of determining the specific ways in which this particular dimension of neurodiversity might influence human languages.

3.4.2 Case marking, communicative efficiency, and social biases

A growing body of theory and data has highlighted that many of the core features of linguistic systems can be explained as adaptations that facilitate effective and efficient communicative interaction (Zipf, 1935; Kanwal et al., 2017; Kurumada & Jaeger, 2015; Fedzechkina & Jaeger, 2020). This is often framed as a trade-off between communicative accuracy and production effort[1]. For instance, Zipf (1935) used this trade-off – what he termed the ‘Principle of Least Effort’ – to explain the well-known ‘Law of Abbreviation’, which states that there is an inverse relationship between the length of a word and its frequency. In other words, the most frequent words in a language tend to be the shortest. This observation has been demonstrated to hold both in a wide range of natural languages (e.g. Strauss et al., 2007) and in artificial language learning experiments (e.g. Kanwal et al., 2017).

1. It is important to recognise that Zipf’s law and the general notion of ‘efficiency’ as a value judgment can be construed as ableist. For example, any implication that there is a ‘most’ efficient way of doing something – such as language – implies that there is a ‘wrong’ way of doing it, and attributes blame on those who behave differently. However, we are not attempting to make any value judgment or suggest that there is a ‘correct’ way to balance these pressures, only that these pressures do trade off in different ways in different circumstances, contexts, and cultures. We are interested in how these differing circumstances impact the balance of these elements.

Over the last decade, research in language evolution has increasingly turned to such artificial language learning experiments to probe cognitive biases that contribute to tendencies found in typological data. For instance, artificial language learning has been used to probe the inverse correlation between whether a language has a fixed word order, and whether it uses case to mark grammatical role assignment, i.e., to indicate who did what to whom (Sinnemäki, 2008). Through these studies, the inverse correlation has been linked to the communicative efficiency trade-off (Jäger, 2007; Koplenig et al., 2017; Levshina, 2021; Fedzechkina et al., 2012). Specifically, if fixed word order alone is a strong cue to grammatical role assignment, redundantly marking these with case as well means extra production effort. However, if a language has (more) flexible word order, the extra effort of producing case is justified by the need for robust cues to grammatical roles.

Here, we focus on the influence of social goals on the development of communicatively efficient languages. Social goals are known to influence how people use language, and recent evidence also indicates that they impact how people learn and restructure languages. One area in which striving to meet social goals has been demonstrated to impact language change is in modulating the trade-off between communicative accuracy and production effort (Fedzechkina et al., 2022; G. Roberts & Fedzechkina, 2018).

G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) find that when a social goal is introduced, participants are willing to sacrifice communicative accuracy, or put in more production effort, in order to meet that goal. For instance, participants will use more case marking in a fixed word order language, even though it is redundant, if they are biased towards a group that also uses said case (G. Roberts & Fedzechkina, 2018). On the other hand, they will use less case marking in a flexible word order language when biased towards a group that does not use the case, even though the case is necessary to understand the language (Fedzechkina et al., 2022). This result is intriguing since it helps to explain why a general pressure for communicative efficiency can hold, while at the same time allowing for individual languages, and specific linguistic patterns in languages, to vary with respect to efficiency.

We chose to study these phenomena in the context of autism due to socio-communicative differences between autistic and allistic people; under both the deficit and difference approaches to autism, autistic people would be expected to behave differently to meet social goals. For instance, a deficit model would predict that autistic people would pay less attention to social goals when using language, as it is characterised as a deficit in socio-communicative skills (American Psychiatric Association, 2013).

On the other hand, difference models would make alternative predictions. For example, recently, the role of ‘masking’ in autistic people’s behaviours has begun to be recognised. Masking, referred to by various names in the literature, including ‘camouflaging’ and ‘adaptive morphing’, is broadly conceptualised here as a group of behaviours adopted by autistic people to ‘pass as normal’ to non-autistic people (Hull, Petrides, Allison, Smith, Baron-Cohen, et al., 2017; Cook et al., 2023; Pearson & Rose, 2021; Radulski, 2022b). For instance, this might involve mimicking non-autistic behaviours. Masking for autistic people can be considered a matter of survival, as differences in social behaviour can lead to them being marginalised in society (Ai et al., 2022; Cook et al., 2021; Miller et al., 2021b; Radulski, 2022b; Pearson & Rose, 2021). Further, the model of autism proposed by the Double Empathy problem, suggests that there is nothing inherently deficient in autistic communication, but rather that the neurological differences between autistic and allistic individuals are so great that both sides have difficulty communicating with the other. Difference-based models might predict autistic people to in fact pay *more* attention to social goals, thus impacting their language use, as they are used to having to do so in day-to-day life.

The current experiments therefore aim to partially replicate G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) in the autistic population. First, we aim to establish whether autistic people show a tendency to restructure non-efficient languages—i.e., to reduce redundant case, and maintain or increase informative case—by replicating G. Roberts & Fedzechkina (2018) and Fedzechkina et al.'s (2022) 'no bias' conditions. This baseline of behaviour is first established as it is currently unknown how autistic people behave in artificial language learning paradigms used in language evolution, including paradigms targeting the communicative efficiency trade-off. Whilst some research has examined statistical learning in autistic people through artificial grammar learning in its classical sense (see Obeid et al. (2016), for review), these often involve non-linguistic stimuli or specifically only target syntactic patterns without reference to other elements of natural language, such as semantics and pragmatics. We are not aware of any studies that have examined how autistic people respond to artificial *language* learning paradigms that we use in language evolution to probe cognitive biases (see Culbertson (2012) for discussion of the application of artificial language learning in language evolution studies).

Second, we aim to replicate G. Roberts & Fedzechkina (2018) and Fedzechkina et al.'s (2022) social bias conditions in the autistic population. We predict that autistic people will behave differently to their neurotypical peers in the presence of social biases. We entertain two hypotheses as to what this might look like. First, they may pay less or no attention to the social bias, and thus their language outputs remain as efficiently structured as they would have been in the absence of a bias.

However, an alternative possibility is that autistic people may in fact pay *more* attention to the social bias, as a consequence of their experience paying increased attention to social cues in order to compensate and function socially. Based on a qualitative study of self-reported experiences of autistic masking, Hull, Petrides, Allison, Smith, Baron-Cohen, et al. (2017) identify two key aspects of masking: suppressing autistic traits and using strategies to compensate for any social difficulties experienced by the autistic person. It is the second aspect that is key to the prediction that autistic people may pay *more* attention to a social bias in this task. Potential compensatory masking behaviours include purposefully imitating the speech and body language of non-autistic people (Hull, Petrides, Allison, Smith, Baron-Cohen, et al., 2017; Miller et al., 2021b). If autistic participants employ these strategies in our study, they may imitate the speech of the population targeted by the bias even more closely, and therefore produce even less efficient output when influenced by the bias manipulation than allistic participants.

3.5 Experiment 1: Efficient restructuring of language in autistic people

In Experiment 1, participants were trained on one of two artificial languages, one using fixed word order and the other using variable word order. Both languages also incorporated the optional use of an object case marker, present on 50% of training trials. This meant that when word order was fixed, the case marker was redundant, but when word order was variable the case marker was informative (on those trials where it appeared). The study therefore tested whether learners, when reproducing the language, would reduce the use of redundant case marking (in the fixed word order condition), and increase the use of informative case marking (in the variable word order condition). In both conditions, the language was used by different "alien" populations (blue and orange aliens), to match as closely as possible what we will do in Experiment 2. One alien uses case consistently, the other never uses case. However, in this experiment no explicit social information was given that would introduce a bias toward either alien population. We examined the impact of autistic traits, measured by the Autism Quotient 10 (AQ-10) (Allison et al., 2012; NICE, 2021), on the trade-off between maximising accuracy and minimising production effort.

3.5.1 Method

Participants

A total of 162 participants were recruited via Prolific. Participants were aged 18 or over, and were self-reported native speakers of English. Participants were required to indicate their consent by a button press. Participants were compensated at £8-9 per hour for their participation[2]. 89 participants identified as female, 62 as male (including 1 identified trans man), 9 as non-binary, and 2 as other genderqueer identities. The mean age for those who identified as autistic was 35.5. (SD = 11.2), whilst for the allistic group the mean age was 38.7 (SD = 13.4). This study was granted ethical approval by the University of Edinburgh PPLS Ethics Committee (reference number 209-2122/2).

We measured autistic traits in all participants using the Autism Quotient 10 (AQ-10), and aimed to recruit participants with a range of scores, including at least half who scored 6 or above (the cut off for referral for Autism diagnosis on the National Health Service (NHS) in the UK (NICE, 2021)). The AQ-10 (and AQ-50) has been consistently shown to have high accuracy in Western, anglophone populations, though it does have a number of limitations which we return to in Section 3.7.2.

We initially aimed to recruit 80 participants per condition, 40 of whom were allistic, and 40 of whom were autistic, to achieve a good spread of AQ-10 scores both below and above 6. For the first phase of recruitment, we relied on Prolific's pre-screening filters to recruit equal numbers of autistic and allistic participants. However, we found that many participants who had identified themselves as autistic in Prolific's pre-screening questionnaire then did not identify as/were not diagnosed autistic when asked at the end of our study. Furthermore, these participants tended to score below the AQ-10 threshold (though this should not be taken as evidence that they are not autistic).

2. Prolific's recommended wage standards were raised during data collection for this study.

Therefore, it was necessary to over-sample into the autistic population on Prolific in order to achieve a good spread of AQ-10 scores. In total, 101 participants reported being autistic, while 61 participants did not. 51 participants reported a formal diagnosis of autism. 80 participants scored a 6 or above on the AQ-10, 40 in each condition. We note that we do not dispute that the self-reported autistics who scored below 6 on the AQ-10 are autistic, and we did not exclude participants who scored below this threshold. We also note that it is possible that some of our allistic participants are also indeed autistic (and some did have high AQ-10 scores), but did not identify/were not diagnosed as such.

Materials

Participants learned one of two artificial languages, used by a set of orange and blue aliens depicted in Figure 3.1[3]. Each language consisted of seven words: four nouns, two verbs, and one object case marker. Each of the four nouns in a language referred to a character (a chef, a burglar, a clown, a policeman) and each verb referred to an event (kicking and hugging). These meanings were depicted in line drawings. The written forms of the four nouns and two verbs were randomly drawn from the set {*koofta, rizba, peza, barsa, velmik, tegud*} at the start of the study, and the object marker was always *di*. These written forms were used to generate auditory presentations of the language using the speech synthesiser Amazon Polly (voice: British English Amy)[4]. All stimuli sentences were presented both auditorally and orthographically.

The *redundant case* language had a fixed SOV word order, so object case marking added no information, while the *informative case* language used SOV order in 50% of sentences and OSV order on the remaining 50%, so interpretation was only unambiguous when the object case marker was used.

All possible three-word content sentences were generated for each condition, with the restriction that the object and subject could not be the same referent. There were 24 possible meaning combinations in the language, but more possible sentences due to case marking and word order.

In the *redundant case* condition, there were a total of 48 possible SOV sentences conveying 24 scenarios (24 with case, 24 without). Of these, 24 sentences were used for training (12 with case, 12 without) . In the *informative case* condition, because word order varied there were a further 48 possible OSV sentences (again 24 with case, 24 without). In training, participants in this condition were shown 24 sentences (6 OSV with case, 6 OSV without case, 6 SOV with case, 6 SOV without case). For participants in both conditions, all 24 possible scenarios were presented during testing, for a total of 24 test trials.

As mentioned above, the languages were used by two different alien groups in order to match the design as closely as possible to Experiment 2, without introducing any social biases. The orange aliens always used case and the blue aliens never used it. Participants heard equal numbers of training sentences from the orange and blue aliens, so that overall the case marker was heard on 50% of trials.

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3. All materials and data analysis are available here: https://osf.io/u6kp9/
4. https://aws.amazon.com/polly/

Procedure

The experiment was presented in participants' browser using jsPsych (de Leeuw, 2015).

Following the no social biases conditions of G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022), participants were told that they were on a mission to a planet with two groups of aliens, and that they would be learning the language of those aliens to facilitate trade. It was emphasised that the participant should aim to impress both groups of aliens, as they had important resources and were friendly (see Figure 3.1).

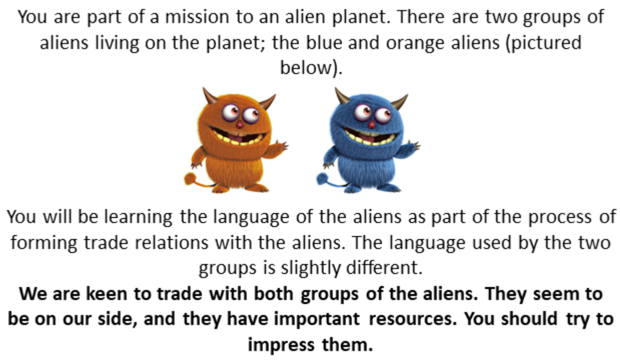


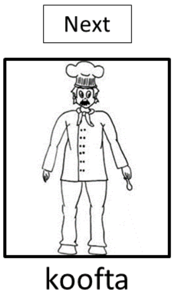
Figure 3.1: Initial instructions given to participants.

Participants were then taught the noun lexicon. On each trial of the noun exposure task (see Figure 3.2a) a picture of a character was displayed along with its noun label. Participants were able to study the word-image pair for as long as they wished, but only heard the name once per trial. Each character was displayed twice, in random order.

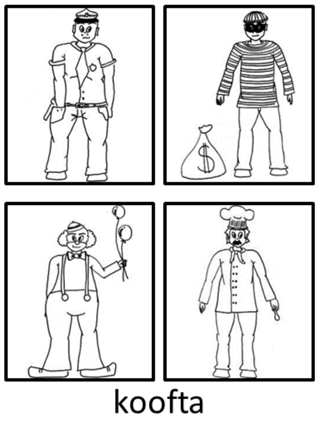
Next, we tested noun learning through a comprehension task (see Figure 3.2b). On each trial, participants heard and saw one noun, and clicked on its referent from the four characters. They were given correct/incorrect feedback on their answers, and each noun was tested twice in random order.

Next, we tested participants' ability to identify the nouns (see Figure 3.2c). Participants were shown one character and had to choose its name amongst the four noun options. Each character was named twice, in random order, and correct/incorrect feedback was given. If participants did not achieve 80% accuracy on this task, they repeated the noun production task until they met the criterion.

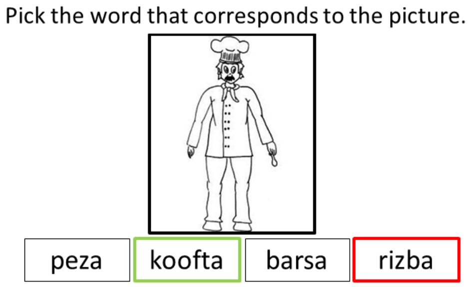
Having learned the nouns, participants were then trained and tested on sentences in the language. In the sentence exposure task (see Figure 3.3a), on each trial an image of an event was displayed along with a sentence and the corresponding coloured alien (dependent on the presence of case). Each of the 24 sentences in the exposure set was displayed 2 times, for a total of 48 trials, randomly ordered by participant.



(a) Example of a noun exposure trial.



(b) Example of a noun comprehension trial.



(c) Example of a noun production trial, showing example feedback for an incorrect selection.

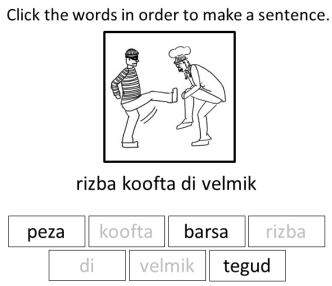
Figure 3.2: Examples of noun training and testing trials.

In the sentence comprehension task (see Figure 3.3b), on each trial two event images appeared along with a sentence (the same set of sentences as in the exposure trials), and the corresponding alien (dependent on the presence of case). Participants were asked to select the image that corresponded to the sentence. They were given correct/incorrect feedback on their answers. Each of the 24 scenarios was displayed 2 times, for a total of 48 trials, randomly ordered by-participant.

In the sentence production task (see Figure 3.3c), on each trial an event image appeared along with buttons for each word in the language. Participants were asked to construct sentences by selecting the words in order. They were required to use at least three words (the minimum required to form a correct sentence without case marking) and could reset their choices as many times as they wished. No alien appeared in these trials, following G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022). Each event in the test set of 12 sentences was presented a single time, for a total of 24, previously unseen, trials, randomly ordered by-participant.

(a) Example of a sentence exposure trial in the informative case condition with the case-using alien.

(b) Example of a sentence comprehension trial in the informative case condition with the non case-using alien.



(c) Example of a sentence production trial.

Figure 3.3: Examples of sentence training and testing trials.

After the study, participants were asked to complete the Autism Spectrum Quotient 10 (AQ-10). The AQ-10 consists of the 10 most discriminating (in terms of distinguishing between an autistic and an allistic individual) questions from the longer Autism Spectrum Quotient (AQ-50) (Baron-Cohen et al., 2001), retaining predictive validity, sensitivity, and specificity (Allison et al., 2012). The AQ-10 consists of 10 short statements with four choices of answer for each question: ‘definitely agree’, ‘slightly agree’, ‘slightly disagree’, and ‘definitely disagree’, though these are scored as a binary agree/disagree. There are 5 subscales within the AQ-10, each with 2 questions: attention switching, imagination, attention to detail, communication, and social (Allison et al., 2012).

We treated autistic traits as multi-dimensional and continuous to reflect the fact that their manifestation is highly heterogeneous, with different individuals having considerably different profiles and needs. Using a binary measure of autistic versus allistic could obscure any effects that individual autistic traits have on performance in our studies. The AQ-10’s short length allows us to gain insight into the impact of autistic traits within a limited experimental setting. Additionally, the AQ-10’s 5 subscales allow us to consider which particular autistic traits may have a greater impact on our results. All participants completed the AQ-10.

Participants also completed a short questionnaire reporting their native language, any other language experience, age, gender, level of motivation during the experiment, and whether they themselves would use their data as a researcher. Finally, participants were asked whether they had ever received a diagnosis of ASD, whether they identified as being autistic, and whether they had a close family history of ASD.

Due to an issue with participants reporting to Prolific that they met one of these criteria, but then reporting in our study that they did not, this question was moved to the beginning of the experiment for the latter half of participants. This was to ensure that when we targeted recruitment towards autistic participants, the participants actually did identify as autistic. This also increased the likelihood of scoring >6 on the AQ-10, though we again note that scoring >6 on the AQ-10 is not necessary to be autistic. When we were recruiting autistic participants, if they told us in this pre-screening question that they were not autistic, they were asked to return the study to Prolific, and thus did not proceed with the rest of the experiment.

Analysis

Our analyses focused on the sentence production task. Analyses were conducted in R (R Core Team, 2022), using binomial generalised linear mixed effects models with the lme4 package (Bates et al., 2015). Since our critical factors (language type, AQ-10 score) were between subjects, the only random effects structure was a random by-participant intercept. Contrasts were sum-coded and AQ-10 scores (as well as each of the subscale scores) were standardised to scale over two standard deviations. Models are specified using lme4 syntax.

3.5.2 Results

Word order in production

Before examining participants' use of case, we evaluated which word orders participants used. The results reported below for word order usage take into account only productions with correct subject, verb and object. In the *redundant case* condition, where participants were only trained on SOV order, the by-participant average for the proportion of SOV use was 0.93 (SD = 0.21). SVO, the native language word order, was the most likely alternative (M = 0.03, SD = 0.17), though this was driven by 2 participants who used it 100% of the time. Other word orders used were OSV (M = 0.03, SD = 0.11) and VSO (M = 0.001, SD = 0.01). In the *informative case* condition, participants were trained on 50% SOV and 50% OSV input. The proportion of SOV usage was 0.59 (SD = 0.31), whilst the proportion of OSV usage was 0.36 (SD = 0.30). Most participants used a mix of the two orders, but 16 participants only used SOV and 3 only used OSV. SVO was again the most likely alternative order (M = 0.04, SD = 0.16), driven primarily by 2 participants who used it 90% of the time or more. Other word orders used were OVS (M = 0.01, SD = 0.08) and VSO (M = 0.003, SD = 0.03). These results indicate that participants have generally learned the word order in the languages they were trained on. Importantly, while participants in the *informative case* condition introduced a skew favouring SOV order, overall, case remained informative in this condition.

We also examined whether AQ-10 score had an impact on the use of word order. We fit models with AQ-10 score as a fixed effect, predicting the proportion of trials on which participants used SOV order in each condition. In neither the *informative* ($\beta = -0.43, p = 0.61$) nor *redundant* ($\beta = 0.050, p = 0.86$) conditions was there a significant effect of AQ-10 score. In the *informative case* condition, we also considered the impact of AQ-10 score on OSV word order, as this was the other order presented in training; this also showed no impact of AQ-10 score ($\beta = 0.009, p = 0.91$). This indicates that autistic participants were not more or less likely to shift the word order of the input than allistic participants.

Case use by condition

Recall that both G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) found that participants in the *informative case* condition produced case markers more than 50% of the time, i.e., more often than in the language they were trained on, though this effect only emerged after two rounds of training. By contrast, they found that participants in the *redundant case* condition produced case markers less than 50%, i.e., less often than in the language they were trained on. To evaluate whether this finding was replicated in our study, without distinguishing participants based on AQ-10, we analysed all sentences produced, regardless of word order and lexical accuracy. We fit intercept-only GLMMs to this data in each condition, with the structure Case Marker Usage $\sim$ 1 + (1|Subject). These models indicated that participants in the *informative case* condition used case numerically more than 50% of the time, but this was not significantly above chance (M = 0.54 [SD=0.31], $\beta = 0.30, p = 0.25$). In contrast, participants in the *redundant case* condition used case at a rate significantly below chance (M = 0.37

[SD=0.35], $\beta = -1.41, p = 0.0017$). A third model, fit on all the data from Experiment One, with the structure Case Marker Usage $\sim$ Condition + (1|Subject) revealed a significant difference between the two conditions such that participants in the *redundant case* condition were significantly less likely to use case ($\beta = -0.77, p = 0.00088$). These results replicate the basic difference between conditions reported in previous studies: that individuals retain or increase informative case, and reduce redundant case.

Case use mediated by AQ-10 Scores

Turning to the key question of our study, we additionally evaluated how use of informative and redundant case varied by AQ-10 score (Figure A.2). We fit a GLMM model with the structure Case Marker Usage $\sim$ AQ-10 Score * Condition + (1|Subject). This model revealed no relation between AQ-10 score and use of case marking ($\beta = -0.072, p = 0.75$). This held both overall and in interaction with condition ($\beta = -0.23, p = 0.33$). Thus, there was no evidence of a difference in the behavioral trade-off between production effort and informativity based on autistic traits.

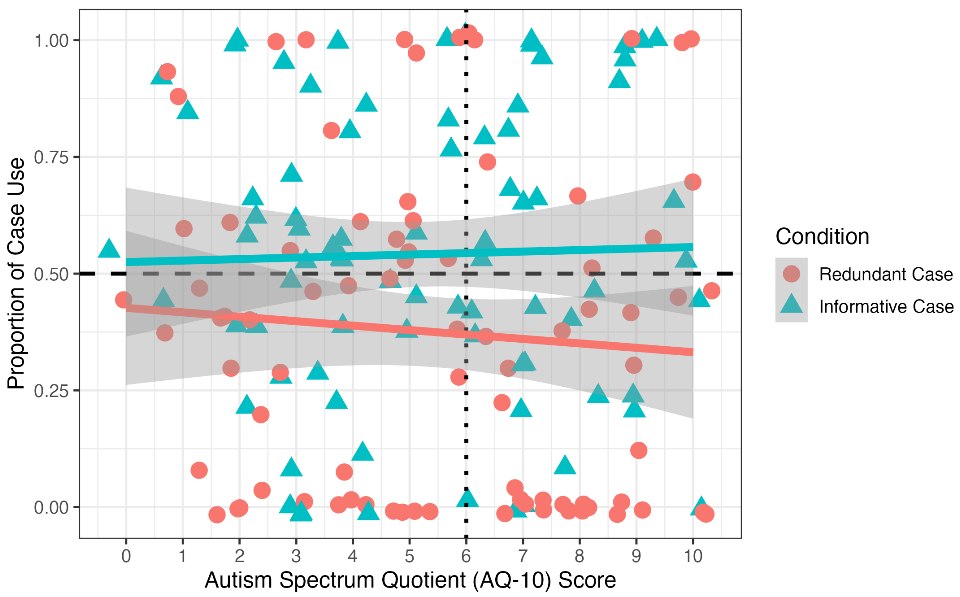


Figure 3.4: Proportion of case use in both conditions by AQ-10 score. The dashed horizontal line cutting the y axis indicates the proportion of case use in the input. The dotted vertical line cutting the x axis represents the cut-off point on the AQ-10 for consideration for referral for diagnosis on the NHS.

Gender, AQ-10 scores, and case marker usage

The relationship between gender and autistic traits has received a significant amount of research (for review, see Lai et al., 2015). For instance, researchers have suggested that autistic traits manifest differently in women, leading to the hypothesis of a specific 'female autism phenotype' (Hull et al., 2020). As a result, we explored whether gender had any impact on our results.

We initially collapsed the categories of our participants' gender into four levels: female, male, non-binary, and other genderqueer identities; however, the small number of participants who were non-binary or other genderqueer identities caused convergence issues. We have therefore excluded those participants here.

We examined whether gender impacted the use of case marking. A model with the structure Case Marker Usage $\sim$ Gender + (1|Subject) showed that there was no impact of gender on case marker usage ($\beta = 0.14, p = 0.56$). A linear model with structure AQ-10 Score $\sim$ Gender (no random effects structure) also showed no significant impact of gender on AQ-10 scores ($\beta = 0.0072, p = 0.67$).

3.5.3 Discussion

In this study, we sought to replicate findings from a set of previous experiments investigating the relationship between case marking and fixed vs. variable word order. In the languages of the world, there is a negative correlation between fixed word order and case marking. Previous experiments have indicated that participants learning an artificial language will actively change the systems they are trained on to bring them in line with this (Fedzechkina et al., 2012, 2017; G. Roberts & Fedzechkina, 2018; Fedzechkina et al., 2022). When word order is variable, and thus case marking is informative participants will use or increase case marking in their production. When word order is fixed and thus case marking is redundant, participants will reduce case marking in their productions. These results support a link between individual-level cognition and language evolution.

Here, we investigated whether this result, which has been taken as evidence that learners are biased in favor of efficient communication, replicates with autistic participants. We used a gradient measure of autism, the AQ-10. We found that the relationship between case and word order held regardless of AQ-10 score. More specifically, participants used less case when it was redundant compared to when it was informative. As in previous work, compared to the training language, case use was significantly reduced when case was redundant. Differing from previous work, we did not find that case use significantly increased when case was informative, though it did numerically increase. This effect was somewhat more subtle in previous work, and potentially reflects the fact that case is difficult to learn, at least for English-speakers. Most importantly, however, we found no indication that case-marking behaviour in either condition was impacted by overall AQ-10 score. This suggests that autistic people's behavior is in line with the efficiency-production trade-off, as reported previously for (presumably) allistic participants, at least in the absence of social biases.

3.6 Experiment 2: The impact of social biases on efficient language use in autistic people

In Experiment 2, we introduced social biases to the two language conditions from Experiment 1. Previous research (Fedzechkina et al., 2022; G. Roberts & Fedzechkina, 2018) has demonstrated that social biases can impact the communicative efficiency trade-off, with participants willing to use more redundant case (more production effort) and less informative case (less communicative accuracy) to match the behaviour of a group that they are biased towards. We now investigate whether these findings generalise to autistic people.

Following previous work, we did this by manipulating the social information given to participants in each condition. In one condition, participants were taught a language where case was redundant, and were told that they should pay more attention to the aliens who used case. In the other condition, participants were taught a language where case was informative, and were told that they should pay more attention to the aliens who did **not** use case. Thus, in one condition participants were biased toward aliens who needlessly expend production effort by producing redundant case, and in the other condition participants were biased toward aliens who refuse to use production resources to produce informative case. In both conditions, therefore, this social biasing should encourage participants to be less communicatively efficient—to use *more* redundant case when the bias is for redundant speakers, and *less* informative case when the bias is for uninformative speakers. As in Experiment 1, we recruited both autistic and allistic participants, as measured using both self-identification (for recruitment) and the Autism Quotient 10 (AQ-10, for analysis).

Recall that we put forward two hypotheses which might lead to the prediction that autistic participants should behave differently from allistic participants in this experiment. First, following a deficit-model approach to autism which argues that autistic people are ‘deficient’ in social skills, autistic people may pay less attention to the social bias than their allistic counterparts, and thus will not alter their use of redundant/informative case in response to the presence of a social bias. Second, in line with more recent theories of autism such as the Double Empathy Problem (D. Milton, 2012a), we hypothesise that it is possible that autistic people may pay *more* attention to the social bias as a result of over-compensatory social behaviours, and thus their use of redundant/informative case will change more radically in the presence of a social bias than their allistic peers.

3.6.1 Method

Participants

A total of 181 participants were recruited via Prolific[5]. Participants were required to indicate their consent by a button press. Participants were aged 18 or over, and were self-reported native speakers of English. Participants were compensated at £8-9 per hour for their participation[6]. 93 participants identified as female (including 1 identified trans woman), 82 as male, 5 as non-binary, and 1 as other genderqueer identity. The mean age of participants who identified as autistic was 36.1 (SD = 11.7), whilst for allistic participants it was 37.6 (SD = 12.9).

We followed the same recruitment procedure as in Experiment 1, aiming to ensure that at least half of our participants scored 6 or above on the AQ-10. Again, it was necessary to over-sample into the autistic population to achieve this spread. In total, 50 participants reported being diagnosed autistic, while 131 did not. 98 participants reported identifying as autistic (including all diagnosed participants except 3), while 83 participants did not identify as autistic. 81 participants scored a 6 or above on the AQ-10, 40 in the *bias for no informative case* condition, and 41 in the *bias for redundant case* condition.

Materials

The materials used were the same as in Experiment 1 (see Section 3.5.1).

Manipulation

The key difference between Experiments 1 and 2 is that in Experiment 2, participants were provided with instructions intended to bias them towards one of the two alien groups. We used two of the bias conditions from G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022). In the first condition, participants were biased towards the aliens who **do** use redundant case (G. Roberts & Fedzechkina, 2018) (this condition is henceforth referred to as *bias for redundant case*). In the second condition, participants were biased towards the aliens who **do not** use informative case (Fedzechkina et al., 2022) (this condition is henceforth referred to as *bias for no informative case*). Details of the biasing procedure can be found below.

In the *bias for redundant case* condition, the input language was the same as the fixed word order condition in Experiment 1, with SOV order used 100% of the time. In the *bias for no informative case* condition, the input language was the same as the flexible word order condition in Experiment 1, with SOV used 50% of the time and OSV used 50% of the time. In both conditions, one colour of aliens used case, while the other did not, leading to 50% case input overall.

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5. This study was granted ethical approval by the University of Edinburgh PPLS Ethics Committee (reference number 209-2122/2)
6. Prolific's recommended wage standards were raised during data collection for this study.

Procedure

The experiment tasks were the same as described in Experiment 1 (see Section 3.5.1), with two exceptions. First, before the beginning of the noun exposure task, participants were introduced to the intended social bias. This page indicated that one of the two alien species (identified by colour) had more to offer in trade and were friendlier, whilst the other species had less to offer and were not friendly. The alien species that the participants were biased towards depended on the condition, as described above. Example instructions for each condition are shown in Figure 3.5 The text used was adapted from G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022).

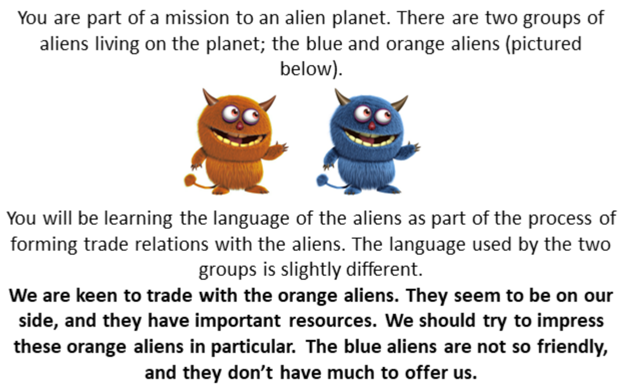

Figure 3.5: The biasing procedure presented to participants in the *bias for redundant case* condition.

Second, before the beginning of the sentence exposure phase, participants were asked to indicate which one of the aliens was considered to have more to offer and to be more friendly, by clicking on the appropriate alien. This functioned both as an attention check and as a means to reinforce the bias. If participants answered correctly, their answer was highlighted in green and accompanying text told them that they were correct. If participants answered incorrectly, their answer was highlighted in red, the correct answer was highlighted in green, and they were told by accompanying text that they were wrong and that the other alien was the one that we wish to trade with. This reminder was not used in previous studies, but was added to ensure that participants had not forgotten about the social bias in the course of initial noun training. Only one participant failed this check.

We also note that the majority of participants in Experiment 2 completed the autistic criteria question at the beginning of the experiment, as with the latter half of participants in Experiment 1.

Data Analysis

Data analyses followed the same process described in Section 3.5.1.

3.6.2 Results

Word order in production

As in Experiment 1, we first examined participants' word order usage in each condition, including only productions with correct subject, verb and object. In the *bias for redundant case condition*, input word order was 100% SOV. The by-participant average for the proportion of SOV use was 0.97 (SD = 0.14). Alternative word orders were SVO (M = 0.003, SD = 0.03), OSV (M = 0.03, SD = 0.12), and OVS (M = 0.003, SD = 0.03). In the *bias for no informative case condition*, recall that language exposure was split between 50% SOV and 50% OSV. The by-participant average for the proportion of SOV usage was 0.57 (SD = 0.3), whilst the proportion of OSV usage was 0.32 (SD = 0.26). Most participants used a mix of the two word orders, but 8 participants only used SOV, whilst 1 only used OSV. The most common alternative word order was SVO (M = 0.08, SD = 0.24). Other order used, though very rarely, were OVS (M = 0.03, SD = 0.13) and VOS (M = 0.001, SD = 0.009). As in Experiment 1, these results suggest that overall participants learn the order they were trained on, however there is some skew introduced in the *bias for no informative case* condition where word is flexible. Nevertheless,case remained informative in this language.

As in Experiment 1, we examined whether AQ-10 scores had an impact on word order used, to ascertain whether autistic participants were more likely to restructure the input than allistic participants. We fit models with AQ-10 score as a fixed effect, predicting the proportion of trials on which participants used SOV order in each condition: SOV $\sim$ AQ-10 Score * Condition + (1|Subject). In neither the *bias for no informative case* ($\beta = -0.39, p = 0.55$) nor the *bias for redundant case* ($\beta = 0.27, p = 0.47$) conditions was there a significant effect of AQ-10 score. In the informative case condition, we also considered the impact of AQ-10 score on OSV word order, as this was the other order presented in training; this also showed no impact of AQ-10 score ($\beta = 0.057, p = 0.35$). Again, like in Experiment 1, this indicates that there is no evidence that autistic participants restructure the input more or less than their allistic colleagues.

Case use by condition

Turning to case use, we first examined the results without distinguishing participants based on AQ-10, to check whether our results replicate those of G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022). They find that redundant case was more likely to be used when participants were biased in favour of the aliens who used redundant case, and informative case was more likely to be dropped when participants were biased in favour of the aliens who did not use informative case. In other words, participants sacrificed efficiency—either producing more effortful sentences than necessary for accurate communication, or producing sentences that were ambiguous—in order to conform to the social bias.

To analyse our own data, we fit intercept-only models predicting the use of the case marker in the *bias for redundant case* and *bias for no informative case* conditions respectively, both with the structure Case Marker Usage $\sim$ 1 + (1|Subject). The first model indicated that participants used case in the *bias for redundant case* condition significantly more than predicted by chance (($\underline{M}$) = 0.81 [SD=0.27]) $\beta = 4.93, p = 8.91e-07$). The second model indicated that participants used case in the *bias for no informative case* condition significantly less than predicted by chance (($\underline{M}$) = 0.36 [SD=0.30]) $\beta = -1.19, p = 2.17e-05$). These results replicate the findings of G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022), showing that the manipulation of social biases significantly impacts participants' case marking behaviour.

A third model, fit on all the data from Experiment Two, with the structure Case Marker Usage $\sim$ Bias + (1|Subject) revealed a significant difference between the two bias conditions such that participants in the *bias for redundant case* condition were significantly more likely to use case ($\beta = 2.55, p = 2e-16$) than those in the *bias for no informative case* condition. These results replicate the basic difference between conditions reported in previous studies: participants use *more* redundant case when they are biased towards a group that uses it, and *less* informative case when biased towards a group that does not use it.

Case use mediated by autistic traits

We now analyse our data taking AQ-10 score into account in order to address the key question of this study. Figure 3.6 shows the impact of autistic traits in the bias conditions, as measured by the AQ-10. To analyse these results, we fit a model with the structure Case Marker Usage $\sim$ AQ-10 Score + (1|Subject). This model showed that there was no significant overall impact of AQ-10 score on case marking ($\beta = 0.14, p = 0.63$). A second model including both AQ-10 score and condition as fixed-effects, as well as their interaction, was fit with the structure Case Marker Usage $\sim$ AQ-10 Score * Bias + (1|Subject). This model revealed a significant interaction driven by behaviour in the *bias for redundant case* condition ($\beta = 0.66, p = 0.01$).

When participants were biased toward the aliens who produce redundant case, use of case increased in individuals with higher AQ-10 scores. That is, these participants were even more likely to expend communicatively unnecessary effort to produce redundant case. However, when participants were biased toward the aliens who did not produce case even when it was informative, then there was no significant difference in case production based on AQ-10. Thus, individuals with higher (rather than lower) AQ-10 scores were more willing to expend production effort to meet their social biases, but they were not more willing to be uninformative to meet their social biases.

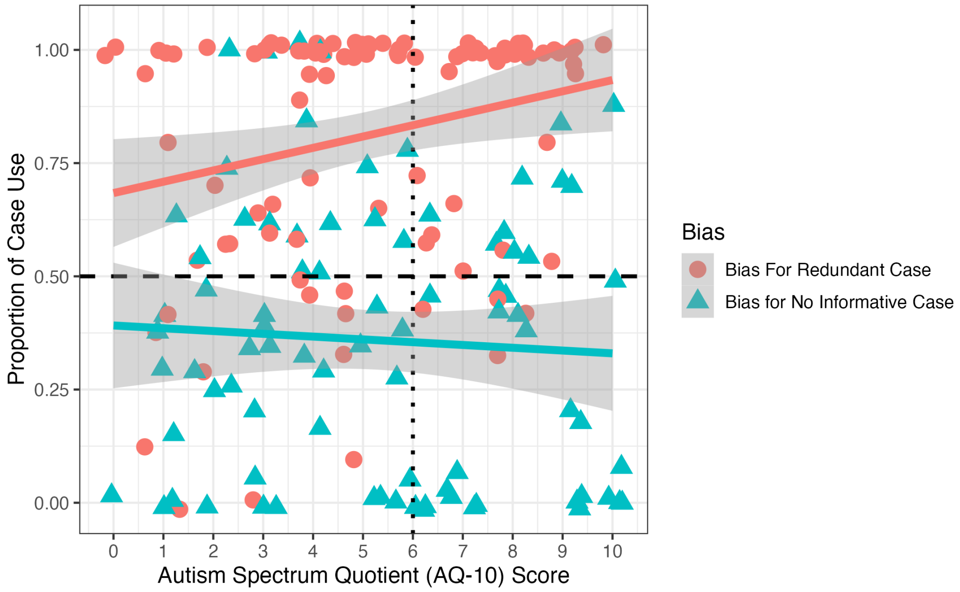

Figure 3.6: Proportion of case use in both conditions by AQ-10 score. The dashed horizontal line cutting the y axis indicates the proportion of case use in the input. The dotted vertical line cutting the x axis represents the cut-off point on the AQ-10 for consideration for referral for diagnosis on the NHS.

Case use by autism status

In recognition of the inherent limitations of the AQ-10, further to examining case use by AQ-10 score in a continuous manner, we also consider the impact on case use by self-identified autism status; that is, a binary measure of our allistic versus autistic groups. We note that we explicitly do not exclude self-identified autistics from our sample. When we discuss the results below, we refer to all participants who identified as/were diagnosed as autistic as autistic.

We fit a GLMM model with the structure (Case Marker Usage $\sim$ Bias * Autism Status + (1|Subject)). Interestingly, unlike with the continuous AQ-10 score, this binary measure revealed both no significant impact of being autistic on case marking overall ($\beta = -0.052, p = 0.84$) and no significant interaction between between being autistic and the bias, though autistic participants did use numerically more case in the *bias for redundant case* condition than the grand mean and the effect was marginal ($\beta = 0.41, p = 0.115$). We discuss this further in the General Discussion.

Case use mediated by specific AQ-10 subscales

We conducted an exploratory analysis examining whether individual AQ-10 subscales had an impact on the use of case in Experiment 2, and whether there was an interaction with condition. We did not have any *a priori* hypotheses regarding which subscales may impact our results. We fit models predicting case use by each AQ-10 subscale, as well as the interaction between the subscales and condition. Each model had the structure Case Marker Usage $\sim$ Subscale Score * Bias + (1|Subject). The models revealed no significant main effect of any subscale alone on case use. However, the models did reveal significant interactions between case use in the *bias for redundant case* condition for the attention to detail ($\beta = 0.84, p = 0.0012$), attention switching ($\beta = 0.52, p = 0.042$), and communication ($\beta = 0.60, p = 0.023$) subscales. In each case, a higher score on these subscales predict an increased use of redundant case in the bias for redundant case condition. There was no significant interaction between the bias and the imagination ($\beta = -0.13, p = 0.62$) or social ($\beta = 0.33, p = 0.20$) subscores.

Comparing case use in Experiment 1 & 2

Since the key finding of G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) is that participants are less efficient in the presence of social biases, we also compared case use across our two experiments. Recall that in both experiments, participants were trained on the same two languages—one with fixed order and redundant case, the other with variable order and informative case. However, in Experiment 1, there was no social bias in either condition. In Experiment 2, participants were either biased toward aliens who used redundant case, or failed to use informative case.

First, we considered the data from the two informative case conditions (*informative case* (Experiment 1); *bias for no informative case* (Experiment 2)). Figure 3.7 visualises the differences in case use across the conditions. We found that the presence of a social bias had a significant impact on informative case use; specifically, participants in the *bias for no informative case* condition used significantly less case compared to the no bias *informative case* condition ($\beta = -0.74, p = 0.00011$). Second, we considered the data from the two redundant case conditions (*redundant case* (Experiment 1); *bias for redundant case* (Experiment 2)). We found that the presence of a social bias again had a significant impact on redundant case use; participants in the *bias for redundant case condition* used significantly more case compared to the no bias *redundant case* condition ($\beta = 2.91, p = 1.37e-14$). These results replicate the main findings of G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022).

We also considered the impact of AQ scores when comparing Experiments 1 and 2. We first fit a model on the data from the two informative case conditions (*informative case* (Experiment 1); *bias for no informative case* (Experiment 2)). This model had the structure Case Marker Usage $\sim$ AQ-10 Score * Bias + (1|Subject). The model showed a significant impact of the *bias for no informative case* on case marking, such that it significantly reduced the case marking used ($\beta = -1.27, p = 1.16e-09$), but found no significant impact of AQ-10 score ($\beta = -0.070, p = 0.73$) nor an interaction between the bias and AQ-10 score ($\beta = -0.20, p = 0.31$).

Second, we fit a model with the same structure on the data from the two redundant case conditions (*redundant case* (Experiment 1); *bias for redundant case* (Experiment 2)). This model showed a significant impact of the *bias for redundant case*, which significantly increased the use of case marking ($\beta = 2.63, p = 2e-16$). The model also showed no overall significant impact of AQ-10 score ($\beta = 0.37, p = 0.20$), but did show a significant interaction between the *bias for redundant case* and AQ-10 score ($\beta = 0.70, p = 0.015$). This confirms the impact of autistic traits on communicative efficiency when it comes to social biases for redundant case, but not informative case.

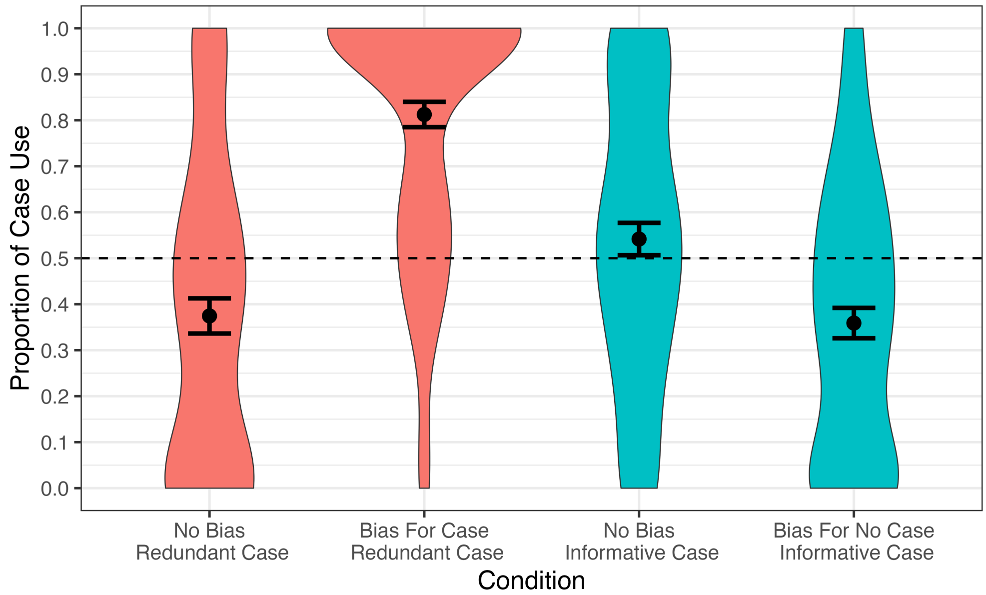

Figure 3.7: Case use across all four conditions. Colored pairs indicate conditions that share an input language (redundant case or or informative case) but differ in the presence or absence of a social bias. including the no bias conditions from Experiment 1 and the bias conditions from Experiment 2. Error bars show the standard error, with the dot indicating the mean case use.

Gender, AQ-10 scores, and case marker usage

As in Experiment 1, we also considered the impact of gender (female or male) on AQ-10 scores and case marker usage. First, we fit a model with structure Case Marker Usage $\sim$ Gender + (1|Subject). This showed that there was no significant impact of gender on case marker usage, though the effect was marginal ($\beta = -0.65, p = 0.058$). Second, we fit a linear model with the structure AQ-10 Score $\sim$ Gender. This showed that AQ-10 scores significantly differed across genders ($\beta = -0.12, p = 9.3e-15$), such that participants who identified as female were more likely to have lower AQ-10 scores.

As a result, we further examined whether the impact of AQ-10 scores on case marking above could instead be accounted for by the gender of participants. We fit a model, on all the data, with the structure Case Marker $\sim$ (Bias * Gender) + (Bias * AQ-10 Score) + (1|Subject). This model revealed a significant effect of the *bias for redundant case* condition ($\beta = 2.63, p = 2e-16$) and a significant interaction between the *bias for redundant case* condition and AQ-10 score ($\beta = 0.74, p = 0.0064$), but no significant impact of the interaction between gender and condition ($\beta = 0.19, p = 0.48$).

We also split the data into two sets, one containing the data from female participants, and the other from male participants. On each set of data we ran a model with structure Case Marker Usage $\sim$ Bias + (1|Subject), to ascertain whether the effect we observe on all of the data holds across both sets of data. We find that this is the case. For both male ($\beta = 0.80, p = 0.038$) and female ($\beta = 0.74, p =$

0.046) participants, there is a significant interaction between AQ-10 Score and condition on case marker usage, such that participants with higher AQ-10 scores use more case marking in the *bias for redundant case* condition. This suggests that the effect we find in Experiment 2 is driven by AQ-10 score, rather than gender.

3.6.3 Discussion

In this experiment, we added a social bias to our experiment on case and word order variability. Importantly, we replicated the findings from previous studies, indicating that the introduction of social biases changes how participants restructure their linguistic input G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022). At a group-level, participants were willing to reduce communicative accuracy to meet social goals, by significantly reducing use of informative case, and also sacrificed production efficiency to meet social goals significantly increasing their use of redundant case.

Importantly, however, we further found that autistic traits modulated the impact of social biases—but only in certain respects. Autistic traits were associated with an increased adherence to the social bias in the *bias for redundant case* condition. People with higher levels of autistic traits retained significantly more redundant case when biased towards a population that used it, despite it being unnecessary for communication and requiring more production effort. Autistic traits do not, however, predict a significant reduction in the retention of informative case in the *bias for no informative case* condition. Participants with higher autistic traits, as with their lower autistic traits peers, do use less informative case in this condition, and participants are across the board unlikely to reach the extreme of no usage. This may reflect the fact that, in the informative case conditions, case is necessary to understand the language; without it, it was not possible to reliably understand which referent was the object and which was the subject. On the other hand, redundant case requires more effort to produce, but including it does not obscure understanding of the target language. These results indicate that higher autistic traits leads people to weigh communicative accuracy more heavily than minimising production effort when these two trade off.

We also ran an exploratory analysis of 5 AQ-10 subscales. We found that high scores in the attention to detail, attention switching, and communication AQ-10 subscales increased the use of redundant case, while the imagination and social subscales did not. It makes intuitive sense that participants with higher attention to detail scores showed a greater effect of social bias, although again this appears only in the *bias for redundant case condition*. By contrast, it is less clear why increased scores on the communication subscales, i.e., more difficulty in conversation, would predict a greater effect of social bias. It could be that participants with higher communication scores use compensatory masking behaviours more (Pearson & Rose, 2021), or are required to pay more attention to communicative situations in their everyday life. That the imagination subscale does not affect behavior in the task is perhaps unsurprising; it is not clear how this relates to the task at all. On the other hand, scores on the social subscale might seem potentially relevant, however participants in this experiment are explicitly told what intentions and thoughts/feelings are relevant, so they do not have to infer such information. However, this was an exploratory analysis, and our discussion here is post-hoc. Therefore we set this aside for future research.

We further examined the impact of a binary group classification (self-identified autistic-allistic) on the use of case and the interaction with the two bias conditions. We do not find any significant impact of autism status on case marking nor an interaction between being autistic and bias condition, though there was a marginal and numeric impact of being autistic in the *bias for redundant case* condition. One possible explanation for not finding a significant difference on the basis of autism status, but finding it in terms of the AQ-10, is that whilst AQ-10 scores and autism identification correlate significantly[7], not all participants with high AQ-10 scores identified/were diagnosed as autistic, and not all self-identified autistic participants had high AQ-10 scores.

This variation within groups may reflect a variety of factors. For instance, it is possible that some of our presumed allistic participants are autistic, but have not been diagnosed, which would obscure the impact of autism status in our results.

Additionally, it is likely that treating our participants using a binary grouping prevents our model from capturing key information about the heterogeneity amongst the autistic and indeed allistic participants. For example, it is possible that the AQ-10 captures certain traits that are characteristic of autism but also not consistently found in all autistic people, and that some of these traits are also likely to be present in the general allistic population to different degrees (see Lundin et al. (2019) and Ruzich et al. (2015) for discussion of AQ-10 and AQ-50 traits in the general population). Moreover, the AQ-10 is not a comprehensive measure of autistic traits, and thus future studies should include alternative measures in order to understand specifically what autistic traits may be driving our results.

3.7 General Discussion

3.7.1 The impact of autistic traits on social biases and communicative efficiency

Communicative efficiency—the trade-off between production effort and communicative accuracy—has been argued to be a central mechanism in shaping language evolution. One particularly well-studied example of this is the relationship between case marking and word order flexibility. Cross-linguistically, languages with fixed word order are less likely to have case marking, while languages with flexible word order are more likely to have case marking. This has been argued to reflect principles of efficient communication: case is only necessary for communication when word order doesn't already indicate grammatical roles. Indeed, in a number of studies using artificial language learning experiments, participants have been found to actively restructure or change the languages they are learning to make them

7. For Experiment 2, a Pearson correlation was used to assess the relationship between self-identification of autism and AQ-10 score. This found that these measures were positively correlated, $r(1808) = .67, p < 2.2e-16$.

more communicatively efficient: they reduce case in the language when it would be redundant, and use it more when it would be informative (Kurumada & Jaeger, 2015; Kanwal et al., 2017; Fedzechkina et al., 2012; Fedzechkina & Jaeger, 2020). However, G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) crucially show that this general cognitive bias can be overridden by social factors. When participants are biased in favour of a group that uses case or not, they will follow that group, even if it means using case redundantly, or omit case where it would be informative. This suggests an additional mechanism by which languages, or language communities can come to vary from one other. Here, we were interested in whether these experimental results hold in a neurodivergent population, specifically autistic people.

First, we investigated whether autistic traits impact the accordance with this trade-off in the absence of social factors. We taught both autistic and allistic people two varieties of a language, both of which featured a variably-used object case marker: in the first, word order was fixed, making object case redundant; in the second, word order was flexible, making object case informative. We found that autistic traits did not impact the trade-off, and autistic people, like their allistic peers, reduce their use of redundant case where it is not necessary for communicative accuracy but does increase production effort. Likewise, they continue to use an informative case marker which is necessary for communicative accuracy, despite increased production effort. It is worth noting that our participants do not significantly increase informative case use above the input threshold. This accords with the findings of Fedzechkina et al. (2022), who only found such an increase in their second production test (which occurred after a second round of sentence training and comprehension), while our participants only went through one round of sentence training, comprehension and test. This reinforces Fedzechkina et al.'s (2022) finding that participants only begin to increase the use of informative case when they become more proficient with the artificial language. On the other hand, and as found in G. Roberts & Fedzechkina (2018), participants need less training to significantly reduce the amount of redundant case used.

Second, we investigated whether autistic people's cognitive bias for communicative efficiency is influenced by social biases in the same way as their allistic peers. G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) found that (presumably) allistic people are willing to reduce communicative efficiency in order to reach a social goal. More specifically, they use *more* redundant case despite it requiring extra effort to produce for no communicative benefit, and they use *less* informative case, despite it having clear communicative benefit. We entertained two hypotheses for the behaviour of autistic people: first, that they would pay less attention to the social bias, based on the autism as communicative deficit model; second, that they would pay more attention to the social bias, based on the concept of autistic masking. We found that autistic traits mediated the impact of the social bias. Individuals with higher autistic traits are only willing to give up as much communicative accuracy as those with lower traits; they do not reduce their use of an informative case beyond what individuals with lower autistic traits do (though we note that this means that those with higher autistic traits are paying at least as much attention to the social bias as those with lower traits). However, we did find that individuals with higher autistic traits were willing to put in more production effort when it did not serve a communicative purpose in order to meet a social goal, as they increased their use of redundant case beyond the increase seen by those with lower autistic traits. This supports the second hypothesis.

Before we speculate on some mechanistic reasons for our results below, we first highlight why we believe they are important, regardless of the mechanism. As far as we know, this is the first empirical study that considers the impact of neurodiversity on language evolution, i.e., how different neurotypes within the population may influence why languages look the way that they do. We argue that in language evolution, as in cognitive science as whole, we cannot understand the full picture unless we also take into account neurodiversity. In particular, our results provide insight into language differences that autistic people may display. At least some of these differences may impact how languages change. In the Introduction, we gave an example of a case where a linguistic device, tone markers, was apparently first used in communities of autistic people, and later spread into the larger community. This points to one particular area of language where autistic traits might encourage change. Our results point to another. They suggest that autistic people may in some cases be more affected by community-level social biases, in particular if these biases favor the loss of redundant language features.

We note that we do not find this result when we performed a binary comparison between autistic and (presumed) allistic individuals based on self-report of diagnosis/identification; as such, 98 participants were treated as autistic, and 83 were treated as allistic. We argued that this was due to the fact that modelling the groups this way, rather than in a continuous manner based on autistic traits, does not allow us to account for autistic within-group heterogeneity, and that some of our allistic participants may not be allistic. However, as discussed below (Section 3.7.2), our measure of autistic traits is far from comprehensive or representative of all autistic experiences. Furthermore, we are not suggesting that autistic participants who scored higher on the AQ-10 are 'more' autistic in some way than those who scored lower. Rather, autism is experienced differently by every autistic person, and it is possible that some autistic traits impact these trade-off more than others do.

We hope that this study encourages language evolution researchers to include and consider the impact of neurodiversity. Future work should continue to investigate areas in which neurodiversity may have an impact in shaping language; for instance, it has been demonstrated that while autistic-autistic peer communication is highly efficient, autistic-allistic communication is much less so (Crompton, Ropar, Evans-Williams, et al., 2020). The differences between autistic and allistic communication styles when autistic and allistic individuals interact with each other has potentially interesting ramifications on the language that emerges as a result.

As we have suggested above, the specific mechanism that might be responsible for the differences based on autistic traits in our study is masking. Masking is a process by which autistic people try to act more like their allistic peers, in order to avoid discrimination and social exclusion (Radulski, 2022b). Interestingly, while masking is attested across many autistic individuals, it may be particularly relevant for the autistic participants tested in this study, who are likely to have lower support needs and be able to communicate in day to day situations. These participants are more likely to successfully engage in autistic masking. These individuals, however, are also most likely to be active members of their language communities, and thus are best positioned to potentially impact language change. Masking is also not necessarily limited to the autistic population, and has been shown to be correlated with autistic traits in the allistic population (Hull, Mandy, Lai, Baron-Cohen, et al., 2019), though it may be qualitatively or quantitatively different in autistic people (see Ai et al. (2022) for discussion). Overall, our results emphasise the need to consider a broader range of cognitive diversity when forming theories of language evolution and change, as neurodivergent individuals may act differently than their neurotypical peers in sometimes unexpected ways.

These results also potentially lend support to the Double Empathy Problem hypothesis (D. Milton, 2012a) and difference, rather than deficit, models of autism. By contrast, our results do not align with the notion that participants with higher autistic traits have a strict social deficit, and in fact suggest that at least some autistic people may in fact put in *more* effort in order to meet social goals. Communicative and social difficulties may instead arise from the significant differences between autistic and allistic cognitive functioning.

While we have speculated here about explanations related to autistic masking and the Double Empathy Problem, it should be noted that there are other potential explanations or contributors to the results that we have not measured here. Autism is a neurocognitive style (Walker, 2021), which entails differences in various cognitive functions that could be relevant to our results. For instance, autistic people can (but certainly do not universally) exhibit variation in both expressive and receptive language abilities at all levels (including lexical, phonological, and morphosyntactic), but whether these differences are specific or attributable to autism or instead to a co-occurring language disability remains unclear (see Schaeffer et al. (2023) for review). Further, much of this work on autistic language profiles has been conducted with children, and thus it is unclear what the linguistic profile of our autistic adult participants looks like, or how this might contribute to our results, though see Manenti et al. (2024) for a recent discussion of language profiles in autistic adults.

Another potentially important factor is executive functioning. Work on executive functions in autistic people, such as working memory, has shown mixed results, with group effect sizes between autistic and allistic people generally being moderate despite autistic people consistently reporting challenges with executive functioning (Kenny et al., 2024). With respect to the relationship between language and executive functions in autism, the literature remains unclear, particularly in regards to the directionality of the relationship; it is unclear whether executive functioning abilities impact language abilities or vice versa (L. Friedman & Sterling, 2019). Autistic cognitive profiles are also sometimes described as ‘spiky’ across both domains and time (e.g., Doyle, 2020; Wilson, 2024). They may change depending on the situation; for instance, highly structured lab tasks such as the one in this study may be easier for autistic people than language use and learning ‘in the wild’ (Kenny et al., 2024). This may contribute to contradictory results within the literature regarding executive functions in autism and their relation to language.

It is possible that whilst identifying as autistic alone is not significantly associated with our results, other cognitive functions related to the autistic cognitive profile, such as those discussed above, are. Most specifically, we found that some (but not all) of the AQ-10 subscales were significantly related to the use of redundant case marking in Experiment 2: attention to detail, attention switching, and communication. This suggests that executive functioning, given the attention-related subscale results, and also nonverbal intelligence, and/or structural language ability may play a role.

It is important to note that variation in these traits is not specific to autistic people, and that allistic people also display differences in these functions. However, the impact of these various cognitive functions still reflects neurodiversity, which encompasses the diversity in functioning of all human minds. Cognitive characteristics typically measured by studies within the individual differences paradigm amongst neurotypical people are also relevant to neurodivergent people, who may differ qualitatively or quantitatively in these characteristics compared to the neurotypical population. For instance, if our results are related to executive functioning, then this has implications for a variety of neurodivergent people whose executive functioning differs substantially from the neurotypical norm, such as many autistic people and individuals with ADHD. In other words, differences in specific cognitive abilities may be found within the neurotypical population, and yet be related to the autistic cognitive profile, or indeed many other neurodivergent cognitive profiles. Future research should thus continue to explore how variation in cognitive abilities interacts with language learning in a way that goes beyond variation within neurotypical populations. As argued by Manalili et al. (2023b), it is necessary to examine the full spectrum of neurodiversity in order to gain a full picture of any cognitive phenomenon.

Finally, the social bias within this experimental paradigm is of course rather simple, and it could be argued that it is more appropriately considered a transactional bias. While we modelled our experiment after G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) in order to replicate their results with a different population, future work could expand the range of social pressures tested with a view toward increasing their ecological validity. For instance, we explicitly give participants information about who they should be biased towards. In naturalistic scenarios, this would likely not be explicitly provided, and it may be particularly difficult for autistic people to infer this sort of information.

3.7.2 Neurodiversity in language evolution research: practical considerations

Given the lack of research on neurodivergent populations in language evolution, it is worth noting that in conducting our studies we were able to successfully recruit autistic participants on Prolific, a website that is widely accessible and widely used in cognitive science research. However, we did encounter some difficulties in the recruitment process. Prolific provides pre-screening questions that allow researchers to specify who they want to participate in their studies. Identifying as or being diagnosed as autistic is one of them. As we have noted above, in early recruitment, we found that some participants who had answered yes to this Prolific pre-screening question contradicted this within our study, stating that they neither identified as or were diagnosed as autistic. These participants also generally scored below the typical cut-off threshold on the AQ-10. It is unclear whether this was a technical issue with Prolific's screening service, whether some individuals misunderstood the questions asked during screening, or whether some individuals answered screening questions dishonestly.

In order to alleviate this problem and increase the likelihood of success in sampling into the autistic group, in later recruitment, we asked the question about diagnosis/identification at the very start of our study. We then required individuals who answered no to return the study. This led to a substantial number of returns and also increased our success rate at recruiting participants who were both diagnosed/identified as autistic and who scored above 6 on the AQ-10. We therefore recommend that other researchers repeat screening questions, and potentially use confirming measures, when trying to sample autistic populations on this platform.

Recall that we used the short AQ-10 as our proxy measure for autistic traits, rather than longer questionnaires such as the full AQ (Baron-Cohen et al., 2001), or measures that directly test masking, such as the Camouflaging Autistic Traits Questionnaire (CAT-Q) (Hull, Mandy, Lai, Baron-Cohen, et al., 2019). The AQ-10 has a number of strengths, but it also has certain weaknesses. Both the AQ-10 and the larger AQ-50 were developed on the basis of the deficit model of autism, and in a UK-based population. They thus do not necessarily reflect the diversity of autistic people and autistic experiences. Studies have suggested that there may be cross-cultural differences that impact the accuracy of at least some items of the AQ (Freeth et al., 2013; Carruthers et al., 2018). Further, there are likely to be some gender-based differences, though evidence on this issue remains mixed (Belcher et al., 2023; Murray et al., 2017); we note that these samples focused on white cisgender women from the global North, meaning that they do not capture all autistic womens' experiences, nor do they reflect the experiences of gender diverse autistic people.

However, the AQ-10 and AQ-50 have both been consistently shown to have high accuracy in Western, anglophone populations such as those that make up the majority of our sample. Given the nature of our participants, the AQ-10 remains a useful proxy measure of autistic traits in this research environment. The AQ-10 and AQ-50 are not the only measures of autistic traits available in the literature, but many other self-report tools for autistic adults also face issues such as biased and stigmatising language. Thus, there remains a clear need for the development of self-report measures of autistic traits that capture a wider range of autistic experiences. Future work would do well to draw upon self-report measures of autistic traits that are developed in tandem with autistic people to ensure that they capture more autistic experiences (e.g., see Ratto et al. (2023)).

Future research should also consider more specific measures to better inform our understanding of what aspects of autism might contribute to language evolution. For instance, the CAT-Q (Hull, Mandy, Lai, Baron-Cohen, et al., 2019) in particular would help illuminate whether the differences displayed by autistic participants in this study are the result of masking behaviours.

Finally, we note that our data does not account for the full impact of neurodiversity on our results beyond autism; many of our presumed allistic participants may be neurodivergent in other ways. Some other forms of neurodivergence may also have an impact on the social biases that we target here. It should also be noted that, as discussed by Manalili et al. (2023b), many ‘neurotypical’ samples are in fact *not* neurotypical, and we cannot be certain that all reported allistic participants are indeed allistic. Future work should continue to investigate the impact of all forms of neurodiversity on language evolution.

3.8 Conclusion

There is evidence both from typological and behavioral research that language evolution is shaped by a trade-off between balancing communicative accuracy and production efficiency. One way in which this manifests in language is the inverse correlation between whether a language has fixed word order, and whether it uses case to mark grammatical role assignment, in both natural languages and experimental settings with presumed neurotypical participants. Here we have expanded the base of evidence for this trade-off by showing that neurodivergent, specifically autistic, participants, produce the behavioral signature of efficient communication in artificial language learning experiments. However, we also find that when faced with a social bias, higher autistic traits lead individuals to be more willing to use redundant signals, involving more production effort, to meet social goals. These results underscore the importance of considering a broader range of neurotypes in language evolution research. While there is anecdotal evidence that neurodivergent people impact language change within their communities, our study marks what we hope is the start of a better understanding of the potential impact that neurodivergent people have on language evolution.

3.9 Positionality Statement

The authorship comprises of both neurodivergent and neurotypical individuals; the first author is diagnosed as autistic. The authors explicitly adopted the viewpoint of the neurodiversity paradigm during the study design. All authors are anglophone, which may influence their viewpoint on language and how they constructed the paradigms used here.

3.10 Acknowledgments

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3.11 Postface: communicative efficiency and neurodiversity

An insightful reviewer comment on the initial submission of this paper noted that the notion of communicative efficiency could be read as ableist. Whilst this was not something I considered in the original conception of the study, I have given it a good deal of thought since. At the core of this debate is what 'efficient' means, and if being 'efficient' means being the 'best'. In other words, if neurodivergent people's language turned out to be less 'efficient', would this suggest something *bad* about neurodivergent people?

To answer this question, I turn to the conception of communicative efficiency. From an information-theoretic standpoint, a communicatively efficient language is one which "enable[s] a speaker to transmit many different messages successfully with minimal effort" (Gibson et al., 2019, p.3). From this perspective, I argue that what is 'successful' or 'minimal effort' are not necessarily the same for all speakers, cultures, or even situations. Consider, for instance, colour terms; in some cultures, it may be more important to label one colour than it is in another society. Conway et al. (2020) give the example of purple, which describes a colour rarely found in the natural world, but that has become more widespread due to the modern production of pigments. But in cultures that do not make use of that technology, it would seem inefficient to have a separate word for purple, when it is to be used so rarely. Conway et al. (2020) reframe the evolution of colour in terms of usefulness under a communicative efficiency account. As certain colours become more pertinent to behaviour in a society, they are more likely to be described by singular words. The same could apply to neurodivergent speakers; as their cognition and perception may be different, what is important for them to communicate may also be different.

On the notion of 'minimal effort', it is likely that what is minimal effort for neurotypical or abled people is not the same as what is minimal effort for neurodivergent or disabled people. Consider autistic people. For them, producing a word which is more specific, yet supposedly requires more production effort (so-called 'pedantic' language), may in fact *not* require more effort, and actually increase communicative accuracy. Recent work suggests that there is no difference between autistic and allistic people in verbal fluency when naming category members (e.g. the number of word produced or the speed of producing them), despite the fact that autistic people produce more specific and rare words (Tóth et al., 2022). This suggests that for autistic people, it may not require more effort to produce these more specific words which could increase accuracy. More work is needed in this area to understand autistic people's use of non-prototypical words and its relation to accuracy and production effort, as existing work touching on these issues is almost universally conducted in a deficit framework. As discussed by Grissom et al. (2024), any differences between autistic and allistic people in these tasks has been taken as evidence that autistic semantic processing is impaired (see, for instance, Dunn et al., 1996).

Another way to describe communicative efficiency is that "languages are efficient in meeting the communicative needs of their users" (Levshina & Moran, 2021, p.1). This definition, I argue, gets to the heart of my argument: communicative needs are not homogeneous, and thus what is efficient is also not homogeneous. It is clear that neurotypical speakers balance the two halves of communicative efficiency differently in different situations to meet the needs of language users, such as in the face of social biases as discussed in this chapter (Fedzechkina et al., 2022; Fedzechkina & Roberts, 2020), or to help language learners (Tal et al., 2023). Whilst in the paper above I have described these practices as speakers being ‘less efficient’, in hindsight, I would argue that they are actually being *more efficient*, in the sense that they are adapting language to the needs of the language situation. What is efficient is not just defined by the needs of the speaker, but also the needs of the listener.

It is clear that psychology has a long history of ableism and other prejudices, through claiming a ‘normal’ human and then pathologising anyone who does not fit this perspective (see Gernsbacher, 2007, 2010; Rudkin et al., 2025, for discussions on this issue). But as for the individuals who developed ideas such as communicative efficiency, ultimately, I cannot speak to their intentions. These ideas may have been shaped by normative assumptions about communication that reflected ableist frameworks, whether or not intentionally. As cognitive science seeks to value human diversity more broadly, however, we should move away from imposing a single standard for what is ‘efficient’.

4

Autistic camouflaging, attention to detail, and social biases in the trade-off for communicative efficiency

"If a person's behavior doesn't make sense to you, it is because you are missing a part of their context. It's that simple."

– Devon Price, 2018

4.1 Preface: chapter four

Chapter Four reports on experimental work that follows up from that reported in Chapter Three. In Chapter Three, there was some speculation about the mechanism behind the main finding (that autistic people adhere more to a social bias and make their language more redundant to do so). It was proposed that this mechanism might be autistic masking. However, a key limitation to this was that we did not measure masking directly in the study. The work in this chapter rectifies this by including a measure of masking. Further, we also found that attention to detail seemed to be related to behaviours in Chapter Three, and we sought to understand this further by including much more detailed measures of attention to detail than were used in the experiments in Chapter Three. A third key motivation behind this work was to experiment with different 'types' of social biases. As discussed in Chapter Three, the social biases of the original experiment were rather simple and transactional in nature. It was not clear that they reflected the social pressures that autistic people are likely to face.

The paradigm used in this chapter is similar to that in Chapter Three, but key changes were made: increasing the proportion of case marking used in training, altering the social bias conditions (introducing 'negative' and 'positive' bias conditions), and including masking and attention to detail psychometric measures. Furthermore, the reader will notice that unlike in Chapter Three, the results here are analysed with Bayesian methods. For the sake of comparison between this study and the previous one, Bayesian analyses are included in the appendices for Chapter Three.

4.2 Fletcher et al. (in preparation) author contributions

The following manuscript is in preparation for journal submission. The paper was co-authored with my two supervisors, Jennifer Culbertson and Hugh Rabagliati. The development of the experimental design, hypotheses, and approach for analysis was developed during supervision meetings by all three authors. I collected the data and performed the analysis, with feedback and support from my co-authors. I drafted the manuscript, also with feedback from my co-authors. The manuscript has been re-formatted in line with the format of this thesis. Changes to the text may occur as a result of the review process.

4.3 Abstract

The trade-off for communicative efficiency – where language users balance production effort and communicative accuracy – has been argued to be a crucial mechanism behind language structure. Despite this, previous work has shown that language users are willing to reduce efficiency in order to meet social goals by being more redundant or less informative. These results highlight the often untapped role of social factors in language evolution. Importantly, however, not all people react to social situations in comparable ways; for instance, neurodivergent people often show differences in socio-communicative contexts. This is demonstrated by prior work that shows participants with higher autistic traits are willing to be more redundant in the face of a bias towards a group that uses it. In this study, we investigate *why* this pattern occurs by testing two potential mechanisms: autistic camouflaging and attention to detail. We also expand the range of social contexts participants are exposed to, to more accurately reflect real-life scenarios. We find that the combination of being autistic and scoring high on a test of autistic camouflaging increases the use of redundant case to meet a social goal. In an explanatory analysis, we find evidence that different dimensions of autistic camouflaging interact with redundant case marking, condition, and neurotype in different ways. We discuss our results with respect to their implications for debates on the nature of autistic camouflaging (compared to general impression management). Finally, we discuss the crucial question of who causes language change, and argue that our results continue to highlight the importance of considering a broader range of neurodiversity in studies of language evolution.

4.4 Introduction

Communicative efficiency is an oft-appealed to concept in the study of language evolution. In general, communicative efficiency is framed in terms of a trade-off between communicative accuracy and production effort, whereby the speaker maximises the information conveyed but minimises the effort required. Evidence of this trade-off can be found throughout languages at a variety of levels (for review, see Gibson et al., 2019; Levshina & Moran, 2021). One example is Zipf's Law of Abbreviation (Zipf, 1935; Strauss et al., 2007; Piantadosi et al., 2011; Kanwal et al., 2017), the observation that across language, more frequent words are shorter. Another example, our focus in this paper, is the the relationship between whether a language has a fixed word order and whether it marks grammatical roles using case. Languages with a fixed word order, where the order of the constituents reliably indicates grammatical role (i.e. 'who did what to whom'), tend to forgo explicit case that marks grammatical roles, whilst languages with a flexible word order make much more use of it. This has been argued to reflect the trade-off between maximising communicative accuracy on the one hand and minimising production effort on the other; case marking is presumably more costly to produce, so it is more efficient to use it only where it may be needed to more accurately convey grammatical roles. The inverse correlation been case and fixed word order can be found both throughout the world's languages, and a behavioral signature of this kind of efficiency has also been found in artificial language learning experiments (Sinnemäki, 2008; Jäger, 2007; Koplenig et al., 2017; Levshina & Moran, 2021; Fedzechkina et al., 2012; Kurumada & Jaeger, 2015; Fedzechkina & Jaeger, 2020).

However, it is key to the notion of efficiency is that languages obey these principles as they serve a communicative need (cf. Levshina & Moran, 2021). Minimising effort and maximising information transfer are not the only needs of language users. For instance, throughout the world's languages, redundancy persists. Various explanations have been proposed as to what the role of redundancy might be; many appeal to the role of redundancy in language learning. Some evidence suggests that redundancy can improve child language learning (Tal & Arnon, 2022) and is used more with speakers perceived as less proficient (e.g. L2 learners) (Tal et al., 2023). Lupyan & Dale (2010) argue that redundancy is increased in smaller communities where the primary language learners are infants, rather than adults. Keogh & Lupyan (2024) further find that some learners benefit from redundancy in an artificial language learning experiment, highlighting the variation in cognitive strategies that may contribute to the retention of redundancy.

In this paper, we focus on a different – though not competing – explanation as to why redundancy might be maintained in a language: social pressures or biases. In some environments and societies, to meet a social goal, it may make sense to be less traditionally 'efficient'. As noted by G. Roberts & Fedzechkina (2018), social factors, despite being integral to language use, are oft-overlooked in experimental work on language evolution. Language is intrinsically tied to our performance of identity and the navigation of social relationships, and the role of social factors in language change has been long documented (Labov, 2001). For a concrete case of social factors impacting redundancy specifically, G. Roberts & Fedzechkina (2018) give the example of English *whom*. This is a clear example of a redundant marker (English already conveys which person is the subject/object via fixed word order), and yet it nonetheless persists, potentially due to its association with more educated language users or with those of a higher social class (van Ostade, 2024). In other words, redundancy can be used to meet the communicative need of conveying social identity, despite it not clearly fitting in with the traditional communicative efficiency trade-off.

Importantly, G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) take the first steps toward providing a causal link between the use of *more* redundant case and a perceived social benefit using an artificial language learning paradigm. In both studies, one of the artificial languages participants were exposed to had a fixed word order and optional case marking. In terms of conveying grammatical roles, case marking was therefore redundant, however in some experimental conditions, case marking was used by a group of 'speakers' who participants were told had social importance. In this condition, participants used significant more redundant case. In other words, participants were more likely to use case when they were biased towards a case-using group, despite its redundancy. These studies support the claim that social considerations may contribute to the longer-term retention of redundant forms, if there is a motivation to foster a positive relationship with a group that uses the redundant form. Turning again back to the case of English *whom*, if it is considered a prestigious form, then it will likely continue to be used in formal contexts or those where the user otherwise wants to make a good impression.

In the examples above, the social bias is framed as a largely positive one: for example in G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022), participants are told that the relevant group has 'important resources', that they should 'try to impress them', and that the aliens 'seem to be on our side'. However, linguistic performance is not solely done for the sake of positive goals such as relationship development. Prescriptive language ideology still persists throughout modern culture, and many groups that are already otherwise disadvantaged are further discriminated against as a result of their dialects including in contexts such as the workplace (e.g., Levon et al., 2021; Fasoli et al., 2017) and in legal proceedings (e.g. Dunbar et al., 2024; J. R. Rickford & King, 2016). One way in which minoritised groups try to avoid stigma and discrimination is through code-switching, where people alternate between different languages or, more relevantly, different varieties of a single language for different contexts. For instance, Black Americans may use 'standard' White American English rather than African American English (AAE) in predominantly white spaces (e.g. in education (Mills & Washington, 2015), or in the workplace (McCluney et al., 2021)). Notably, such code-switching is often a compulsory form of impression management, necessary to avoid negative repercussions, and can contribute to negative health effects (D. G. Johnson et al., 2021; Hewlin, 2009). Similarly, within the UK, accent bias remains a prominent issue (Sharma et al., 2022; Levon et al., 2021), with individuals being mocked and sometimes openly discriminated against on the basis of their accent and reporting either conscious or subconscious changes in their accent as a result (Levon et al., 2022). The social bias introduced by G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) was not designed to capture the impact of these negative, stigma-avoidance scenarios. Additionally, these prior studies do not investigate the relationship between social biases and identity; some stigmatised groups may be more willing to put in more production effort to meet social goals than non-stigmatised groups.

Here, we consider a different aspect of minority identity that is under-explored in previous sociolinguistic and language evolution research: neurodiversity. There is already evidence that neurodivergent people contribute to language change and show linguistic variation. Consider the terms of the neurodiversity paradigm, largely coined by autistic and otherwise neurodivergent people (Botha et al., 2024), or tone indicators, commonly used online to indicate tone and whose origin is often attributed to autistic communicative needs (Marcus & O'Neill, 2020). Before returning to communicative efficiency, we outline the idea of neurodiversity and neurominority identity, and discuss their potential relevance to linguistic variation.

4.4.1 Neurominorities, autism, and camouflaging

Neurodiversity is a broad term that describes the variety in neurocognitive functioning amongst all human minds (Walker, 2021). Whilst everyone exhibits diversity in their cognitive functioning and abilities, some individuals exhibit variation that is outside of the socially standard typical range. These individuals are neurodivergent. Those who identify as neurodivergent include those who have a range of neurodevelopmental differences, such as autism, dyslexia, ADHD, and intellectual disability, as well as those with mental health conditions such as depression, and people with acquired conditions such as a brain injury.

Some neurodivergent people can be considered to be part of neurominority groups. These groups consist of neurodivergent people who share a similar form of innate neurodivergence that is central to self, such as autism and ADHD (Walker, 2021). Autistic people in particular have recently been increasingly characterised as a minority identity group (Botha & Gillespie-Lynch, 2022). Individuals who identify as autistic (including both diagnosed and self-diagnosed autistics) report struggles with employment, experiencing stigma, and a poorer quality of life, similar to other minority groups (McDonald, 2020).

As a result, neurominority groups navigate a complex linguistic-social landscape, and, like neurotypical people, alter their speech for different social purposes. One area in which this has become more apparent in recent years, both in the literature and in the accounts of autistic individuals themselves, is the process of autistic camouflaging. Generally speaking, autistic camouflaging refers to a set of behaviours autistic people use to try and 'hide' autistic traits, manage social differences, and fit in with others. The general principles behind autistic camouflaging are not unique to autistic people; it has been conceptualised as a manifestation of general impression management (Ai et al., 2022) which, as mentioned above, is also employed by other minority groups, such as Black Americans (D. G. Johnson et al., 2021). Similarly, Radulski (2022b) argues that autistic camouflaging is a response to being a marginalised minority group in contrast to the majority neurotypical group. Similar strategies may also be used by other neurominority groups, though to differing extents or in qualitatively different ways (van der Putten et al., 2024; Hobson & Lee, 2023). As with compulsory impression management in other minority groups, autistic camouflaging can have a negative impact on mental health (Cage & Troxell-Whitman, 2019; Hull, Levy, et al., 2021).

The mechanisms of autistic camouflaging, in both qualitative (Hull, Petrides, Allison, Smith, Baron-Cohen, et al., 2017) and quantitative Hull, Mandy, Lai, Baron-Cohen, et al. (2019) research, have been categorised along different dimensions, which relate to different aims and motivations behind camouflaging. Three of these dimensions are captured by the Camouflaging Autistic Traits Questionnaire (CAT-Q) (Hull, Mandy, Lai, Baron-Cohen, et al., 2019), a measure of autistic camouflaging in both the autistic and broader population: compensation, masking, and assimilation. Compensation refers to behaviours used to compensate for social and communicative differences, such as copying others' body language, learning social cues from others or media, and using scripts in social situations. Masking refers to behaviours that aim to make the autistic person appear less autistic to others, and includes strategies such as monitoring body language and increasing eye contact. Finally, assimilation captures strategies used to 'fit in' in difficult social situations, primarily relating to 'putting on an act' and performing rather than being oneself in social situations.

As outlined above, linguistic choices (e.g. code-switching) are a common method for managing perceived identity. Studies of autistic masking have observed that it can involve imitation of the linguistic behaviours of neurotypical interlocuters (Hull, Petrides, Allison, Smith, Baron-Cohen, et al., 2017; Miller et al., 2021b), similar to code-switching (though further research is needed on the extent and systematicity of this phenomenon). More broadly, whilst some attention has been paid to linguistic differences shown by neurodivergent people, this work is typically conducted within the medical, deficit model, and seeks to highlight ways in which neurodivergent people are 'disordered' in their language use. For instance, all three of the main linguistic differences (pronoun reversal, echolalia, and a reduction of the production-comprehension lag) that are generally considered unique to autism (likely erroneously, see Gernsbacher et al. (2016)) have been largely interpreted using a pathologising narrative. As an example, echolalia (repeating what someone has just said) has traditionally been labelled as disordered and communicatively deficient or 'empty' and something that should be 'treated' in a clinical setting (R. J. Luyster et al., 2022). This has recently been challenged in the literature, with research highlighting the communicative value of echolalia (Jaswal & Akhtar, 2019a; R. J. Luyster et al., 2022; Ryan et al., 2024). Furthermore, recent work has challenged the conceptualisation of autistic social and communicative differences as being based in a one-sided deficit. The Double Empathy Problem (D. Milton, 2012a) highlights that differences in communication in mixed-neurotype pairs (e.g. autistic-allistic) are not one-sided; instead, difficulties are the result of *both* parties coming to the table with different cognitive experiences and expectations. Work building on this theory has demonstrated that autistic-autistic communication is just as effective at transferring information as allistic-allistic communication (Crompton, Ropar, Evans-Williams, et al., 2020). However, this work has not yet considered the importance of specific linguistic choices in such interactions.

4.4.2 Bringing autism and communicative efficiency together

To date, little work in communicative efficiency – or indeed, the cultural-evolution of language more broadly – has considered the impact of neurodiversity. Whilst there is some work considering how individual differences (which are, essentially, neurodiversity but within a constrained range) might impact language evolution from the perspective of learning (T. Johnson et al., 2020), there is no work that explicitly considers the impact of neurominority identity negotiation and language. In this study, we bring together work on communicative efficiency, social factors, and autistic camouflaging, to investigate how autistic people respond linguistically to different social pressures, and how those behaviours may contribute to the overall picture of language.

In previous research (Fletcher, Rabagliati, & Culbertson, 2024), we investigated the impact of autistic traits on the interaction between social biases and communicative efficiency in a partial replication of Fedzechkina & Roberts (2020) and Fedzechkina et al. (2022). First, we investigated whether autistic people balance the traditional pressures of communicative efficiency in the same way as allistic people in the absence of a social bias. We trained both allistic and autistic participants on artificial languages which either used a fixed (e.g. always SOV) or flexible (e.g. 50% SOV, 50% OSV) word order and in which case marking was optional. We found that both autistic and allistic people adhere to the pattern in previous research, reducing case in the fixed word order condition (where it was redundant), and maintaining/potentially increasing case in the flexible word order condition (where it was informative). More relevantly for this study, however, we also investigated the impact of social factors on this trade-off. In a condition where participants were biased towards a group that used redundant case, we found that higher autistic traits were significantly associated with the greater use of a redundant case marker. On the other hand, our participants with higher autistic traits were not willing to sacrifice informative case to meet a social goal. We speculated that this could be related to autistic camouflaging, as many autistic people are accustomed to copying the behaviour of others for social reasons. However, a key drawback of this hypothesis is that we did not test camouflaging specifically, but rather autistic traits more generally. Therefore, we were not able to quantitatively link autistic camouflaging to behaviour in respect to a language learning task in which social factors are relevant. Additionally, we found that attention to detail scores from the AQ-10 were also significantly related to the use of redundant case. This suggests an alternative (though not mutually exclusive) explanation for why autistic traits led to more redundant case usage that is related more to language learning than specific social factors.

In this paper, we investigate the relationship between autistic camouflaging, attention to detail, and social biases in the trade-off for communicative efficiency, following up on outstanding issues raised in Fletcher, Rabagliati, & Culbertson (2024). We do this by training participants on an artificial language in which word order is fixed, but case marking is optional. The task is presented in the context of a single social group that uses a language with redundant case marking. Crucially, we alter the biases from G. Roberts & Fedzechkina (2018); Fedzechkina et al. (2022); Fletcher, Rabagliati, & Culbertson (2024) to investigate the impact of different types of biases; we introduce ‘positive’ and ‘negative’ social motivations (described below), placing more emphasis on the social elements of the relationship, and less (though not none) on the transactional elements. We aim for these biases to more closely mirror the situations in which autistic people might (or might not) camouflage. Additionally, we explicitly measure camouflaging and introduce more comprehensive measures of attention to detail to help distinguish between the two mechanistic explanations entertained in Fletcher, Rabagliati, & Culbertson (2024).

We first seek to replicate the original finding of Fletcher, Rabagliati, & Culbertson (2024), that autistic traits increase the likely of using redundant case to meet a social goal. As relates to the two mechanistic explanations outlined above, if attention to detail is the key mechanism leading to an increased use of redundant case, this would predict increased use of redundant case in participants with higher attention to detail scores, regardless of the valency of the condition. On the other hand, if autistic camouflaging is the key mechanism, this would predict increased use of redundant case in participants with higher camouflaging scores but specifically in the negative condition. We hypothesise that the negative condition will align more closely with the goals of autistic camouflaging; as described above, autistic camouflaging is generally linked to stigma avoidance, and our negative condition is designed such that participants believe the group is more likely to discriminate against them or be intolerant of their differences. Finally, we explore the different features of camouflaging to understand which, if any, may contribute to linguistic behaviour changes.

4.5 Current Study

As outlined above, here we use an artificial language learning task in which participants are first introduced to a group of aliens and told that their goal will be to learn the alien's language. They are then trained on a language with fixed word order and optional (redundant) case marking. The experiment has a 2x2 between subjects design, in which we manipulate neurotype identity (autistic or allistic) and social bias condition (negative or positive framing). We measure participants' use of case marking in a final test phase, as well as their scores on the Camouflaging Autistic Traits Questionnaire (CAT-Q) (Hull, Mandy, Lai, Baron-Cohen, et al., 2019), the Detail and Flexibility Questionnaire (DFlex) (M. E. Roberts et al., 2011), the attention to detail subscale questions of the Autism Quotient 50 (AQ-50) (Baron-Cohen et al., 2001), and the full AQ-10 (Allison et al., 2012). These questionnaires are described in more detail below.

4.5.1 Methods

Participants

161 participants were recruited via Prolific[1]. Participants indicated their consent by button press. Participants were self-reported native speakers of English and aged 18 years or older.

1. This study has been granted ethical approval by the University of Edinburgh PPLS Ethics Committee (reference number 292-2324/1).

Participants were allocated to groups based on their self-reported identity: either autistic or not. To do this, we used Prolific's in-built screening question on autism status to recruit participants, and additionally asked them a similar question before they took part in the study to ensure that they still identified as (non-)autistic. We did not explicitly collect detailed information about diagnostic history, verbal ability, or support needs. However, our autistic participants only represent a subset of the autistic population; participants were at least literate, likely speaking, and may have relatively lower support needs, given the nature of the online platform. Note that we did not ask participants about any other form of neurodiversity, so our allistic participants may be neurodivergent in other ways. Additionally, not all autistic people are diagnosed as autistic or identify as such, and thus some of the allistic group are potentially autistic.

Participants in each group were randomly assigned into social bias conditions, described in detail below. In total there were 84 participants in the negative bias condition (44 autistic, 40 allistic), and 77 participants in the positive bias condition (37 Autistic, 40 allistic). The mean age of the autistic participants in the negative condition was 34.1 (SD = 9.7), whilst for allistic participants in the negative condition it was 32.9 (SD = 10.3). For the positive condition, the mean age of autistic participants was 34.5 (SD = 12.0)[2] and the mean age of allistic participants was 32.4 (SD = 11.7)

Materials

Participants learned an artificial language based on that used in G. Roberts & Fedzechkina, 2018; Fedzechkina et al., 2022; Fletcher, Rabagliati, & Culbertson, 2024. The language consisted of seven words: four nouns, two verbs, and one object case marker. Each of the four nouns referred to a character (chef, burglar, clown, policeman) and each verb referred to an event (kicking, pointing). The meanings were depicted using line drawings[3]. At the start of the experiment, the mapping of meaning to nouns/verbs was randomised for each participant, but came from the set of {*barsa, peza, rizba, koofta*} for nouns and {*tegud, velmik*} for verbs. Audio forms were also generated using the speech synthesiser Amazon Polly (voice: British English Amy)[4]. All stimulus sentences were presented both auditorally and orthographically.

The word order in the language was fixed S(ubject)-O(bject)-V(erb), and there was an optional case marker 'di' (presented orthographically as a separate word), which occurred after the object noun. Since the word order was fixed, the case marker was redundant and not required to understand the intended meaning of the sentence. This language most closely matches the redundant language conditions from G. Roberts & Fedzechkina (2018), Fedzechkina et al. (2022), and Fletcher, Rabagliati, & Culbertson (2024). These previous studies also had conditions in which word order was not fixed, and therefore case was informative rather than redundant. Here we used a redundant language since Fletcher, Rabagliati, & Culbertson, 2024 only found an effect of autistic traits in the redundant case condition.

2. One participant entered their age as 188 and was excluded for the purposes of these statistics, as this value was assumed to be erroneous.
3. Thanks to Liza Tóth for kindly providing the drawings of the aliens for use in the experiment and future publications.
4. https://aws.amazon.com/polly/

In Fletcher, Rabagliati, & Culbertson (2024), the informative case condition was embedded in a context in which participants were biased *against* the aliens that use it. Therefore participants would have had to reduce their use of case, making the language less informative. Regardless of neurotype, participants were generally less likely to do this than they were to increase their use of redundant case in response to a social bias. All possible three-word content sentences were generated, with the restriction that the subject and object could not refer to the same referent. There were thus 24 possible meaning combinations. The case marker 'di' was then added to a random 75% sample of the trials for training.

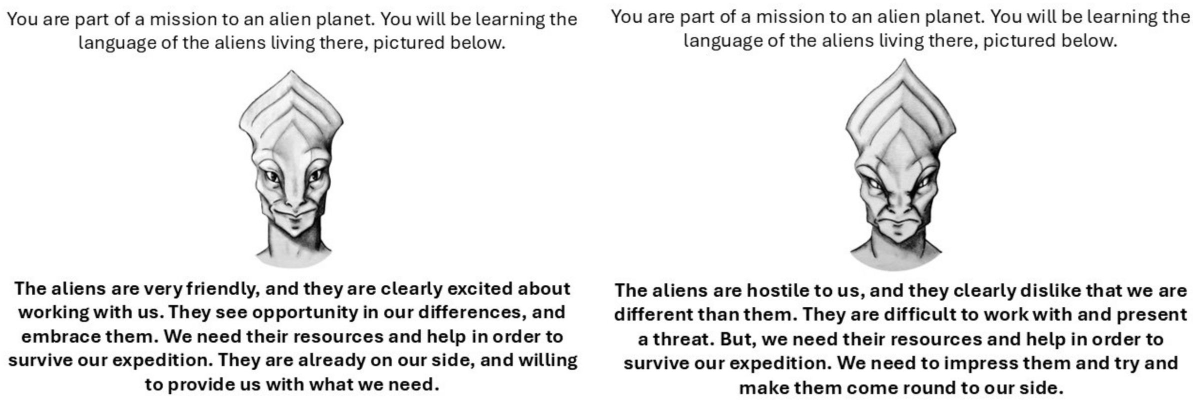
In both the exposure and comprehension phases, described below in Section 4.5.1, the set of all possible 24 sentences was seen twice. In order to reduce potential item bias resulting from this, the sentences where the case marker was added were re-sampled for each block (i.e. generated for the first set of 24 sentences in exposure, and then re-generated for the second set of 24 sentences in the same phase).

Procedure

The experiment was programmed in jsPsych (de Leeuw, 2015), and presented in participants' browser. Before learning the language, participants were introduced to the group of aliens for their condition. In the positive condition, participants were informed that: 'The aliens are very friendly, and they are clearly excited about working with us. They see opportunity in our differences, and embrace them. We need their resources and help in order to survive our expedition. They are already on our side, and willing to provide us with what we need.'. In the negative condition, on the other hand, participants were told that: 'The aliens are hostile to us, and they clearly dislike that we are different than them. They are difficult to work with and present a threat. But, we need their resources and help in order to survive our expedition. We need to impress them and try and make them come round to our side.'. The biases were intentionally worded to focus on the aliens' reaction to the participants' differences from them and to highlight whether or not extra effort might be required for cooperation.

Another important change compared to previous research is the presence of only one alien group, rather than two. We do this to more accurately reflect the situations in which autistic people employ camouflaging behaviours; in real-life settings, a minority group (including a neurominority group) often does not have a choice but to interact with and perform in a way that is socially acceptably for a single majority group – i.e., there is typically no other option but to assimilate to at least some degree with the majority group.

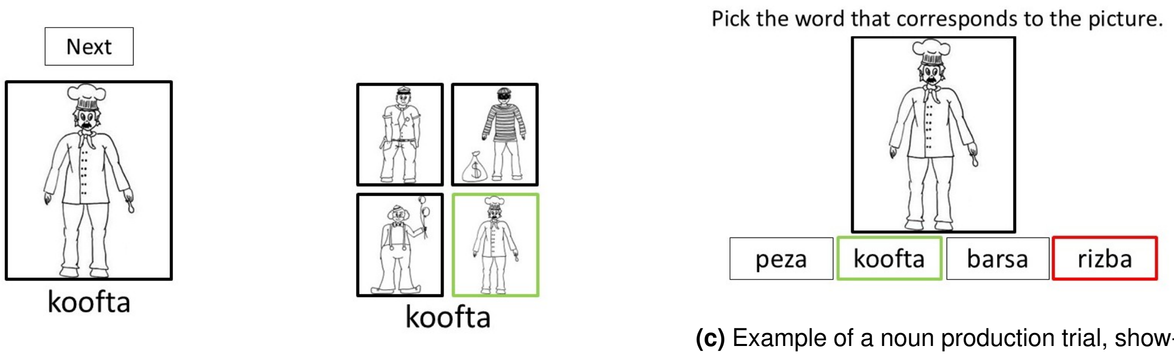
Following the bias exposure, participants were then taught the noun lexicon in a set of three phases: noun exposure, noun comprehension, and noun production. In **noun exposure**, participants were shown a picture of each character along with the associated noun label. Participants were able to view the visual stimuli as long as they wished, but the audio only played once. Each character was displayed twice, in a random order, for a total of 8 trials.



(a) Positive bias instructions given to participants.

(b) Negative bias instructions given to participants.

Figure 4.1: Bias instructions provided to participants.



(a) Example of a noun exposure trial.

(b) Example of a noun comprehension trial.

(c) Example of a noun production trial, showing example feedback for an incorrect selection.

Figure 4.2: Examples of noun training and testing trials.

Then, participants undertook the **noun comprehension** phase. Here, they were presented with a grid of all 4 characters and given one noun (both written and spoken). They were required to identify which character corresponded with the noun. They were given feedback on their answers, with the correct answer highlighted in green and (if applicable) the incorrect answer that they provided highlighted in red. Participants were again tested on each meaning twice, in a random order, for a total of 8 trials.

As the final part of the noun learning, participants undertook a **noun production** task. In this task, they were provided with the image of the character only, and asked to pick the correct noun from the provided four noun options. Participants were again given feedback on their answers in the same manner as in the noun comprehension task. Participants saw each character twice, for a total of 8 trials. Crucially, participants were required to achieve an accuracy of at least 80% on the noun production task to move forward with the study. At the end of the task, they were given feedback (including their % score) on whether they could progress to the next stage of the study. If they did not score above 80%, then they were required to undertake all 3 tasks of noun learning again. They had to repeat the noun learning until they reached 80% accuracy, to ensure accurate learning.

After the noun learning tasks, the bias was reinforced with a short attention-check like test. Participants were asked to pick a statement from 3 (positive, negative, neutral) that best described the alien group using the language. They were given feedback on their answer and reminded of the correct answer if they were wrong.

Then, participants entered a set of three tasks that trained and tested participants on sentences in the artificial language. First, they undertook the **sentence exposure** task. Here, they saw an image of an event, accompanied by both a text and audio description. A picture of the relevant alien was present in the corner of each sentence exposure trial to reinforce the bias. After the audio had played, participants were able to click 'next' to proceed to the next trial. Participants were allowed to view each trial for as long as they wished, though they only heard the audio once. They saw each of the 24 character scenarios twice, for a total of 48 trials.

(a) Example of a sentence exposure trial in the informative case condition with the case-using alien.

(b) Example of a sentence comprehension trial in the informative case condition with the non case-using alien.

(c) Example of a sentence production trial.

Figure 4.3: Examples of sentence training and testing trials.

Following this, participants completed the **sentence comprehension** task. Here, participants were shown two images, each of a possible scenario, along with a sentence and audio that described one of them. As in sentence exposure, the alien was present in each trial. Participants were required to select the image that the sentence was describing. They were provided feedback on whether their answer was correct. Each of the 24 scenarios was the target answer twice, for a total of 48 trials.

As the final part of sentence learning and testing, participants undertook the **sentence production** task. On each trial, an image of one of the scenarios was presented, along with buttons for each word in the language. Participants constructed sentences in the artificial language by clicking the buttons in their desired order; participants could reset their choices at any time by button press. Each sentence had to be at least 3 words long, as this was the length required to create a grammatical sentence in the language. Each scenario was presented once, for a total of 24 trials.

After the artificial language learning component of the study, participants completed a set of psychometric tests. Specifically, they completed the Camouflaging Autistic Traits Questionnaire (CAT-Q) (Hull, Mandy, Lai, Baron-Cohen, et al., 2019), the Detail and Flexibility Questionnaire (DFlex) (M. E. Roberts et al., 2011), the attention to detail subscale questions of the Autism Quotient 50 (AQ-50) (Baron-Cohen et al., 2001), and the full AQ-10 (Allison et al., 2012). The CAT-Q is a measure of autistic camouflaging – though we note that it cannot reliably distinguish between an autistic and allistic person by itself – that considers 3 subcategories of camouflaging: compensation, masking, and assimilation. The DFlex measures cognitive rigidity and attention to detail; it was originally developed for use in the eating disorder population, but has been applied to the autistic population[5] (Tchanturia et al., 2016; Tei et al., 2018; Van Eylen et al., 2018).

Analyses

Analyses were conducted using Stan and brms (Bürkner, 2017, 2018) to fit Bayesian linear regression models with Bernoulli likelihood and a logit function. Before analysing the data, we conducted prior predictive checks for the priors for β, and determined that weakly regularising priors were appropriate. We did consider more informative priors for the intercept, on the basis of our prior knowledge that in bias conditions, participants are likely to retain or increase the proportion of redundant case used. However, as the proportion of case use was different in this study than in prior work, we first conducted a sensitivity analysis to determine whether informative priors would be appropriate. This analysis indicated that there was very little difference in estimates, and thus we used more conservative non-informative priors.

The model contained the sum-coded fixed effects of condition (positive -1, negative +1) and neurotype (allistic -1, autistic +1). All scores were standardised using z-score scaling such that they had a mean of 0 and a standard deviation of 1. Since our critical factors (condition, scores) were between subjects, we include only random by-participant intercepts. The model considered the impact of condition, neurotype, and each score on case marker usage, including the two-way interactions between condition and neurotype, condition and each score, and neurotype each score, as well as the three-way interactions between condition, neurotype, and each score. In other words, the model was specified as Case Marker $\sim$ Condition * Neurotype * (CAT-Q + AQ-50 + DFlex + AQ-10) + (1|Subject). Additionally, we modelled the impact of the three subscales of the CAT-Q (masking, compensation, and assimilation), using a model of the specification Case Marker $\sim$ Condition * Neurotype * (Masking + Compensation + Assimilation) + (1|Subject). Each of the subscale scores were standardised using z-score scaling.

As the interactions between individual scores were not of interest, we did not include these in the model. To avoid any issues of collinearity, we first inspected a correlation matrix between each score. This revealed significant (if not large) positive correlations between CAT-Q and AQ-50 score (r = 0.28, $p < 0.001$), AQ-50 and AQ-10 score (r = 0.30, $p < 0.001$), AQ-50 and DFLex score (r = 0.21, $p < 0.001$), a small negative correlation between DFLex and AQ-10 (r = 0.13, $p < 0.001$), and a moderately

5. It should also be noted that the eating disorder population typically has a higher degree of autistic traits than the general population.

large positive correlation between CAT-Q and DFlex (r = 0.65, $p < 0.001$). Given this, we checked the Variance Inflation Vactors (VIF) for our model. For all of our factors, VIF was no larger than 2.34, and all tolerance values were at least less than 0.43, indicating that multicollinearity is unlikely to be an issue in model interpretation.

4.5.2 Results

The posterior estimates are summarised in Table 4.1. We first examine the posterior estimates for the intercept, condition, and neurotype, before turning to each score and its interactions with condition and neurotype in their respective sections below. The model's intercept represents the grand mean, indicating the overall log-odds of using the case marker. The model is confident in a positive estimate for the intercept (1.25, 95% CrI: [0.80, 1.71]), which indicates that participants are overall more likely to use the case marker than not. This is in line with previous results showing that participants exposed to a social bias are likely to retain redundant case that they would not otherwise use. It is important to note that participants overwhelmingly retain strictly SOV word order (using it 97% of the time overall), meaning that the case did remain redundant.

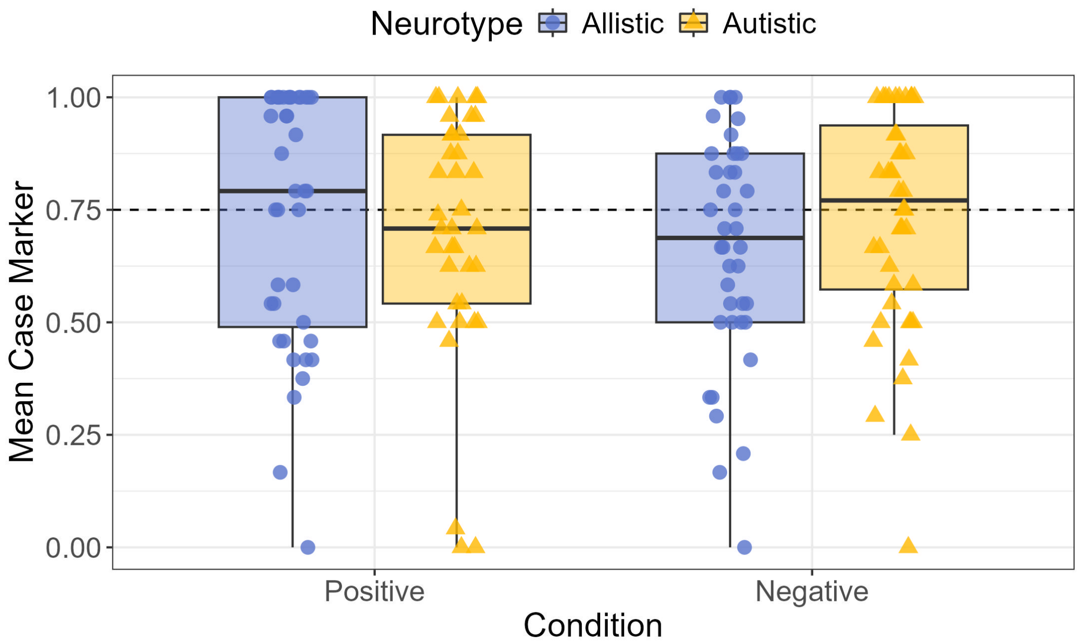


Figure 4.4: Distribution of mean case marker usage by condition and neurotype. Boxplots represent the spread of individual participant means, with the central line indicating the median. Individual participant means are overlaid (circle points for allistic participants, triangles for autistic participants). The dashed horizontal line cutting the y axis indicates the proportion of case use in the input.

Turning to the fixed effects, the model considers both a negative and positive effect of the negative bias to be plausible, as indicated by the 95% CrI: [-0.48, 0.44], with a near-zero posterior mean (-0.02). Essentially, this near-zero estimate indicates that there is no certainty in what direction the effect may go, indicating no overall difference between the negative and positive bias conditions. Looking at neurotype, whilst there is more posterior probability mass on the positive than negative side for autistic participants (95% CrI: [-0.34, 0.58]), and a small positive estimate (0.12), the model still shows considerable uncertainty about the direction of this effect. With respect to the interaction between the negative bias and autistic participants, the model's posterior estimate is positive (0.21). Whilst a good amount of the probability mass is positive, the model still considers negative values to be plausible (95% CrI: [-0.24, 0.68]). This indicates the possibility that autistic participants in the negative bias condition may use more case marking, but the model remains uncertain about the exact nature of the effect.

Parameter	**Posterior Mean**	**95% CrI Lower**	**95% CrI Upper**
Intercept	1.25	0.80	1.71
Negative Bias	-0.02	-0.48	0.44
Autistic	0.12	-0.34	0.58
Negative Bias:Autistic	0.21	-0.24	0.68
Standardised CAT-Q Score			
Standardised CAT-Q score	0.16	-0.39	0.70
Negative Bias:Standardised CAT-Q score	0.33	-0.21	0.87
Autistic:Standardised CAT-Q score	0.67	0.13	1.21
Negative Bias:Autistic:Standardised CAT-Q score	-0.06	-0.62	0.49
Standardised DFlex Score			
Standardised DFlex score	-0.17	-0.67	0.32
Negative Bias:Standardised DFlex score	-0.28	-0.76	0.21
Autistic:Standardised DFlex score	-0.04	-0.54	0.45
Negative Bias:Autistic:Standardised DFlex score	-0.24	-0.74	0.27
Standardised AQ-50 Attention to Detail Score			
Standardised AQ-50 ATD score	-0.35	-0.78	0.08
Negative Bias:Standardised AQ-50 ATD score	0.18	-0.25	0.61
Autistic:Standardised AQ-50 ATD score	-0.39	-0.82	0.04
Negative Bias:Autistic:Standardised AQ-50 ATD score	0.05	-0.38	0.48
Standardised AQ-10 score			
Standardised AQ-10 score	0.02	-0.40	0.44
Negative Bias:Standardised AQ-10 score	-0.03	-0.44	0.38
Autistic:Standardised AQ-10 score	-0.01	-0.42	0.41
Negative Bias:Autistic:Standardised AQ-10 score	0.09	-0.34	0.51

Table 4.1: Posterior means and 95% Credible Intervals from the model examining the influence on case marker usage by condition, neurotype, and standardised CAT-Q, DFlex, AQ-50 (Attention to Detail subscale) and AQ-10 scores. Fixed effects are given in log-odds space.

AQ-10

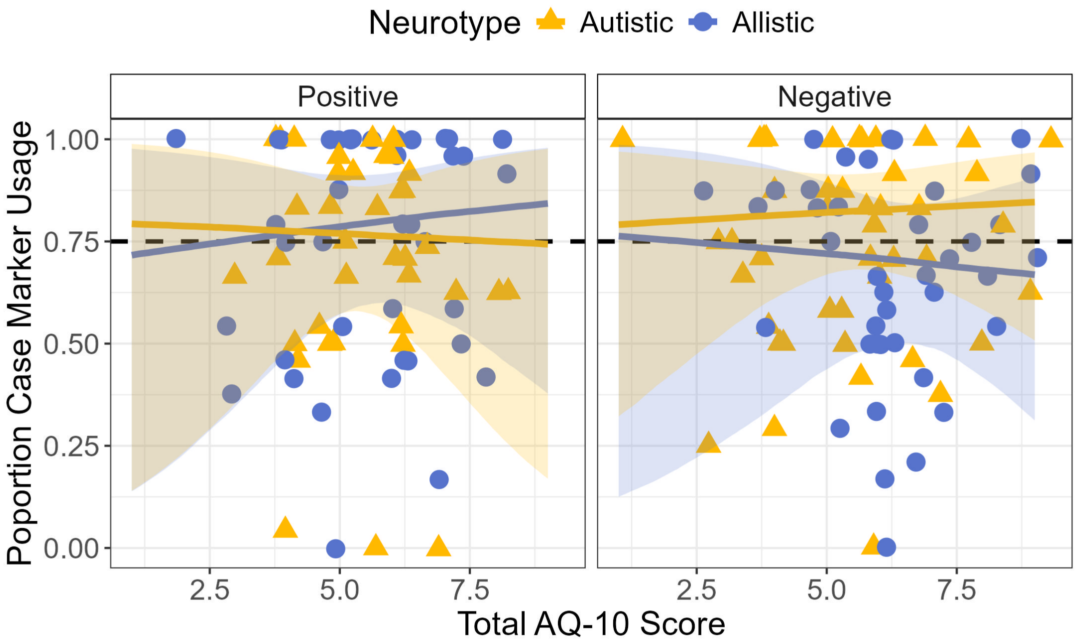


Figure 4.5: Relationship between total AQ-10 score and mean case marker usage by Autistic and condition. Each point represents an individual participant's mean (circles for allistic participants, triangles for autistic participants). Fitted lines show the model's estimates, whilst the shaded intervals represent the 95% Credible Intervals. The dashed horizontal line cutting the y axis indicates the proportion of case use in the input.

For standardised AQ-10 scores, all posterior means are near-zero: 0.02 (95% CrI: [-0.40, 0.44]) for the overall effect; -0.03 (95% CrI: [-0.44, 0.38]) for the interaction with the negative bias condition; -0.01 (95% CrI: [-0.42, 0.41]) for the interaction with neurotype; and 0.09 (95% CrI: [-0.34, 0.51]) for the three-way interaction between AQ-10 score, the negative bias condition, and being autistic. This indicates no effect of AQ-10 score or any interaction between other effects and AQ-10 score on case marking.

CAT-Q

The mean for the CAT-Q parameter posterior estimate is positive at 0.16 log odds, but the 95% CrI spans a range of [-0.39, 0.70], indicating a good degree of uncertainty. Whilst there is more posterior probability mass on the positive side, the model does consider both directions of effect to be plausible. This suggests that there could be a positive effect of CAT-Q score on overall case marker usage – in line with our predictions – but the model remains moderately uncertain.

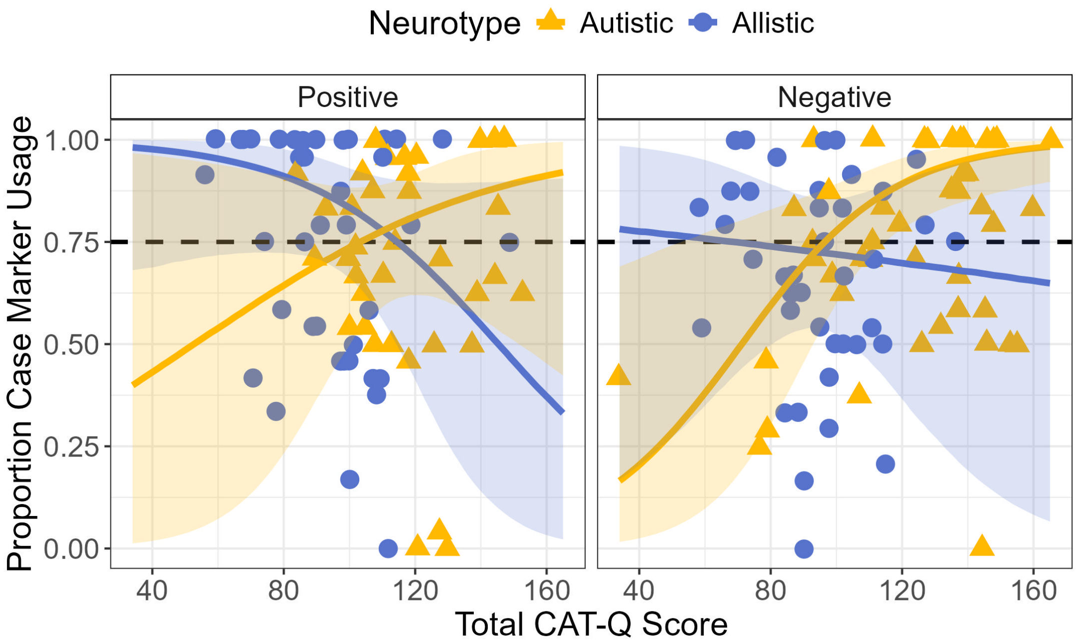


Figure 4.6: Relationship between total CAT-Q score and mean case marker usage by Autistic and condition. Each point represents an individual participant's mean (circles for allistic participants, triangles for autistic participants). Fitted lines show the model's estimates, whilst the shaded intervals represent the 95% Credible Intervals. The dashed horizontal line cutting the y axis indicates the proportion of case use in the input.

Turning to interactions with CAT-Q score, first, the mean of the parameter estimate for the interaction between CAT-Q and the negative bias condition is also positive (0.33). However, whilst most of the probability mass is positive, some remains negative, indicating some degree of uncertainty (95% CrI: [-0.21, 0.87]). Thus, there may be a positive effect of the interaction between CAT-Q score and the negative bias condition on case marker usage, but we cannot be fully certain.

On the other hand, the model shows greater certainty about the impact of the interaction between neurotype and CAT-Q score on case marking. The model predicts a positive posterior mean (0.67), with the 95% CrI spanning only positive values (95% CrI: [0.13, 1.21]). This suggests that autistic people with higher CAT-Q scores are more likely to use the case marker than the grand mean. The three-way interaction between the negative bias condition, neurotype, and CAT-Q score is, however, near-zero (-0.06, 95% CrI: [-0.62, 0.49]), indicating that the model believes both directions of the effect are plausible and suggesting no overall impact of this three-way interaction.

Having considered the overall effect of CAT-Q, we now turn to the second model, using individual CAT-Q subscales. First, we consider the assimilation subscale, which relates to dealing with uncomfortable social situations by putting on an act and presenting a persona rather than one's authentic self. There is no clear evidence for an impact of assimilation score on case marker usage, either overall (0.21, 95% CrI: [-0.27, 0.70]), or in the interactions, where there is also a good degree of uncertainty. Whilst the interaction between the negative condition and assimilation subscore (-0.34, 95% CrI: [-0.82, 0.14]) contains mostly negative probability mass, suggesting a possible negative effect, there is still a good degree of uncertainty. Likewise, the interaction between autistic and assimilation subscore (0.33, 95% CrI: [-0.15, 0.81]) has a mostly positive probability mass, but again with a good degree of uncertainty. The three-way interaction, however, has a posterior mean close to 0 (0.06, 95% CrI: [0.42, 0.53]), indicating no effect of this three-way interaction.

Recall that the compensation subscale refers to strategies used to compensate for social and communicative differences, with CAT-Q questions relating to copying others' body language and repeating others' phrasing and tone. The compensation subscore, overall, appears to have, if any, a negative effect on case marker usage, with a negative posterior mean and only a small amount of positive probability mass (-0.41, 95% CrI: [-0.90, 0.06]). However, in specifically the negative condition, the model is confident in predicting a positive effect of compensation subscore, such that an increased compensation score increases case marker usage (0.57, 95% CrI: [0.06, 1.09]). Considering the visualisation of the model's estimates (see Figure 4.7), this effect is likely largely driven by a decrease in case marking in the positive condition by increasing compensation score. There is no clear evidence of either a two-way interaction between neurotype and compensation subscore (-0.12, 95% CrI: [-0.63, 0.39]) or a three-way interaction between condition, neurotype and compensation subscore (-0.03, 95% CrI: [-0.53, 0.48]).

Parameter	Posterior Mean	95% CrI Lower	95% CrI Upper
Assimilation Subscale			
Assimilation Score	0.21	-0.27	0.70
Negative:Assimilation Score	-0.34	-0.82	0.14
Autistic:Assimilation Score	0.33	-0.15	0.81
Negative:Autistic:Assimilation Score	0.06	-0.42	0.53
Masking Subscale			
Masking Score	0.23	-0.20	0.67
Negative:Masking Score	-0.07	-0.49	0.36
Autistic:Masking Score	0.44	0.02	0.88
Negative:Autistic:Masking Score	-0.20	-0.62	0.23
Compensation Subscale			
Compensation Score	-0.41	-0.90	0.06
Negative:Compensation Score	0.57	0.06	1.09
Autistic:Compensation Score	-0.12	-0.63	0.39
Negative:Autistic:Compensation Score	-0.03	-0.53	0.48

Table 4.2: Posterior means and 95% Credible Intervals from the model examining the influence on case marker usage by the CAT-Q subscales (Assimilation, Masking, and Compensation). Fixed effects are given in log-odds space.

Turning to the masking subscale, which contains questions that are primarily about suppressing autistic traits, there is again no clear effect of this subscale overall (0.23, 95% CrI: [-0.20, 0.67]). Similarly, the interaction between condition and masking subscore is near-zero, indicating no evidence for an effect (-0.07, 95% CrI: [-0.49, 0.36]). The three-way interaction between condition, neurotype and masking subscore also shows no clear evidence of an effect (-0.20, 95% CrI: [-0.62, 0.23]). However, the interaction between autistic and masking subscore has a positive effect on case marker usage (0.44, 95% CrI: [0.02, 0.88]), such that autistic participants with higher masking scores were more likely to use the case marker than allistic participants with higher masking scores.

DFlex

The posterior estimate mean for the overall effect of DFlex score on case marking is negative, (-0.17), but whilst most of the probability mass is negative, suggesting a possible negative effect, the model shows a good degree of uncertainty with 95% CrI spanning [-0.67, 0.32], therefore we cannot be confident in the direction of this effect.

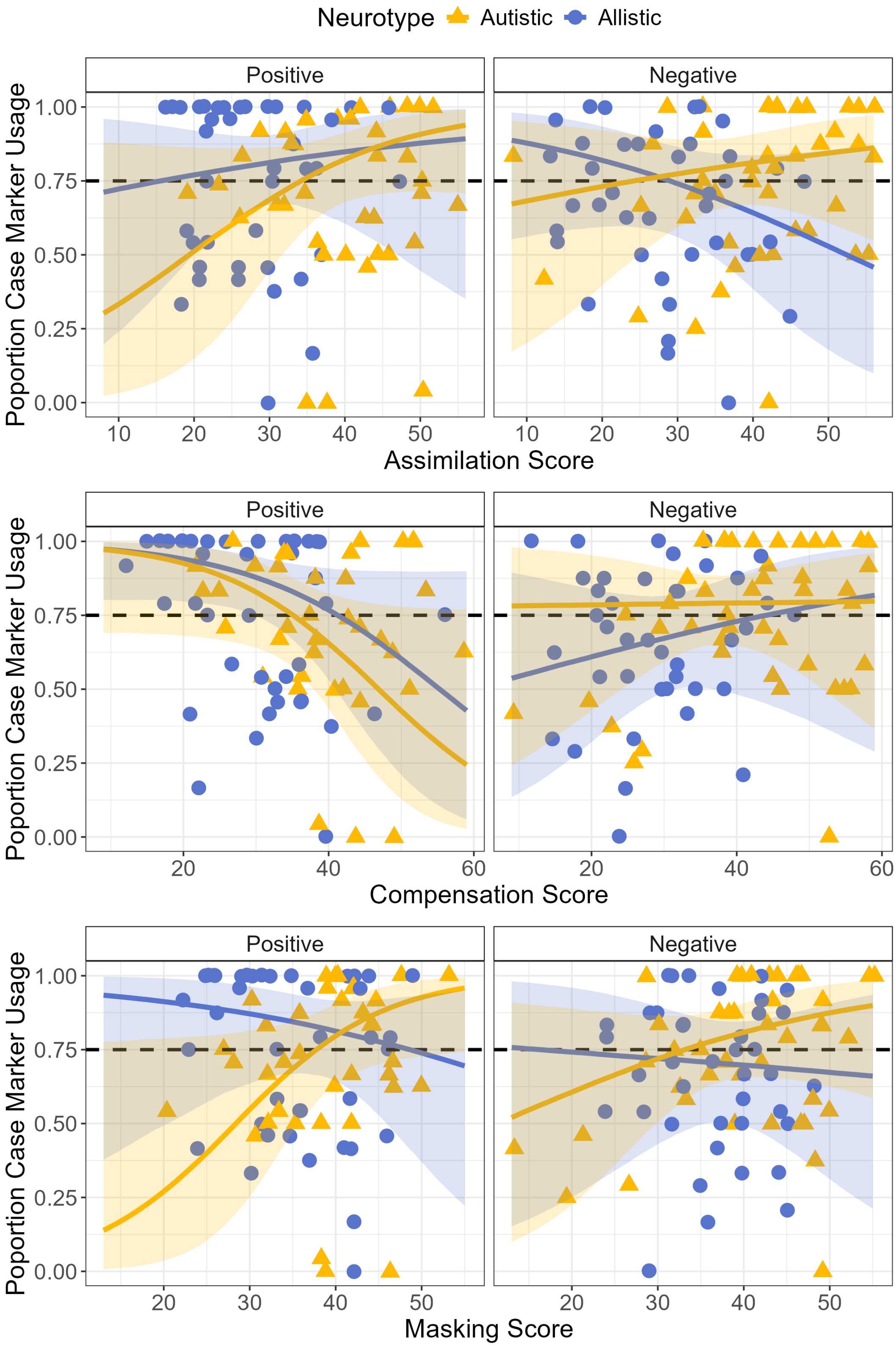


Figure 4.7: Plots showing relationship between the CAT-Q Assimilation, Compensation, and Masking subscale scores and mean case marker usage by Autistic and condition. Each point represents an individual participant's mean (circles for allistic participants, triangles for autistic participants). Fitted lines show the model's estimates, whilst the shaded intervals represent the 95% Credible Intervals. The dashed horizontal line cutting the y axis indicates the proportion of case use in the input.

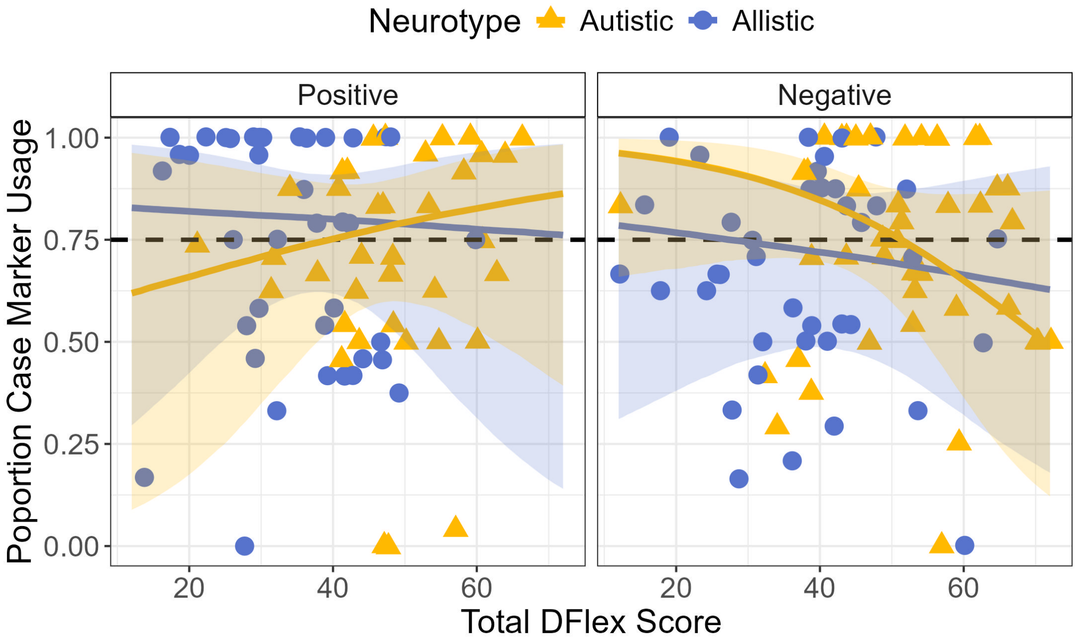


Figure 4.8: Relationship between total DFlex score and mean case marker usage by Autistic and condition. Each point represents an individual participant's mean (circles for allistic participants, triangles for autistic participants). Fitted lines show the model's estimates, whilst the shaded intervals represent the 95% Credible Intervals The dashed horizontal line cutting the y axis indicates the proportion of case use in the input.

The interaction between DFlex score and the negative bias is also negative (-0.28), but again the model is uncertain with 95% CrI spanning [-0.76, 0.21]. As above, this indicates the possibility of a negative effect of the interaction between DFlex and the negative bias condition (such that participants in this condition with higher DFlex scores are less likely to use case marking), but the model does not provide strong evidence for this effect. With respect to the interaction between DFlex score and autistic status, the model's posterior estimate mean is near-zero (-0.04, 95% CrI: [-0.54, 0.45]). The model therefore believes both directions of the effect plausible, indicating that there is no overall impact of the interaction.

Finally, the three-way interaction for DFlex score, the negative bias condition, and neurotype has a negative posterior mean (-0.24) and most of the probability mass is negative (95% CrI: [-0.74, 0.27]). This indicates that autistic participants with higher DFlex scores in the negative bias condition may use case marking less frequently, but, as with the other DFLex effects, the model is uncertain.

AQ-50 Attention to Detail

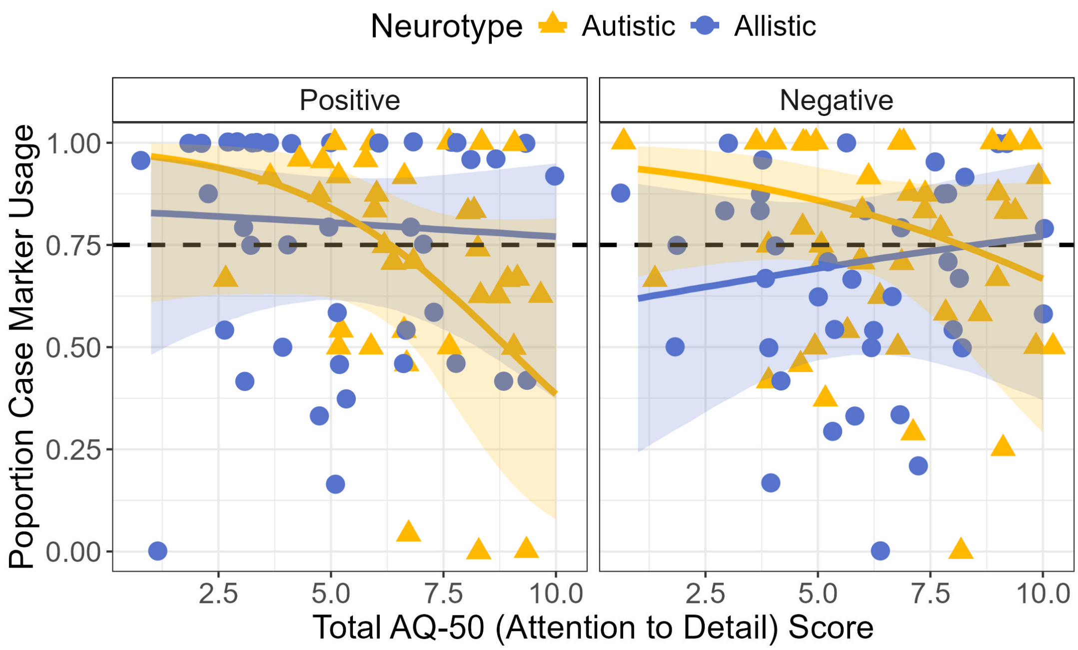


Figure 4.9: Relationship between total AQ-50 (Attention to Detail scale) score and mean case marker usage by Autistic and condition. Each point represents an individual participant's mean (circles for allistic participants, triangles for autistic participants). Fitted lines show the model's estimates, whilst the shaded intervals represent the 95% Credible Intervals. The dashed horizontal line cutting the y axis indicates the proportion of case use in the input.

The attention to detail subscale of the AQ-50 is estimated to have an overall negative effect on case marking (-0.35, 95% CrI: [-0.78, 0.08]). Whilst there is a small amount of positive probability mass, the model is leaning towards a negative effect. Similarly, for the interaction between AQ-50 attention to detail scores and being autistic, the model predicts a likely negative effect (-0.39, 95% CrI: [-0.82, 0.04]), though a small amount of the probability mass is positive.

Conversely, for the interaction between AQ-50 attention to detail scores and the negative bias condition, the model suggests a potential positive effect on case marker usage (0.18, 95% CrI: [-0.25, 0.61]), though it should be noted that the model displays a considerable degree of uncertainty here. Finally, for the three-way interaction between AQ-50 score, the negative bias condition, and neurotype, the posterior estimate is near-zero (0.05, 95% CrI: [-0.38, 0.48]), suggesting that there is no overall effect of this interaction on case marker usage.

4.6 Discussion

In this study, we built on previous research which has used artificial language learning tasks to test predictions about the causal links between how people learning and use language, and how linguistic systems tend to be organised. In particular, there is evidence that languages are efficient – for example, if a language has fixed word order, it does not also use case to mark grammatical roles. In line with this, artificial language learning experiments have shown that when participants are taught fixed word order languages with case marking, they tend to reduce case marking when they themselves produce the language (Fedzechkina et al., 2016a; Fedzechkina & Jaeger, 2020). However, in addition to efficiency, language is shaped by other considerations. People use language to achieve social goals. When social pressures are incorporated into artificial language learning experiments testing efficiency, participants have been shown to *increase* their use of redundant case marking to meet a social goal (Fedzechkina et al., 2022; G. Roberts & Fedzechkina, 2018). This demonstrates the important, but oft-overlooked, connection between learning and production biases on the one hand, and social biases and pressures on the other. Whilst learning and production biases alone would predict a redundant marker would eventually disappear from the grammar of a language, social biases can help explain why redundancies remain throughout the world's languages.

Importantly for the purposes of our study, individuals vary in their response to social situations. Here, we focused on social variation linked to neurodiversity. Many conditions that fall under the neurodivergent umbrella are associated with differences in linguistic and socio-communicative skills, from those characterised by these differences (e.g. Developmental Language Disorder for structural language differences, and autism for socio-communicative differences), to those where these differences may not be the central criteria but are nonetheless present in many individuals (e.g. bipolar disorder, schizophrenia, and ADHD). It is thus intuitive that some neurodivergent people may balance learning, production, and social pressures in a different way than neurotypical people, and that this could impact variation in language.

Indeed, Fletcher, Rabagliati, & Culbertson (2024) found that autistic traits contribute to an increased adherence to a social bias that encourages the retention of a redundant case in an artificial language learning task based on (Fedzechkina et al., 2022; G. Roberts & Fedzechkina, 2018). Individuals with higher levels of autistic traits, measured by the AQ-10, were more likely to increase their use of a redundant marker in response to a social pressure in favour of the group that uses it than people with lower levels of autistic traits. However, it was unclear what mechanism is driving this behaviour. On the one hand, there was some evidence that this trend was driven by heightened attention to detail amongst those with high autistic traits; on the other, recent work has highlighted the role of autistic camouflaging, which involves changing one's behaviour to appear more like a non-autistic person, including one's linguistic behaviour. Further, the bias itself was relatively simple (though this was by design in the original paradigm of G. Roberts & Fedzechkina (2018)), and likely did not reflect the real-world pressures faced by autistic people, including those that drive them to mask.

The aim of this paper was to expand this previous work and address two key areas. First, we examined the two mechanistic explanations outlined above (attention to detail and autistic camouflaging), using measures of both to gain a better understanding of which – if any – was driving the increased use of redundant case marking by autistic people in Fletcher, Rabagliati, & Culbertson (2024). Second, we expanded the social biases that participants were exposed to. Whilst we continued to focus on the notion of in-group/out-group membership that G. Roberts & Fedzechkina (2018) drew on, we manipulated the nature of the in/out-group relationship by introducing 'positive' and 'negative' biases. In the former, the group participants were biased towards was open and welcoming of the differences between them, and was already open to collaboration, whilst in the latter, the group participants were biased towards was shown to be hostile and intolerant of the differences between them. In both scenarios, participants were told that they had to work with the group in order to survive.

We suggested that the second (negative) scenario was more akin to the pressures to camouflage that autistic people face than the first (positive) scenario. Throughout the literature and autistic accounts, camouflaging is linked to the avoidance of stigma, bullying, and other negative outcomes (Cage & Troxell-Whitman, 2019; Bernardin, Mason, et al., 2021; Radulski, 2022b; Perry et al., 2022), rather than with fostering positive relationships. On the other hand, Ridgway et al. (2024) recently specifically considered the relationship between camouflaging and positive relationships and found that it is often a dispreferred strategy and is actually associated with poor outcomes for positive relationships, whilst Khudiakova et al. (2025) find that autistic people are less likely to camouflage when they feel accepted by those around them. Thus, one would expect that autistic camouflaging would be more evident in a scenario with a hostile interlocutor with whom it is nonetheless important to retain a relationship.

Consequently, we hypothesised that the valency of the bias would help distinguish between the two potential mechanisms. If attention to detail is the key mechanism, we expected that the type of bias would not be relevant, and that an increase in attention to detail scores would always increase case marker usage. On the other hand, if camouflaging is the key mechanism, we expected that it would be more impactful in the negative bias condition, as it more closely aligns with the goals of autistic camouflaging.

In both types of bias conditions, we find that participants retain redundant case, in line with previous work showing that people are willing to be more redundant in order to meet a social goal (G. Roberts & Fedzechkina, 2018; Fletcher, Rabagliati, & Culbertson, 2024). However, unlike in prior experiments, our participants did not robustly increase their use of case beyond their initial input; the overall probability of using a case marker is 0.78, which is only marginally above the 75% proportion of case marking they were exposed to in the input. This lack of increased use of case is important, as it may have a knock-on effect on all of our other results, and suggests that our social biases may not have been as effective as those used in previous work. That said, in the absence of a social pressure, English speakers have been found to significantly reduce their usage of redundant marking (see, e.g., Fedzechkina et al. (2016a)) which means our bias was at least successful in encouraging retention of the marker.

Participants overall behaved in similar ways across the two bias conditions, with participants just as likely to retain the case marker in the negative and positive bias conditions. Based on the camoflaging account, we also predicted that autistic people might in general adjust their behaviour more in the negative bias condition than the positive bias condition. There was some evidence to tentatively supports this; numerically, the trend is in the correct direction, and the model does predict an increase of case marker usage by autistic people in the negative bias condition. However, there is a good degree of uncertainty around this effect, meaning further work is needed to establish whether autistic and allistic people respond differently to different types of biases, perhaps beyond the valency dichotomy we used here.

Unlike Fletcher, Rabagliati, & Culbertson (2024), we did not find clear evidence that neurotype or autistic traits (as measured by the AQ-10) impact case marker usage in this experiment. As mentioned earlier, a notable difference between this and prior work is that our participants do not increase their use of case beyond its frequency in their initial input, despite participants starting at a higher proportion of exposure than Fletcher, Rabagliati, & Culbertson (2024) (50% versus the present 75%). In Fletcher, Rabagliati, & Culbertson (2024), many of the participants with high AQ-10 scores were using 100% case marking. We do not see the same extremes here, which could be the result of either the biases being less effective than those used in prior work, or the initial input proportion being too high and obscured resulting effects.

Turning to our psychometric measures of attention to detail and autistic camouflaging, there is no clear evidence that, overall, any of them impact the use of case marking. Whilst Fletcher, Rabagliati, & Culbertson (2024) found that the AQ-10 attention to detail subscale was associated with an increased use in case marking in the bias conditions, the extended measures of attention to detail used here are not. If anything, the evidence suggests that there is more likely to be a negative than positive relationship between attention to detail (particularly when measured with the AQ-50) and case marking, though again we note that the evidence is inconclusive. It is possible that the task did not 'tap into' attention to detail enough for these measures to have an impact. For instance, since participants always saw the same alien, they did not need to keep track of differences between groups, as they had to do in Fletcher, Rabagliati, & Culbertson (2024).

For camouflaging, however, a more interesting pattern emerges. Whilst there is no overall effect of CAT-Q, the interaction between being autistic and CAT-Q scores increases the use of redundant case marking, indicating that the CAT-Q is associated with an increase in redundant case only when the participant is autistic. This is a particularly interesting result given the current debates on the conceptualisation of autistic camouflaging. The CAT-Q cannot reliably distinguish between autistic and non-autistic populations by itself (and indeed is not designed as a diagnostic tool); whilst autistic people tend to have higher CAT-Q scores, there is overlap in the individual scores of autistic and allistic people (e.g. Jorgenson et al., 2020), reflecting the fact that it is likely that allistic people also employ camouflaging behaviours as part of impression management (Ai et al., 2024b). However, as argued by Ai et al. (2022), it is likely that autistic masking is in some way at least qualitatively different than allistic masking, given the specific pressures on autistic people to appear less autistic, and the computational demands of masking. This aligns with our result that CAT-Q alone is not enough to predict increased case marker usage without the mediating effect of neurotype. Our autistic participants who score high on the CAT-Q show specific linguistic behavioural differences compared to their allistic counterparts, supporting the idea that camouflaging might impact language in a unique way in autistic people. Future research is needed to investigate how, when, and why autistic and allistic people use camouflaging strategies, to understand the qualitative differences in camouflaging between the two groups.

As for the subscales of the CAT-Q, we find evidence for two interactions: one between condition and the compensation subscore, and the other between being autistic and the masking subscore. These specific interactions between the subscales and neurotype/condition further highlight the nuances behind the conceptualisation of autistic camouflaging. The compensation subscore is, conceptually, perhaps easiest to link to the linguistic behaviours targeted in this study; it explicitly measures copying other's body language, facial expressions, phrasing, and tone, and intuitively, this may also include more specific linguistic elements such as lexical and morphosyntactic choices. The fact that higher compensation scores are associated with more case marker usage in the negative condition only suggests that, at least in the linguistic domain, these particular camouflaging techniques may be more relevant in situations where the goal is to avoid negative outcomes, rather than foster positive outcomes.

On the other hand, recall that the masking subscale captures strategies to appear less autistic, including monitoring body language and being aware of the impression made on others. It is noteworthy that whilst here we find a clear interaction between this subscore and neurotype, previous work has shown that of the three subscales, masking shows the least difference between autistic and allistic people and is most clearly linked to general impression-management strategies (Hull, Mandy, Lai, Baron-Cohen, et al., 2019). Our result supports Hull, Mandy, Lai, Baron-Cohen, et al.'s (2019) suggestion that whilst autistic and allistic people score similarly on this subscale, the actual strategies used may differ. In our context, it is autistic people with higher masking scores who incorporate the most linguistic adjustments – in this case, in their proportion of case marking – as part of their impression-management strategies, whilst allistic people do not.

The broad goal of our work is to highlight the ways in which neurodivergent – in this case, autistic – people can contribute to language evolution. As highlighted in Fletcher, Rabagliati, & Culbertson (2024), language evolution research to date generally focuses on cognition within prescribed norms. Here, we focus on the potential contributions that neurodivergent people can make to language in their own right. This result suggests that under certain social circumstances, autistic people with high CAT-Q scores, are willing to prioritise social goals more than allistic people over the traditional balance of communiciative efficiency. The resulting structural changes could contribute to the overall shape of the world's languages, and help explain why redundancy is persistent.

Whilst the results outlined above contribute to our understanding of the relationship between autistic camouflaging and linguistic behaviours, we note that there are several limitations. First, our sample is not representative of and may not generalise to the whole autistic community, given the variability inherent to autism. Our participants were recruited online via Prolific and reported a mixture of self-identification and formal diagnosis. As briefly mentioned above, they are likely to be speaking (or at least literate), require less-day-to-day support, and not be intellectually disabled, though we note that we did not explicitly gather this information from participants and there are, to our knowledge, no existing studies examining these characteristics amongst the autistic population on Prolific. Additionally, we do not take into account neurodiversity beyond autism; some of our autistic and/or allistic participants may be neurodivergent in other ways (or indeed, some allistic participants may even be autistic but not aware of such). Other types of neurodiversity may impact how people react to our social biases. Future work should continue to investigate a broader range of autistic people from a variety of socio-demographic backgrounds, as well as multiply-neurodivergent autistic people, and allistic but otherwise neurodivergent populations.

As in other studies both on autism and language evolution, our participants are self-reported native English users, meaning our results are inherently through an anglophone lens and may not generalise to users of other languages. In our study design, we noted that influence from our participants' native language, English, motivated our choice to increase the proportion of redundant case in the input language; with speakers of other languages, particularly those that systematically use case, it is likely that different proportions would be more appropriate. However, we have also suggested that the input proportion of 75% may have been too high and concealed potential effects, thus future work should consider the same phenomenon in English speakers with lower proportions of case marker input.

Finally, our study does not involve in-person interaction, which could impact how autistic people behave. Our task is highly structured and administered online, which could be easier for some autistic cognitive profiles than language use and learning would be in everyday scenarios (Kenny et al., 2024). Additionally, the online environment could alter the relevant behavioural dynamics, such as the extent to which autistic camouflaging is employed; evidence suggests that camouflaging is used less frequently – though it remains present – in online interactions (Jedrzejewska & Dewey, 2022; Koteyko et al., 2024). Further, autistic people often prefer online communication (e.g. Gillespie-Lynch et al., 2014; Hassrick et al., 2021), for reasons such as having extra time to respond, reduced sensory overload, and less pressure to maintain neurotypical expectations such as eye contact (Ritzman & Subramanian, 2024).

As such, some autistic people may find a task like this more difficult in a lab environment where the social pressures are accompanied by real people and higher stakes. Whilst this could actually lead to an increase in the effect of camouflaging due to the pressures of the in-person scenario, future work should test the impact of social biases on autistic language use in ‘real-world’ situations.

4.7 Conclusion

Language evolution and use is linked through extensive behavioural and typological evidence of a trade-off between communicative accuracy and production effort. However, these are not the only relevant aspects of communicative need, and previous work has shown that speakers are willing to be less efficient to meet social goals. We related this work to broader findings in sociolinguistics around language and identity, and the need for minoritised groups to alter their linguistic behaviours to survive. We discussed the potential role of neurodiversity in minority group identity, and argued that neurodivergent people’s linguistic variation remains open for examination beyond looking for ‘deficits’ compared to neurotypical people. In our experiment, we expanded on previous work considering the interplay between social factors and communicative efficiency, considering how autistic people respond to these pressures. We examined two potential mechanisms behind autistic people’s increased use of redundancy to meet a social goal: attention to detail and autistic camouflaging. Our results suggest that it is camouflaging rather than attention to detail driving these prior findings, demonstrating a role for autistic camouflaging behaviours in shaping language. Further, they contribute to debates about the nature of autistic camouflaging, particularly in contrast to general (including neurotypical) impression management strategies, by demonstrating linguistic behavioural differences between autistic and allistic people who both have higher masking scores.

5

Neuro-identity mixing and linguistic accommodation: evidence from regularisation

“There are billions of us – humans everywhere, with access to our own minds and no one else’s, tossing one another songs and sentences to bridge the gap."

– Annie Kotowicz, 2022

5.1 Preface: chapter five

Chapter Five, the final empirical chapter of the thesis, describes a series of experiments investigating the relationship between neuro-identity, accommodation, and language change. This chapter takes something of a turn compared to the previous two content chapters, moving away from communicative efficiency. With this work, we ask questions instead about a potential mechanism of language change – accommodation – and how this might be impacted by neurotype in different ways. Specifically, we consider whether people of different neurotypes accommodate to differing extents, whether they are willing to retain the changes introduced by accommodation, and whether this is impacted by the perceived neurotype of their partner. Further, we wanted to introduce a more interactive element, as while the prior studies in this thesis consider social biases, participants were never actually led to believe that they were *directly* interacting with another person. Finally, we wanted to address an issue previously highlighted in the literature that existing work on linguistic accommodation in autism primarily uses (presumably) neurotype-mixed groups. This potentially reduces the amount of accommodation that would be present in these interactions, given theories such as the Double Empathy Problem, but has not been adequately addressed previously.

We built our hypotheses on the basis of existing work on social differences in autism, as described in Chapter Two. However, we also wanted to expand these theories to a broader range of neurotypes. Past research that has looked at the difficulties in cross-neurotype interactions have only considered the impact of autistic-allistic interactions. They have not considered, for instance, cross-neurotype but still neurodivergent interactions, such as autistic-ADHD or autistic-dyslexic, nor how neurotypical people react to interaction partners who are not autistic, but are nonetheless neurodivergent. As such, we included the first known study of ALL with people with ADHD, introducing them as a second neurodivergent, but not autistic, neurotype. We also chose ADHD as our second case study here due to the overlap between ADHD and autism, which might have made autistic-ADHD interactions easier than autistic-allistic interactions. However, we did not have strong expectations going into this study, as there is a paucity of work considering ADHD in this scenario. Additionally, there is no considering how people with ADHD linguistically accommodate, and thus it was unclear to what extent they would do this even in matched-neurotype interactions.

5.2 Fletcher et al. (in preparation) author contributions

A condensed version of the following was published in the proceedings of the Annual Conference of the Cognitive Science Society. The following expanded manuscript is currently under preparation for journal submission. The paper was co-authored with my two supervisors, Jennifer Culbertson and Hugh Rabagliati. The development of the experimental design, hypotheses, and approach for analysis was developed during supervision meetings by all three authors. I collected the data and performed the analysis, with feedback and support from my co-authors. I drafted the manuscript, also with feedback from my co-authors. The manuscript has been re-formatted in line with the format of this thesis. Changes to the text may occur as a result of the review process.

5.3 Abstract

Linguistic accommodation is the process by which people make their language more like that of their interlocutor, and has been argued to contribute to language change. However, it is unclear to what extent people of different neurotypes accommodate, or how neurotype mixing – which has been shown to reduce communicative success – impacts linguistic accommodation. In this paper, we build on previous research which uses artificial language learning to investigate accommodation as a mechanism for linguistic regularisation (i.e., the reduction of variation in a grammatical system). We test the impact of neurotype mixing on accommodation, with the aim of better understanding whether such mixing impacts processes of language change. Across two experiments, we consider the impact of neurotype mixing across participants in three groups: autistic, allistic, and ADHD. In Experiment One, we find that both allistic and autistic participants accommodate to each other, but participants in the autistic-autistic condition accommodate the most. In Experiment Two, we find that autistic people's accommodation shows something of a gradient effect, accommodating most to other autistic people, least to allistic people, and somewhere in between to people with ADHD. Finally, we find that people with ADHD do not change their accommodation behaviour based on their partners neurotype. We discuss the importance of these results with respect to the Double Empathy theory of mixed-neurotype communication and language evolution.

5.4 Introduction

Linguistic accommodation refers to the process by which language users make their language more like that of the person that they are interacting with (Giles et al., 1991). It is closely related to processes such as alignment and entrainment, with the three terms having much overlap though some distinct conceptual elements. This occurs at every level of language, including lexical choice, prosody, and syntax. There are two broad accounts of accommodation; first, accommodation can be viewed through a communicative lens, either via an audience design account (see, e.g., H. H. Clark, 1996) or as a means of pursuing social-affective goals (see, e.g., van Baaren et al., 2003). Secondly, accommodation behaviours can be viewed as the result of automatic psycholinguistic priming (Pickering & Garrod, 2004). It is likely that both mechanisms are involved in accommodation, perhaps to differing extents at different linguistic levels or in different scenarios, as discussed by Branigan et al. (2010).

Regardless of the specific mechanism, accommodation contributes to short-term communicative success (Pickering & Garrod, 2006; Fusaroli et al., 2012; Reitter & Moore, 2014; Fusaroli & Tylén, 2016), and there is also evidence that it can contribute to longer-term language change. Fehér et al. (2019) found use artificial language learning experiments to show that accommodation leads to the regularisation of an optional linguistic form. However, accommodation is impacted by both linguistic and extra-linguistic factors. As an example of the former, Fehér et al. (2019) found that learners trained on a fully regular language do not accommodate to speakers who use a morpheme optionally (in line with theories of grammaticalisation such as Lehmann, 1985). More relevant to this paper are the extra-linguistic factors. Beliefs about one's interlocuter impact to what extent language users accommodate. Previously studied variables include speaker's beliefs about their interlocuter's perceived competence (Branigan et al., 2011; Cai et al., 2021), nativeness (Chun et al., 2016; Suffill et al., 2021; Zhang & Nicol, 2022), speaker community (Tobar-Henríquez et al., 2021), power (Muir et al., 2016) and gender (Palomares et al., 2016). Additionally, accommodation is mediated by individual differences based on various personality traits (Muir et al., 2016) .

Crucially, this mechanism of language change is thus linked to the fundamental question of *who* drives change. If accommodation varies by the identity of the interlocuter – and, potentially, the identity of the speaker – then this has implications for which groups contribute more to language change. For instance, variationist sociolinguists have long claimed that women are drivers of language change (Tagliamonte & D'Arcy, 2009; Labov, 1990, 2001); if speakers are more inclined to accommodate towards women, changes introduced by women speakers may spread in the population. Notably, there is evidence that beliefs about identity can impact how likely a speaker is to continue using an accommodated variant (Tobar-Henríquez et al., 2021), strengthening the hypothesis that these social factors can contribute to the long-term changes.

In this paper, we consider a different variable of identity that could impact accommodation, and by extension regularisation: *neurotype*. Specifically, we examine how accommodation might be impacted both by the speaker's neurotype, and their beliefs about their interlocuter's neurotype. Before turning back to the key question of who causes language change, we therefore turn to a review of neurotypes and how they impact linguistic accommodation.

5.4.1 Neurodiversity and linguistic accommodation

As a concept, neurodiversity describes the variation in cognitive functioning amongst human minds (Walker, 2021). A neurotype refers to a particular style of cognitive functioning (Walker, 2021). One neurotype, *neurotypical*, describes an individual whose cognitive functioning conforms to the dominant social standard. On the other hand, there are various *neurodivergent* neurotypes; these individuals' cognitive functioning differs in some substantial way from the 'norm'. Examples of neurodivergent neurotypes include autism, ADHD, plurality (referred to as DID and OSDD in the clinical literature), dyslexia, dyspraxia, epilepsy, and Functional Neurological Disorder (FND). We also note that it is possible (even likely) to be multiply neurodivergent, such that an individual fits into more than one of the above categories (e.g. an autistic person with epilepsy). The neurodiversity paradigm frames none of these variations from the social standard as inherently 'deficient' or 'wrong'[1], but rather natural examples of human diversity.

Walker (2021) further develops the concept of a *neurominority* group. This refers to a group of individuals who form a community and whose shared form of neurodivergence is innate and intrinsic to self. It is this neurominority identity (henceforth referred to as neuro-identity) that we focus on in this paper. As such, we are considering neurodiversity as both a cognitive phenotype that impacts neurocognitive functioning *and* a social identity.

Many neurodivergent neurotypes, include differences in language at various levels. Given the role of accommodation in communicative success, accommodation has been the subject of some examination in neurodivergent people who are more likely to display communicative differences. In this paper, we specifically, we focus on autism and ADHD as neurominority groups, both of which do involve differences in communication (though the nature of those differences varies substantially). Taking the case of autism, traditionally characterised as a social-communicative 'disorder' (American Psychiatric Association, 2013), some have turned to reduced accommodation as a potential causal mechanism behind perceived social difficulties (Branigan, Tosi, & Gillespie-Smith, 2016). It has been suggested that reduced prosodic accommodation may explain why autistic people's speech is perceived as different

1. Importantly, the neurodiversity paradigm does not reject pathologising certain forms of neurodivergence that are not intrinsic to self, such as FND or an acquired brain injury Walker (2021); rather, it suggests that we should not simply assume that a difference is something to be pathologised.

in some way than allistic[2] people's speech (Kruyt & Beňuš, 2021). This account has been extended to investigate communication differences in people of other neurotypes, such as those with schizophrenia or bipolar disorder, though results do not indicate reduced accommodation in these neurotypes (Sharpe et al., 2022).

On the other hand, communicative differences in ADHD are less studied but still attested in the literature. For instance, Carruthers et al.'s (2022) and P. B. Kessler & Ikuta's (2023) reviews of research in this area suggests that children with ADHD display pragmatic language differences compared to typically developing peers, particularly in areas such as social and narrative discourse. Many of these studies have compared autistic children and those with ADHD, and often suggest that autistic children have greater differences than those with ADHD. Additionally, some studies find differences in the structural language of those with ADHD (Hawkins et al., 2016; Parks et al., 2023). To our knowledge, the hypothesis that accommodation may be linked to communicative differences in ADHD has not been empirically tested.

The role of accommodation as a clear causal mechanism for communicative differences amongst neurodivergent people remains unclear. Again taking autism as a case study, evidence for reduced accommodation is mixed, and appears to be modulated by linguistic level. Accommodation has been shown to be reduced at the prosodic level in autistic people (Kruyt & Beňuš, 2021; Patel et al., 2022; Lehnert-LeHouillier et al., 2020), but comparable to allistic people's in the syntactic and semantic domains (Allen et al., 2011; Hopkins et al., 2016; Fusaroli et al., 2023; Slocombe et al., 2013). There are mixed results with respect to lexical choices (see Slocombe et al., 2013; Branigan, Tosi, & Gillespie-Smith, 2016; Fusaroli et al., 2023; Hopkins et al., 2017, for evidence that autistic people do lexically accommodate; see Stabile & Eigsti, 2022; Patel et al., 2022 for evidence that autistic people lexically accommodate less than allistic people).

Where the evidence does not indicate reduced accommodation by autistic people, it has been argued that this accommodation must be primarily driven by priming, rather than audience design or social-affective goals, as autistic individuals' social motivations are supposedly 'impaired' (Branigan, Tosi, & Gillespie-Smith, 2016). This explanation has also been extended to other neurodivergent groups (Sharpe et al., 2022). This conclusion, however, rests upon the assumption that neurodivergent people lack social motivation. In autism specifically, this assumption has been challenged by the experiences of autistic people (Jaswal & Akhtar, 2019b). Further, the notion that all autistic people lack social motivation is incompatible with research demonstrating the great lengths autistic people go to to 'fit in' socially via autistic camouflaging or masking, often to the detriment of their mental health (e.g., Cage & Troxell-Whitman, 2019). One of the mechanisms reported by masking autistic people is linguistic imitation (Hull, Petrides, Allison, Smith, Baron-Cohen, et al., 2017; Miller et al., 2021a), suggesting that autistic people do have social motivations behind their use of linguistic accommodation. In this study, we are explicitly testing an audience design account of accommodation in autism and ADHD, but see Section 5.7 for further discussion of the role of masking in this study.

2. Allistic is a neologism that refers to non-autistic people.

5.4.2 Neurotype mixing reduces communicative success, but what about accommodation?

Besides making unwarranted assumptions about autistic social motivation, studies on accommodation in autism commonly share two flaws. First, they are generally conducted with autistic children (see Patel et al., 2022; Stabile & Eigsti, 2022; Slocombe et al., 2013 for exceptions). We thus know little about the accommodation behaviours of autistic adults, and the developmental trajectory of accommodation in autistic people remains an open question. Further, the demographic makeup of diagnosed autistic children is impacted by biases in the diagnostic process; autistic people of colour or feminine-presenting autistic people are less likely to be diagnosed until adulthood (or, indeed, at all) (Aylward, Gal-Szabo, & Taraman, 2021; Loomes et al., 2017; McQuaid et al., 2022). These demographics, particularly with respect to gender, may impact the levels of linguistic accommodation, and thus representative samples of the full diversity of autistic people are needed.

Second, and importantly for this study, the work is mostly conducted in implicitly mixed-neurotype interactions, as also noted by Kruyt & Beňuš (2021). The typical set up for these accommodation experiments involves an autistic child interacting in a highly structured task with a presumably neurotypical, or at least allistic, research assistant. On the other hand, accommodation studies with allistic adults are usually in presumably neurotype-matched pairs; as noted by Manalili et al. (2023b), we often tacitly assume in experimental cognitive science that our samples are neurotypical, even if we do not explicitly collect this information. Thus, neurotype mixing may be at least a partial reason for some results that suggest autistic people accommodate less than allistic people.

Recent research has shown that difficulties in communication in mixed-neurotype (specifically autistic-allistic) interactions are not one-sided, and are instead the result of two individuals coming to the table with vastly different cognitive experiences and expectations (known as the 'Double Empathy Problem' D. Milton, 2012b; see also related work on the Bayesian 'Dialectal Misattunement Hypothesis', e.g., Bolis et al., 2017). For instance, autistic-autistic interactions are just as effective at transferring information as allistic-allistic interactions (Crompton, Ropar, Evans-Williams, et al., 2020). However, mixed neurotype interaction chains are much less efficient at transferring information compared to either allistic-only or autistic-only chains. This challenges the traditional conceptualisation of one-sided autistic communication difficulties.

It is on this basis that we hypothesise that linguistic accommodation by autistic people *and* allistic may be impacted by neurotype mixing. As accommodation increases communicative success (e.g. Pickering & Garrod, 2006; Reitter & Moore, 2014; Fusaroli et al., 2012; Fusaroli & Tylén, 2016), the lack of it (or potentially even divergence) could be one mechanism that contributes to the difficulty in mixed-neurotype interactions. We hypothesise that autistic people may accommodate less to those whose neurotype does not match their own, or more to those whose neurotype does match their own (we note that we do not strongly *a priori* favour a divergent or convergent account in this regard, and both may be at play). Equally, we expect that allistic people will also accommodate less to autistic people (or more to allistic people).

Notably, research in the Double Empathy Problem space has only focused on autistic-allistic differences, likely due to its original formulation as an alternative to Theory of Mind conceptualisations of autism (D. Milton, 2012b; D. E. M. Milton et al., 2018). However, neurodiversity clearly goes beyond the autistic and allistic categories; allistic people may be otherwise neurodivergent (such as a non-autistic person with ADHD), whilst autistic people can be multiply neurodivergent (such as an autistic person with co-occurring ADHD). The Double Empathy Problem refers to a "disjuncture in reciprocity between two differently disposed social actors" (D. Milton, 2012b), and does not inherently require that the disjuncture is a result of autistic status alone (as also noted by Livingston et al., 2025, in their discussion on the lack of unclear theoretical boundaries for the Double Empathy problem). Just as allistic people have difficulty understanding autistic people, we might expect them to have difficulty understanding other neurodivergent people. Similarly, we might expect autistic people to have difficulty understanding others who are neurodivergent, but not autistic.

Furthermore, many other neurotypes can involve differences in social interaction and communication, such as Attention Deficit Hyperactivity Disorder (ADHD) (Bora & Pantelis, 2016; Carruthers et al., 2022; Hawkins et al., 2016; P. B. Kessler & Ikuta, 2023) or Schizophrenia (M. F. Green et al., 2015). In the educational space (though not explicitly using the Double Empathy problem framework), research has shown that individuals with ADHD, similarly to autistic people, are judged more negatively by neurotypical peers and are less likely to form meaningful relationships (A. de Boer & Pijl, 2016; Normand et al., 2013; Greenway et al., 2023). Findings such as these could be explained using the Double Empathy Problem framework; instead of an inherent 'impairment' on the side of the individual with ADHD, difficulties arise as a result of a mismatch in cognitive experiences and expectations between individuals with and without ADHD. However, this has not yet been explicitly tested within this theory. In this study, we contribute to questions around the boundary of the Double Empathy Problem as a theory by considering mixed-neurotype interactions beyond just autistic-allistic interactions by including participants with ADHD. We consider the impact of matched-neurotype interaction beyond the allistic-autistic dichotomy (e.g. ADHD-ADHD matched pairs), and how mixed-neurotype yet still neurodivergent pairs (e.g. ADHD-autistic) interact, specifically with regards to linguistic regularisation.

5.4.3 Regularisation as a link between accommodation and change

As mentioned above, accommodation is one of the potential mechanisms of language change. Fehér et al. (2019) investigate the impact of accommodation through the lens of regularisation, and find that users whose training language demonstrates evidence that a variant is redundant and optional are likely to reduce the use of it when tested after training. However, when they interact with a partner who uses the morpheme obligatorily, they increase their use of the morpheme; in other words, they accommodate. The population-level grammar therefore becomes more regular as a result of this accommodation. Fehér et al. (2019) also found some evidence that the effect persisted post-interaction. Thus, they argue that accommodation is a mechanism by which non-obligatory, and even redundant, patterns may be retained and regularised in language.

This research does not, however, consider the social identity aspect of accommodation, despite the importance of social factors on accommodation. We expand Fehér et al.'s (2019) paradigm to more explicitly consider how the social aspects of accommodation might impact language use and change. Using this paradigm, as opposed to more traditional lexical/structural alignment paradigms, allows us to gain a broader understanding of how neurotype as both a cognitive characteristic and a social identity impacts the processes of language learning, use, and change.

5.4.4 Research Questions and Hypotheses

We extend the prior work on mixed-neurotype interactions by considering a broader range of neurodiverse dyads. In Experiment 1, we test both mixed and matched pairs of allistic and autistic individuals. Following from those results, in Experiment 2 we consider the linguistic accommodation behaviours of individuals with ADHD[3] – which has not, to our knowledge, been previously studied – in both mixed and matched neurotype pairs. Additionally, we test dyads where both members of neurodivergent, but they do not share a neurotype (i.e. autistic-ADHD or ADHD-autistic), thus asking whether accommodation depends on having the *same* neurotype, or whether it is related to being neurodivergent or having a neurominority identity more broadly. Our central questions here are: (1) to what extent theories such as the Double Empathy Problem can be applied to neurominority groups other than autistic people?, (2) how does neurotype mixing impact linguistic accommodation when the mixed pairs are differently neurodivergent, rather than comprised of a neurodivergent and a neurotypical individual?

Though not the primary goal of our study, our experiments also contribute to the literature on accommodation in autistic people by testing autistic adults and a linguistic phenomena that has not (to our knowledge) previously been tested. We predict that autistic people will accommodate, however this will be to a lesser extent in mixed neurotype pairs than matched neurotype pairs. Further, Experiment 2 contributes, as far as we are aware, the first experiemental investigation of linguistic accommodation in individuals with ADHD. Finally, these experiments give insight into the process of language learning – specifically of an optional morpheme – in neurodivergent individuals outside of a deficit-based approach.

3. We use person-first language to describe individuals with ADHD as that was the preferred choice of our participants when surveyed.

5.5 Experiment 1: The impact of neurotype mixing in allistic and autistic participants on linguistic accommodation

5.5.1 Design and Materials

Participants

243 participants completed this pre-registered study[4] and were recruited via Prolific[5]. Participants were required to indicate their consent by button press. Participants were self-reported native speakers of English and 18 years or older.

Participants were split first by neurotype. Participants were allocated to their group (autistic or allistic) based on two measures: Autism Quotient 10 (AQ-10) (Allison et al., 2012) scores and self-report of autistic identity. The AQ-10 is a short self-report measure of autistic traits. Participants in the autistic group all reported a diagnosis or identification as autistic and scored AQ-10 $\geq$ 6 (the cut-off score for referral for diagnosis on the National Health Service (NHS) in the UK (NICE, 2021)). The allistic group did not report a diagnosis and did not identify as autistic, and scored AQ-10 $\leq$ 3. We note that for both groups, we did *not* ask about any other neurodivergent status; thus, our allistic participants were potentially neurodivergent in other ways, and our autistic participants may have been multiply-neurodivergent. The neurotype groups were subsequently split into two conditions as described in Section 5.5.1.

For both groups, we initially recruited from an existing pool of participants from an earlier study, using already gathered AQ-10 scores and diagnostic status to determine who to invite. However, not all eligible participants participated in this second study, and some were excluded per the criteria outlined below. As a result, we conducted further pre-screening in a separate study[6] which measured reported diagnosis status and the AQ-10. Participants who met the criteria outlined above for each group were then invited to complete the main study. A total of 423 participants completed the pre-screening study.

Materials

The stimuli consisted of a simple artificial language (6 nouns, 1 verb, a plural marker and a singular marker) and accompanying pictures (showing each noun by itself or in a pair, either moving or not). The vocabulary and images were the same as Fehér et al. (2019), with the exception of the removal of 1 verb from the set to reduce the length of the study. The language itself was intended to be semantically transparent to aid learning, e.g., a pig is labelled ‘oinko’, and the verb for bounce is ‘boingla’. There were a total of 12 distinct pictured scenarios (6 animals x 1 verb x 2 numbers). The language was ordered V(erb)-S(ubject)-m(arker)

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4. The pre-registration can be found here: https://aspredicted.org/5tf3-k74q.pdf
5. This study has been granted ethical approval by the University of Edinburgh PPLS Ethics Committee (reference number 267-2223/2)
6. This study was granted ethical approval by the University of Edinburgh PPLS Ethics Committee (reference number 398-2223/1)

Throughout training, participants were shown the plural marker on 100% of applicable trials, meaning that their input for the plural marker was categorical. However, the singular marker was only present on 33% of applicable trials, meaning that their input was variable.

Procedure

The first phase of the study was **noun training**. In this phase, participants are shown the noun and its accompanying picture, and then asked to select the word that corresponds with the picture. Participants were given feedback on whether they had correctly selected the right noun (6 trials per noun, randomly ordered by participant).

Participants then completed **noun testing** in which they were asked to select, from a set of buttons with all noun labels, the appropriate label for a given picture. Participants were again given feedback on whether they had correctly selected the right noun (6 trials, 1 per noun, randomly ordered by participant).

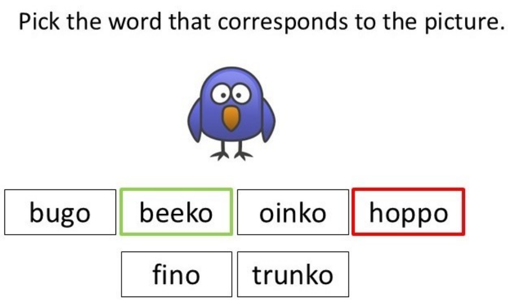
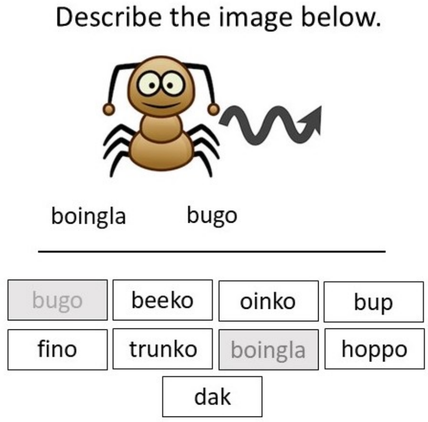


Figure 5.1: Example of a noun training trial.

Participants then entered the **sentence training** phase. First, they were exposed to a sentence (see 5.2a). Then, they were asked to re-create the sentence that they just saw by button press (see 5.2b). They were shown sentences in the artificial language in six blocks of 12 sentences (for a total of 72 sentences) with their accompanying pictures; the order of the sentences within each block was randomised for each participant. In each block of trials, participants were shown 6 plural scenarios, each marked with a plural marker. The other 6 scenarios were singular, 4 of which were unmarked, and 2 of which were marked. This resulted in 100% exposure to the plural marker, and only 33% exposure to the singular marker, throughout training. The 6 blocks were balanced such that no particular noun was associated more strongly than any other with being marked or unmarked in the singular.

The next phase was **recall test one**. Participants were shown all 12 possible scenarios. For each, they were asked to select words in order to create a sentence that described the given picture.

(a) Example of the first half of a sentence training trial (exposure).



(b) Example of the second half of a sentence training trial (reinforcement).

Figure 5.2: Examples of sentence training trials.

After the first recall test, participants were told that they would be matched with another participant in the study in order to play a short game with them using the language. In fact, this 'partner' was a pre-programmed agent. Participants were asked to give a brief description of themselves (excluding any identifying information), and were in turn given a brief description of their partner.

This **partner description** formed the key manipulation of the study, which was to examine whether accommodation levels differed based on whether participants were interacting with someone who matched their neurotype or not. The description provided mirrored the guidance given to participants for creating their own description ('...please type a short message that greets them, describes two things that you like to do, and then something that is important to you.'). First, two hobbies were described ('I like to cook and listen to music'; 'I like to go running and watch movies'). This was followed by either disclosure of autism status ('One thing that is important to me is that I am autistic') or no diagnosis disclosure ('One thing that is important to me is my pets'). The pair of hobbies was chosen randomly per participant, whilst the disclosure was controlled to form the four conditions: ALL-AUT (allistic participants told the partner is autistic); ALL-ALL(allistic participants not given a diagnosis disclosure); AUT-AUT (autistic participants told the partner is autistic; and AUT-ALL (autistic participants not given a diagnosis disclosure). Thus, there were two conditions in which neurotype was matched, and two in which neurotype was mixed.

Participants then began the **director-matcher** phase (see Figure 5.4), in which they and their 'partner' took turns in a director-matcher game. The participant first acted as director. They were shown a picture, and were asked to click the words to make a sentence describing it. They were told that their partner would then attempt to pick the correct picture from their description. The participant was given feedback

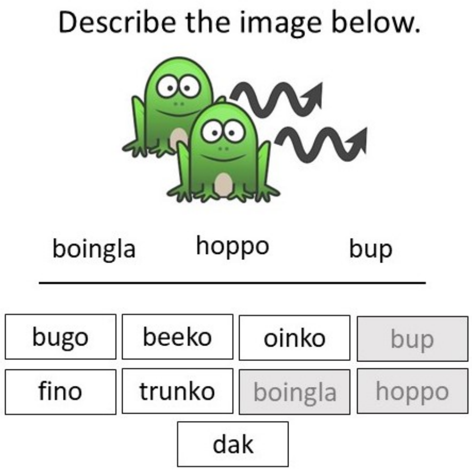
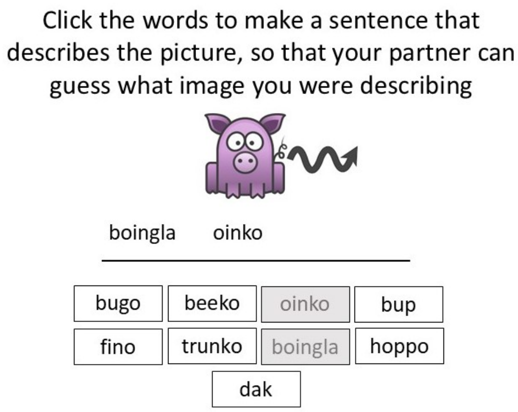


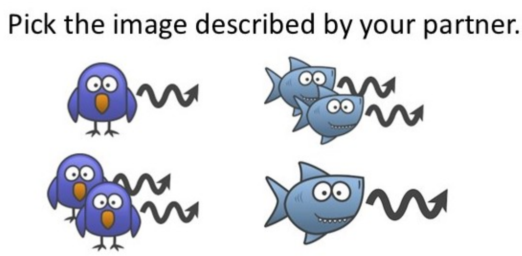
Figure 5.3: Example of a sentence testing trial.

as to whether their partner was able to do this successfully (i.e., whether the sentence provided was correct). Then, the participant acted as matcher. They were shown a the sentence generated by their partner, and were asked to select the image that corresponds to it from a set of 4 images. They were given feedback on whether they selected the correct image.

Crucially, during the **director-matcher** phase, the pre-programmed partner produced 100% plural **and** singular marking, in contrast with the input from the training phases. Accommodation is indicated by an increase in participants' use of the singular marker compared to the first recall test. There were two blocks of director-matcher trials, with each block consisting of 12 trials.



(a) Example of a directing trial.



(b) Example of a matching trial.

Figure 5.4: Examples of director-matcher trials.

After the director-matcher phase, participants undertook **recall test two**, which was identical to the first recall test.

Finally, participants were asked a set of questions about their partner and their own behaviour, e.g., did the participant find their partner helpful? This included a free-text field for participants to give any further feedback about their partner. Participants were then given a set of language background questions. They were then asked a multiple choice question about what features they remember their partner disclosing before the director-match; the key option of interest was whether participants (in)correctly identified that their partner was autistic. Participants were finally asked whether they believed their partner to be a person, and when the manipulation is revealed, whether they believed the manipulation.

Exclusion Criteria

We excluded participants whose performance indicated insufficient learning of the novel language, specifically those with an error rate of $\geq 20\%$ on the noun test, used the plural $< 90\%$ of the time in the first recall test, or whose productions in the first recall test were ill-formed (i.e. missing a verb or a noun) $\geq 20\%$ of the time. We excluded any remaining trials which were not well-formed from the overall analysis. After exclusions, 161 participants were included (40 participants in ALL-ALL match, 40 in AUT-AUT match, 40 in AUT-ALL mix and 41 in ALL-AUT). The final gender split was 87 female, 64 male (including self-disclosed 1 transgender man), and 10 non-binary/other (including 1 participant who did not disclose their gender). The mean age for the autistic group was 35.99 years (SD = 11.12), whilst for the allistic group it was 37.87 years (SD = 14.31).

Our pre-registration also noted that we would exclude participants who correctly identified that the ‘partner’ was a computer agent, rather than another person. However, we found that most participants – especially those who formed our autistic group – answered that they didn’t think that the computer was a ‘real person’ (ALL-ALL 25 no, 17 yes; ALL-AUT 45 no, 22 yes; AUT-ALL 45 no, 17 yes; AUT-AUT 44 yes, 14 no).

This is possibly explained by the fact that the question was asked at all; indeed, the introduction of the suggestion that the partner may not have been another person could have led participants to realise that it had not been a person after the task. Despite participants’ answers to these questions, accommodation was still present in varying degrees dependent on neurotype disclosure (see Section 5.5.3).

5.5.2 Analyses

In our pre-registration, we stated that we would conduct analysis using binomial generalised linear mixed models with the lme4 package (Bates et al., 2015). However, due to the large degree of variance within the models and the behaviour of participants, it was determined that a Bayesian regression approach would better suit the data. As such, the analysis presented below was conducted using Stan and brms (Bürkner, 2017, 2018) to fit Bayesian linear regression models with a Bernoulli likelihood and a logit function. We conducted prior predictive checks, and determined that weakly regularising priors generated plausible data.

Instead of using typical contrasts for our model, we specified the model using indexing, suppressing the intercept using 0 + syntax. As such, each coefficient directly represents the model estimate for that specific condition, rather than being expressed relative to a baseline or a grand mean. This approach has the advantage of ensuring that there is equal uncertainty distribution across all levels of the predictors, but still allows the calculation of all of the desired contrasts between predictors (McElreath, 2020). As such, the model was specified as Singular Marker $\sim$ 0 + Phase:Neurotype:Condition + (0 + Phase$|$Subject).

After fitting the model, we extracted the posterior draws of the fixed regression coefficients. Then, to calculate differences between our effects of interests, we calculated the posterior difference between the relevant condition estimates; for instance, calculating β Recall Test One:Autistic – β Recall Test Two:Allistic would indicate the difference between autistic and allistic usage of the singular marker in the first recall test. Where necessary, we averaged across coefficients before calculating posterior differences. For example, for comparing the overall difference between Recall Test One and Directing, irrespective of neurotype and condition, we would average first across all of the estimates of Recall Test One, and then of Directing, and compute the difference between them. We quantified uncertainty with 95% and 80% posterior Credible Intervals (CrI) using the posterior package (Bürkner et al., 2024). We use more than one probability level to calculate the Credible Intervals in order to gain a more fine-grained understanding of our model's estimates. The model converged, with all Rhats = 1.00. Posterior predictive checks indicated a good model fit to the data. All results are given in log-odds.

5.5.3 Results

Figure 5.5 visualises the raw data. The model's posteriors are summarised in Table 5.1, and visualised in Figure 5.6.

First, we consider the overall differences between the different phases, to establish whether our overall result pattern concurs with Fehér et al. (2019). In their experiment they found that in the first recall test (before interaction), participants regularise by reducing their use of the singular marker. In the director-matcher phase (during interaction), participants increased their use of the marker significantly, to match the partner who was trained on a categorical version of the singular marker. Finally, in recall two (after interaction), Fehér et al. (2019) found some evidence of retention of changes introduced during the interaction, though there was a reduction compared to the immediate interaction phase.

We compared singular marker usage across the phases by computing the difference between the average of coefficients for each phase, summarised in Table 5.2. Across CrIs at both given levels of probability, there is a clear increase in the use of singular marking in Recall One compared to the directing phase (95% CrI: [2.39, 3.39]), in line both with Fehér et al.'s (2019) results and the hypothesis that, overall, variably-trained participants would accommodate to a partner who uses a marker categorically. As in Fehér et al. (2019), the negative estimate for the difference between Directing and Recall Two (95% CrI: [-1.37, -0.22] indicates that participants do reduce their use of the singular marker after interaction. However, importantly for the hypothesis that accommodation can lead to lasting

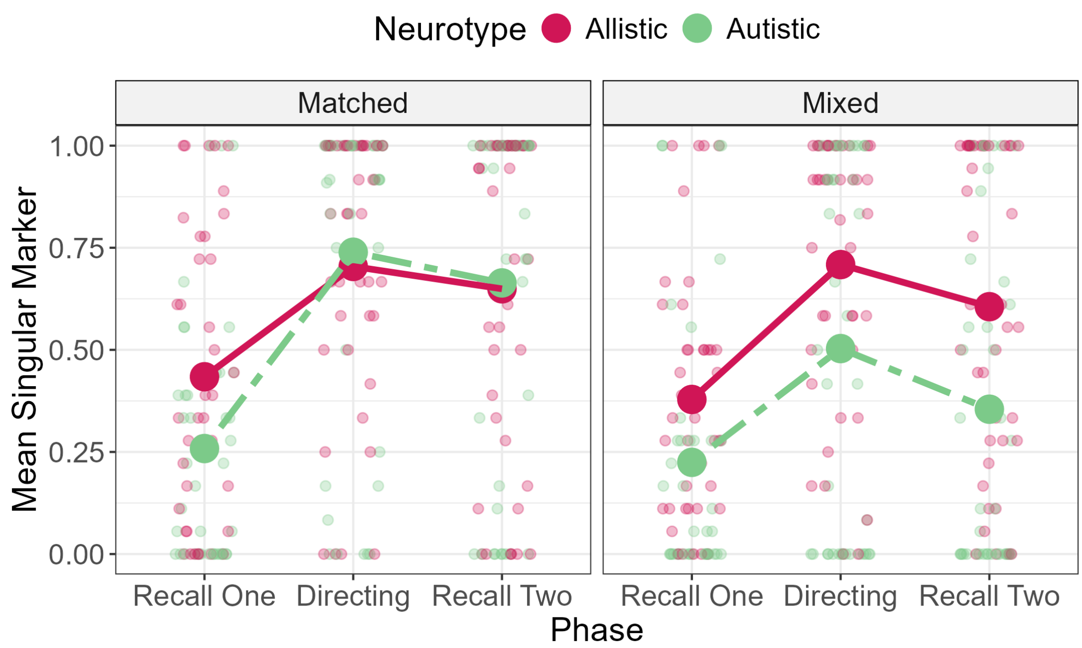


Figure 5.5: Mean of singular marker use for autistic and allistic participants in Experiment 1 across all matching/mixing conditions.

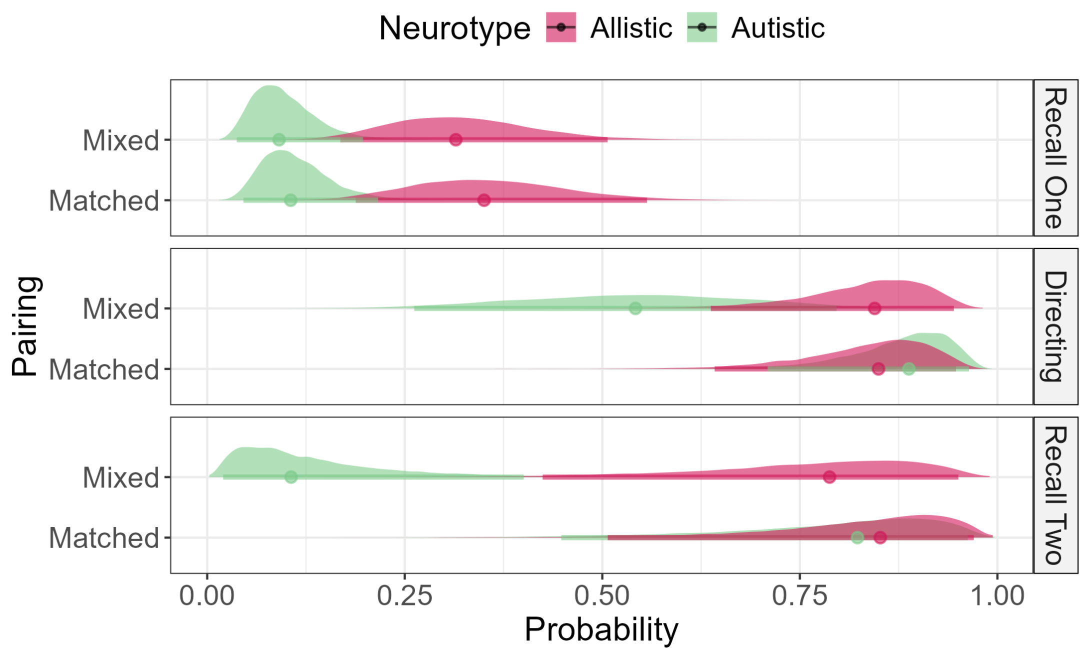


Figure 5.6: Posterior distributions of the model estimates for the effect of neurotype, phase, and condition in probability space. The shaded areas represent the 95% CrI.

change, we see that compared to Recall One, there is a large increase in the log-odds of using the singular marker in Recall Two (95% CrI: [1.38, 2.78]), suggesting that participants have increased

Parameter	Posterior Mean	95% CrI (Lower)	95% CrI (Upper)
Recall One:Matched:Allistic	-0.62	-1.46	0.23
Directing:Matched:Allistic	1.73	0.58	2.89
Recall Two:Matched:Allistic	1.75	0.03	3.48
Recall One:Mixed:Allistic	-0.78	-1.60	0.03
Directing:Mixed:Allistic	1.70	0.56	2.84
Recall Two:Mixed:Allistic	1.31	-0.30	2.96
Recall One:Matched:Autistic	-2.14	-3.03	-1.29
Directing:Matched:Autistic	2.07	0.89	3.29
Recall Two:Matched:Autistic	1.53	-0.21	3.24
Recall One:Mixed:Autistic	-2.31	-3.25	-1.40
Directing:Mixed:Autistic	0.17	-1.04	1.36
Recall Two:Mixed:Autistic	-2.13	-3.88	-0.40

Table 5.1: Posterior means and 95% Credible Intervals for the fixed effects in log-odds space

their use of the singular marker after interaction compared to initial training. This result indicates that accommodation could contribute to linguistic regularisation over time, particularly with repeated interactions. As none of the 95% CrI spans discussed above contain 0, these effects are estimated with a high degree of certainty.

Comparison		**95% CrI**	**80% CrI**
Directing – Recall One	Lower	2.39	2.55
	Upper	3.39	3.21
Recall Two – Directing	Lower	-1.37	-1.17
	Upper	-0.22	-0.43
Recall Two – Recall One	Lower	1.38	1.63
	Upper	2.78	2.53

Table 5.2: Comparisons between phases, computed as the difference between the average of coefficients for each phase.

Turning to the overall effect of neurotype, without considering the interaction with condition, we considered the difference in posterior estimates between the average of the autistic and average of the allistic posteriors for each phase (see Table 5.3). First, there is a negative log-odds estimate for the comparison between autistic and allistic participants in the first recall phase, such that autistic participants are less likely to use the singular marker in Recall Test One compared to allistic participants (95% CrI: [-2.38, -0.67]). This indicates that autistic participants are regularising the marker more than allistic participants. The estimate for the direction of effect in the Directing phase is less certain. Both the 95% and 80% CrIs include 0, although most of the probability mass lies in the negative direction (95% CrI: [-1.77, 0.58]). In other words, whilst there may be a negative trend, there is no convincing evidence that the two neurotypes use singular marking to differing extents in the Directing phase. Finally, at both CrIs, the model is confident that there is a negative effect of singular marker usage in the autistic group compared to the allistic group in Recall Test Two (95% CrI: [-3.55, -0.16]), such that autistic people are less likely to use the marker in this phase.

Comparison		95% CrI	80% CrI
Autistic R1 – Allistic R1	Lower	-2.38	-2.07
	Upper	-0.67	-0.97
Autistic Directing – Allistic Directing	Lower	-1.77	-1.34
	Upper	0.58	0.17
Autistic R2 – Allistic R2	Lower	-3.55	-2.94
	Upper	-0.16	-0.74

Table 5.3: Comparisons between neurotypes within each phase, computed as the difference between the average of coefficients for each neurotype.

As well as the absolute difference between neurotypes for each phase, we were also interested in comparing the magnitude of *change* between phases across the two neurotypes, particularly in the change between recall one and directing as this is most relevant to the question of whether autistic people accommodate. To do so, we calculated the difference in scores for each phase separately for both groups, and then compared the differences (see Table 5.4). For the difference between Directing and Recall One, the estimates suggest that there may be a *greater* difference in singular marker usage by autistic than allistic people. In other words, they may in fact be accommodating *more*. There is some uncertainty in this effect; whilst the 80% CrI only spans positive intervals, the 95% CrI contains a small amount of negative probability mass (95% CrI: [-0.05, 1.93]). Turning to the difference between Recall Two and Directing, however, we can see that the model confidently estimates a negative effect for both CrI probability levels (95% CrI: [-3.43, -0.09]), suggesting that autistic people reduce their use of the singular marker from Directing to Recall Test Two more than allistic people do. Finally, for the change between Recall Test Two and Recall Test One, the model displays a significant degree of uncertainty, assigning a good degree of probability mass to both directions of the effect (95% CrI: [-1.72, 1.09]). This suggests that there is no difference between the two groups in the change between Recall Test One and Recall Test Two; in other words, despite differences in the initial Recall Test and Directing, both groups end up with similar levels of the overall increase in the likelihood of using the singular marker from the beginning to the end of the experiment.

Turning to condition, we examined whether condition (mixed or matched-neurotype) impacted the change in singular marker usage between phases by calculating the difference between the average of the matched and mixed posterior estimates for each phase. The results are summarised in Table 5.5. For the difference between Directing and Recall Two, the 80% CriI spans entirely negative values, suggesting that in mixed pairs, participants are less likely to accommodate compared to those in matched pairs. However, the 95% CrI ([-1.81, 0.18]) does include both positive and negative values

Comparison		95% CrI	80% CrI
Autistic D-R1 – Allistic D-R1	Lower	-0.05	0.30
	Upper	1.93	1.57
Autistic R2-D – Allistic R2-D	Lower	-2.43	-2.00
	Upper	-0.09	-0.50
Autistic R2-R1 – Allistic R2-R1	Lower	-1.72	-1.24
	Upper	1.09	0.59

Table 5.4: Comparison of differences between phases using the difference between the average of all coefficients of each phase, with 95% and 80% credible intervals.

(though most of the probability mass is negative), indicating uncertainty about this effect. Similarly for the difference between Recall Two and Directing, the 80% CrI spans only negative values, indicating that participants in the mixed condition reduce their use of the singular marker after interaction more than those in the matched condition. Again, however, the 95% CrI contains a small amount of positive probability mass ([-2.26, 0.05]), meaning that there is some uncertainty about the direction of this effect. Finally, for the difference between Recall Two and Recall One, the CrIs at both probability level are fully negative (95% CrI: [-3.35, -0.49]), indicating that participants in mixed pairs are less likely than those in matched pairs to continue using the singular marker after interaction.

Comparison		95% CrI	80% CrI
Mixed D-R1 – Matched D-R1	Lower	-1.81	-1.45
	Upper	0.18	-0.15
Mixed R2-D – Matched R2-D	Lower	-2.26	-1.84
	Upper	0.05	-0.33
Mixed R2-R1 – Matched R2-R1	Lower	-3.35	-2.81
	Upper	-0.49	-0.97

Table 5.5: Comparisons of the mixed and matched conditions across different phases, showing confidence intervals at different levels.

Next, we examine the three-way relationship between neurotype, condition, and phase. Again, we look at the change between phases, rather than the absolute value of each phase, as this gives us insight into the accommodation behaviours and potential linguistic change. The comparisons are summarised in Table 5.6 for the mixed condition, and Table 5.7 for the matched condition.

For the difference between autistic participants in mixed pairs and allistic participants in mixed pairs for the change between Recall One and Directing, the CrIs at both levels of probability average at near-zero (95% CrI: [-1.41, 1.38]). This suggests that both direction of the effect are plausible and, thus, that we do not have clear evidence that there is a difference between the neurotypes in mixed pairs in terms of how much they accommodate during the Directing phase. On the other hand, for the difference

Comparison		95% CrI	80% CrI
Autistic Mixed D-R1 – Allistic Mixed D-R1	Lower	-1.41	-0.90
	Upper	1.38	0.88
Autistic Mixed R2-D – Allistic Mixed R2-D	Lower	-3.58	-2.98
	Upper	-0.33	-0.87
Autistic Mixed R2-R1 – Allistic Mixed R2-R1	Lower	-3.93	-3.23
	Upper	0.02	-0.65

Table 5.6: Comparisons of mixed autistic vs. allistic conditions across different phases, showing confidence intervals at different levels.

between Recall Two and Directing, the 95% CrIs at both probability levels are fully negative (95% CrI: [-3.58, -0.33]). This indicates that autistic participants in the mixed condition are less likely than allistic participants in the mixed condition to retain the singular marker after interaction. The 80% CrI is fully negative for the difference between autistic and allistic participants in the mixed condition in the change between Recall One and Recall Two, but the 95% CrI has a small amount of positive probability mass (95% CrI: [-3.93, 0.02]). This suggests, with a degree of uncertainty, that autistic participants in mixed pairs see less of an increase from Recall 1 to 2 in their use of the singular marker, thus reducing how much their grammar has changed.

Comparison		95% CrI	80% CrI
Autistic Matched D-R1 – Allistic Matched D-R1	Lower	0.49	0.95
	Upper	3.26	2.77
Autistic Matched R2-D – Allistic Matched R2-D	Lower	-2.22	-1.63
	Upper	1.06	0.48
Autistic Matched R2-R1 – Allistic Matched R2-R1	Lower	-0.71	0.00
	Upper	3.27	2.57

Table 5.7: Comparisons of matched autistic vs. allistic conditions across different phases, showing confidence intervals at different levels.

With respect to the differences between Directing and Recall One for autistic and allistic participants in the matched condition, the CrIs at both probability levels span only positive values (95% CrI: [0.49, 3.26]). This indicates that the effect of matching is stronger for autistic participants than allistic participants, such that they accommodate more in matched pairs than allistic participants do. For the difference between Recall Two and Directing, a good deal of uncertainty in the estimates is seen across both the CrIs (95% CrI: [-2.22, 1.06]); thus, we do not have clear evidence for a difference between autistic and allistic matched pairs here. Finally, for the difference between Recall Two and Directing, the 95% includes 0 (95% CrI: [-0.71, 3.27]). However, most of the probability mass is positive, and the

80% CrI spans only positive values, though the lower bound includes 0 (80% CrI: [0.00, 2.57]). This provides some weak evidence of a positive effect whereby the autistic matched pairs use more singular marking in Recall Two than in Recall One compared to allistic matched pairs. However, the evidence is not strong enough to be conclusive.

5.5.4 Discussion

In Experiment 1, we examined how neurotype mixing impacts linguistic accommodation and regularisation in pairs comprised of both autistic and allistic individuals. We used Fehér et al.'s (2019) methodology, which involves teaching participants a miniature artificial language with an optional grammatical morpheme for singular nouns, and tested whether participants accommodate to a partner who uses that morpheme categorically. Our results replicate the general finding of Fehér et al. (2019) that participants who were trained on a variable singular marker were willing to accommodate towards a partner who uses that marker categorically. Additionally, we found that whilst there is a decrease in the use of the singular marker after interaction, it remains higher than it was before interaction, pointing towards potential longer-lasting effects of accommodation on language change.

Turning to our predictions with respect to neurotype and neurotype mixing, recall that our first hypothesis was that both autistic and allistic adults would accommodate in neurotype-matched pairs. Previous literature has provided conflicting results regarding accommodation by autistic people, with some studies finding that autistic people accommodate substantially less than allistic people. However, recent theories of autistic communicative success have proposed that at least some communicative difficulties experienced by autistic people are the result of mixed neurotype interactions.

Our statistical model suggests that autistic people fact accommodate *more* than allistic participants in matched-neurotype pairs. This could be related to the fact that our model predicts autistic people use less of the optional marker before interaction than allistic participants. Consider the pattern of the raw data visualised in Figure 5.5; we can see that autistic participants in matched pairs start off at a lower baseline in Recall One than allistic participants, but reach around the same average singular marker usage in the Directing phase. They have had to, relatively speaking, alter their linguistic behaviour *more* to reach this point than allistic people. The finding that autistic participants regularised more after initial training was unexpected; Fletcher, Rabaglati, & Culbertson (2024) found that (in the absence of any interacting social pressure). To summarise, however, our main result here is that autistic people do accommodate in pairs where their conversational partner has disclosed a matching neurotype, and even to a greater extent than allistic people did.

Our second hypothesis was that in neurotype-*mixed* pairs, participants of both neurotypes would accommodate less than they do in neurotype-matched pairs. Following on from this, we also hypothesised that mixing neurotypes would reduce any longer-term retention of an accommodated variant. Our model suggests a possible negative effect of mixing on the change between Recall One and Directing and Directing and Recall Two, and more confidently predicts a negative effect in the difference between Recall Two and Recall One. This suggests that, even though mixed neurotype pairs accommodate in interaction—possibly to a lesser degree than in matched pairs—the products of that accommodation may be less likely to be retained on a longer time-scale. The negative impact of mixing, however, is stronger in the autistic than the allistic group both in the difference between Recall Two and Directing and Recall Two and Recall One, though there does not appear to be a difference in initial accommodation.

The fact that autistic people appear to be more sensitive to neurotype mixing and matching in their linguistic behaviours is contrary to our prediction that autistic and allistic participants would be equally affected by neurotype mixing, as would be expected under an account based purely on the Double Empathy Problem (D. Milton, 2012b). It is, however, in line with recent work on rapport in mixed-neurotype interactions by Foster et al. (2025), who found an effect of neurotype mixing in groups in autistic people, but not allistic people. Methodological limitations may contribute to the disparity between the two groups. First, for the autistic group in the mixed condition, no specific neurotype (e.g., allistic) was declared; on the other hand, for the allistic group in mixed conditions, a specific neurotype (autistic) was declared. Conversely, for matched conditions, it was the autistic group who saw an explicit declaration of neurotype, and the allistic group for whom it was implicit. It is possible that this difference in when identities were explicitly disclosed impacted both our autistic and allistic participants, as Foster et al. (2025) also suggest. For instance, autistic people often prefer autistic-autistic interactions than interactions with allistic people, generally finding interaction easier with other autistic people and gaining benefits from shared autistic community (see Watts et al., 2024 for a recent review). As a result, the explicit neurotype match may have encouraged accommodation behaviour by our autistic participants. On the other hand, previous research has indicated that allistic people react more favourably to autistic people when they are aware of diagnostic status than when they are not, and indeed, that wrongly labelling allistic people as autistic increases ratings, whilst correctly labelling them as non-autistic does not (Sasson & Morrison, 2019). On the other hand, diagnostic disclosure does not impact the first impressions of individuals by autistic people (DeBrabander et al., 2019). Thus, the difference between autistic and allistic participants in mixed and matched interactions may be less evident in more naturalistic settings where diagnostic status is not explicitly outlined.

5.6 Experiment 2: Neurominority group mixing and linguistic accommodation

Experiment 1 demonstrates that neurotype mixing can indeed have an impact on linguistic accommodation and regularisation in autistic and allistic participants. However, these results only consider two possible neurotypes, and they do not consider what happens in more neurodiverse settings (i.e. a mix of neurodivergent individuals of different neurotypes, as well as neurotypical individuals). Notably, existing research on the implications of mixed neurotype interactions is also limited to autistic-allistic pairings.

Using the same methodology as Experiment 1, Experiment 2 investigates the impact of neurotype mixing both in a second neurodivergent group (adults with ADHD), and in pairs where both participants are from neurominority groups, but do not share a common neurotype. Whilst we do not have strong prior knowledge on to what extent people with ADHD typically accommodate, we expected that, in line with our results with autistic individuals, neurotype mixing would reduce accommodation, but that this effect may be less strong when the mixed neurotypes are both neurodivergent. In particular, with respect to ADHD and autism, the overlapping characteristics of these neurotypes could help facilitate accommodation. We then compared these new conditions to the data from Experiment 1, to provide a more complete picture of the impact of neurotype mixing across neurodiverse groups on linguistic accommodation.

5.6.1 Design and Materials

Participants

186 participants completed the full study and were recruited via Prolific[7]. As in Experiment 1, participants indicated consent by button press, and were self-reported native speakers of English and 18 years or older.

Similarly to Experiment 1, participants were recruited first by neurotype group, and then split into experimental conditions. In order to allocate participants to neurotype groups, they first undertook a pre-screening questionnaire. Participants were asked to indicate whether they were diagnosed with/identified as autistic and/or ADHD. All participants then undertook both the AQ-10 and Part A of the Adult ADHD Self-Report Scale (ASRS) (R. C. Kessler et al., 2007). As described in Section 5.5.1, the former is a short self-report measure of autistic traits. The ASRS is a short (6 question) self-report measure of ADHD traits, which has been shown to reliably distinguish an individual with ADHD from one without (Ustun et al., 2017; R. C. Kessler et al., 2007). The autistic group identified/were diagnosed as autistic, scored AQ-10 ≥ 6 and ASRS < 4. The ADHD group identified/were diagnosed as ADHD, scored AQ-10 ≤ 3 and ASRS ≥ 4. Participants who identified as having ADHD additionally completed a short, likert-scale type survey on how their preferences in describing people with ADHD[8]. As per their reported preferences in this questionnaire, we use person-first language to describe people with ADHD in this paper.

In total, 2009 participants who reported to Prolific that they had a diagnosis of ADHD and 350 participants who reported a diagnosis/identity as autistic undertook the pre-screening questionnaire. 87 autistic participants were eligible and invited to complete the full study. 201 participants with ADHD were eligible to be invited to complete the full study. However, recruiting participants with ADHD for the full study proved challenging, potentially due to the cognitive and attentional demands of the task. The

7. This study was granted ethical approval by the University of Edinburgh PPLS Ethics Committee (reference number 392-2324/1)
8. Due to a technical issue, some participants with ADHD were not administered this questionnaire. This did not impact their overall eligibility for the study.

study's 50-minute duration may have posed a barrier, as sustained attention can be more difficult for individuals with ADHD (see, e.g., Marchetta et al., 2008; Tucha et al., 2017; Salomone et al., 2020; Fuermaier et al., 2022), and individuals may use compensatory strategies including the avoidance of difficult tasks (Kysow et al., 2017). Whilst we aimed to include 40 participants per condition as in Experiment 1, the difficulty in recruitment combined with filtering as per the exclusion criteria outlined in Section 5.5.1 meant it was not logistically or financially feasible to include 40 participants in each condition within the study's resource constraints.

Materials

The materials used were the same as in Experiment 1 (see Section 5.5.1).

Procedure

The phases of the procedure were the same as in Experiment 1, outlined in Section 5.5.1. The key difference was in the **partner description**. Specifically, participants with ADHD were either informed their partner identified as having ADHD (ADHD-ADHD), being autistic (ADHD-AUT), or no disclosure of neurotype was given (ADHD-NT). Autistic participants similarly were informed that their partner identified as having ADHD (AUT-ADHD).

Exclusion Criteria

The exclusion criteria was the same as outlined in Section 5.5.1. After exclusions, 134 participants were included for final analysis (32 ADHD-ADHD, 39 ADHD-AUT, 22 ADHD-NT, 41 AUT-ADHD). The mean age for participants with ADHD was 35 (SD = 8.84), whilst it was 36.7 (SD = 11.12) for autistic participants. 83 participants reported their gender as female, 45 as male, and 6 as non-binary/other (including one agender person).

As in Experiment 1, we originally intended to exclude participants who correctly identified their 'partner' as a non-human agent. Similarly to Experiment 1, we found that many participants answered that they did not think that the partner was a 'real person' (AUT-ADHD 34 no, 18 yes; ADHD-AUT 44 no, 35 yes; ADHD-ADHD 29 no, 14 yes; ADHD-NT 19 no, 11 yes). For similar reasons as in Experiment 1, we did not use this exclusion criteria for our analyses below.

5.6.2 Analyses

Data analysis followed a similar process as described in Section 5.5.2, using Bayesian regression models with a Bernoulli likelihood, and an indexing approach (suppressing the intercept) rather than typical contrasts. Our model contained the data from Experiment 1 as well as 2, to maximise the information available to the model as well as answer our key research questions regarding neurotype mixing in neurotype pairs and its relation to linguistic accommodationx. As not all possible combinations of participant neurotype and partner neurotype were tested (i.e. NT-ADHD was not tested, as our interest was primarily in neurominority identity mixing in Experiment 2), pairing was used as a predictor variable, rather than separate predictors for partner and partner neurotype[9]. Thus, the model was specified as Singular Marker $\sim$ 0 + Phase:Pairing + (0 + Phase|Subject). The model converged, with all Rhats = 1.00. Posterior predictive checks indicated a good model fit to the data. All results are given in log-odds.

5.6.3 Results

The model's posterior estimates are summarised in Table 5.8 and visualised in Figure 5.7.

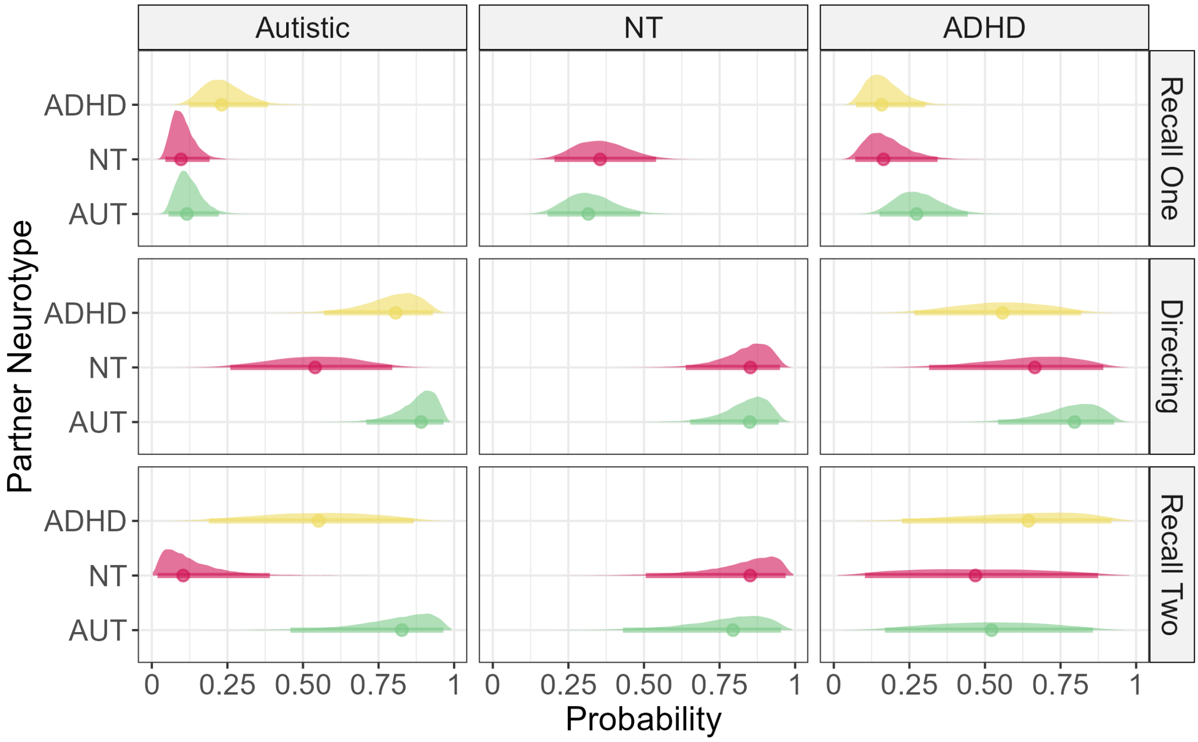


Figure 5.7: Posterior distributions of the model estimates for the effect of neurotype, phase, and condition in probability space. The shaded areas represent the 95% CrI.

9. If the structure Phase:Neurotype:Partner Neurotype was used, the model would attempt to estimate the effect of NT:ADHD, despite no data being available for this pairing. Whilst the inclusion of this estimate did not appear to impact the overall model results – NT-ADHD was correctly estimated with a posterior mean of 0 due to a lack of evidence – we conservatively chose to use pairing instead. This approach ensures that the model only estimates effects for the combinations we actually tested, avoiding unnecessary complexity. The model specified as Phase:Neurotype:Partner Neurotype is available in the supplementary material here: `https://osf.io/u6kp9/overview?view_only=a9c60ff44542414fb104012b43210af9`

Parameter	Posterior Mean	95% CrI (Lower)	95% CrI (Upper)
Recall One:ADHD-ADHD	-1.68	-2.53	-0.83
Directing:ADHD-ADHD	0.24	-1.01	1.50
Recall Two:ADHD-ADHD	0.59	-1.23	2.42
Recall One:ADHD-AUT	-0.98	-1.73	-0.23
Directing:ADHD-AUT	1.36	0.17	2.54
Recall Two:ADHD-AUT	0.09	-1.59	1.79
Recall One:ADHD-NT	-1.62	-2.57	-0.65
Directing:ADHD-NT	0.68	-0.78	2.10
Recall Two:ADHD-NT	-0.12	-2.17	1.94
Recall One:AUT-ADHD	-1.21	-1.97	-0.47
Directing:AUT-ADHD	1.43	0.28	2.58
Recall Two:AUT-ADHD	0.21	-1.46	1.87
Recall One:AUT-AUT	-2.03	-2.83	-1.26
Directing:AUT-AUT	2.10	0.89	3.31
Recall Two:AUT-AUT	1.58	-0.17	3.30
Recall One:AUT-NT	-2.24	-3.07	-1.44
Directing:AUT-NT	0.16	-1.05	1.36
Recall Two:AUT-NT	-2.17	-3.96	-0.45
Recall One:NT-AUT	-0.77	-1.51	-0.05
Directing:NT-AUT	1.74	0.63	2.86
Recall Two:NT-AUT	1.36	-0.28	3.02
Recall One:NT-NT	-0.60	-1.36	0.16
Directing:NT-NT	1.75	0.57	2.94
Recall Two:NT-NT	1.74	0.02	3.44

Table 5.8: Posterior means and 95% Credible Intervals for the fixed effects in log-odds space

5.6.4 Neurominority identity mixing and matching in autistic people

First, we examine the use of singular marking in each phase by autistic people with partners of various neurotypes (including the allistic partners from Experiment 1). Figure 5.8 provides a visualisation of the raw data.

Table 5.9 summarises pairwise comparisons of the estimates of autistic people's use of the singular marking in the Directing and Recall Test Two phases with partners of different neurotypes. First, we consider the Directing phase. Looking at the difference in usage with an autistic partner versus a partner with ADHD, we can see that there is a large degree of uncertainty in the estimates at both probability levels (95% CrI: [-0.73, 2.05]). Whilst more probability mass is positive than negative, there is overall no clear evidence for a difference between the use of the singular marker between these two partner neurotypes. In other words, we can say that in the Directing phase, autistic participants use singular marking to the same extent with partners with ADHD as they do to autistic partners.

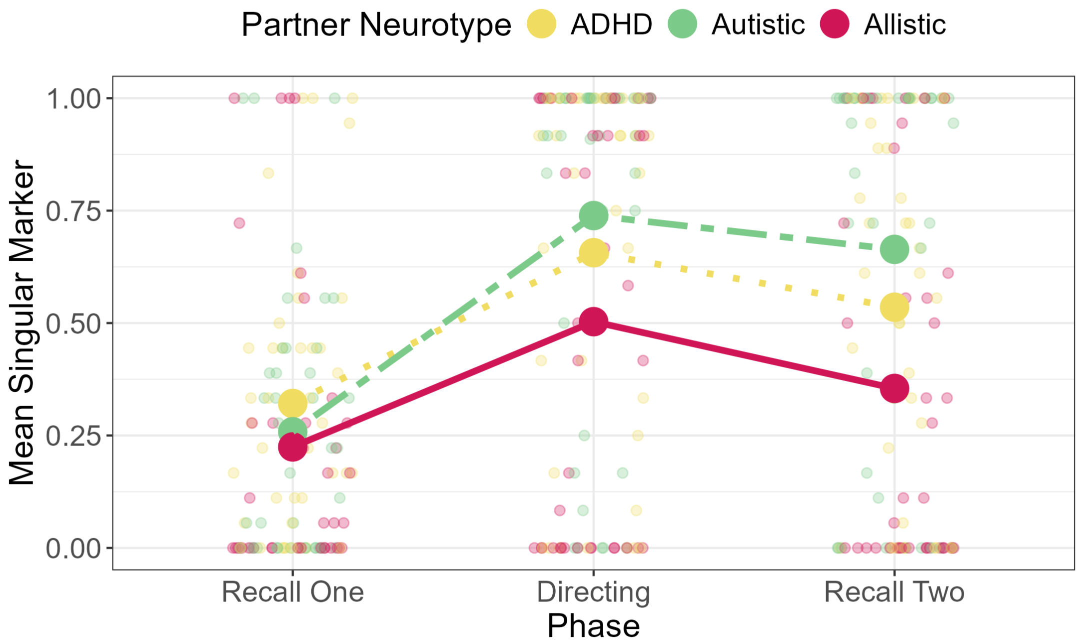


Figure 5.8: Mean of singular marker use for autistic participants across all conditions in Experiment 1 and Experiment 2.

With respect to autistic partners versus neurotypical partners, the CrIs at both probability levels only span positive values (95% CrI: [0.51, 3.38]), therefore confidently indicating that autistic participants use more singular marking in the directing phase with autistic than allistic partners (as was also shown in Section 5.5.3). Considering the difference in singular marker use by autistic participants with neurotypical partners versus partners with ADHD, there is moderate evidence of a negative effect, such that participants are less likely to use singular marking in this phase with neurotypical partners than partners with ADHD. Whilst the 95% CrI contains a small amount of positive probability mass ([-2.66, 0.11]) the 80% ([-2.35, 0.19]) CrI contains only positive values.

Now, we turn to Recall Test Two. Looking again first at the use of singular marking by autistic participants with autistic partners versus partners with ADHD, the 95% and 80% CrIs span both positive and negative values (95% CrI: [-0.63, 3.38]). Whilst there is more probability mass on the positive side, particularly in the 80% CrI (80% CrI: [-0.19, 2.93]), we cannot be confident in a positive effect here, with the model considering both directions of the effect plausible. For autistic partners versus neurotypical partners, the CrIs only span positive values (95% CrI: [1.68, 5.81]). As also shown in Section 5.5.3, this is strong evidence that autistic people use much more singular marking with autistic partners than neurotypical partners in Recall Test Two. Finally, the CrIs at both probability levels for the difference between neurotypical partners and ADHD partners span only negative values (95% CrI: [-4.43, -0.35]), indicating that autistic people use more singular marking with partners with ADHD than neurotypical partners.

Comparison		95% CrI	80% CrI
Directing			
Autistic Partner vs. ADHD Partner	Lower	-0.73	-0.42
	Upper	2.05	1.74
Autistic Partner vs. NT Partner	Lower	0.51	0.83
	Upper	3.38	3.06
NT Partner vs. ADHD Partner	Lower	-2.66	-2.35
	Upper	0.11	-0.19
Recall Two			
Autistic Partner vs. ADHD Partner	Lower	-0.63	-0.19
	Upper	3.38	2.93
Autistic Partner vs. NT Partner	Lower	1.68	2.14
	Upper	5.81	5.36
NT Partner vs. ADHD Partner	Lower	-4.43	-3.96
	Upper	-0.35	-0.79

Table 5.9: Comparison of singular marker usage in the directing phase by autistic participants with different neurotypes, showing confidence intervals at the 95%, 80% and 60% probability levels.

As in Section 5.5.3, we are also interested in the magnitude of change between different phases, and how these relate to the reported neurotype of the autistic participants' partner. Table 5.10 summarises the comparisons across partner neurotypes for the magnitude of change between the phases. For autistic participants with autistic partners compared to partners with ADHD, the CrIs span only positive values (95% CrI: [0.32, 2.64]). This is also the case for autistic participants with autistic partners compared to neurotypical partners (95% CrI: [0.50, 2.96]). In other words, the magnitude of change from Recall Test One to Directing is larger for autistic participants with autistic partners than with either neurotypical partners or partners with ADHD, indicating that autistic participants accommodate more to partners with their own neurotype. Finally, there is no clear evidence for a difference in the magnitude of change between partners with ADHD and neurotypical partners, with CrIs at both probability levels spanning both positive and negative values (95% CrI: [-0.95, 1.41]).

The CrIs for the comparison between autistic partners and partners with ADHD in the change from Directing to Recall Test Two show a good degree of uncertainty in the direction of the effect (95% CrI: [-0.68, 2.09]). In other words, the retention of the singular marking after interaction is similar for autistic participants with either autistic partners or partners with ADHD. On the other hand, the CrIs at both probability levels are fully positive for autistic partners compared to neurotypical partners (95% CrI: [0.38, 3.29]), indicating that autistic participants retain more singular marking with autistic than neurotypical partners. Finally, whilst the 95% CrI ([-0.27, 2.51]) shows some uncertainty, the 80%

Comparison		95% CrI	80% CrI
Directing – Recall One			
Autistic Partner D-R1 – ADHD Partner D-R1	Lower	0.32	0.58
	Upper	2.64	2.41
Autistic Partner D-R1 – NT Partner D-R1	Lower	0.50	0.77
	Upper	2.96	2.69
ADHD Partner D-R1 – NT Partner D–R1	Lower	-0.95	-0.68
	Upper	1.41	1.15
Recall Two – Directing			
Autistic Partner R2-D – ADHD Partner R2-D	Lower	-0.68	-0.37
	Upper	2.09	1.78
Autistic Partner R2-D – NT Partner R2-D	Lower	0.38	0.66
	Upper	3.29	2.95
ADHD Partner R2-D – NT Partner R2-D	Lower	-0.27	0.04
	Upper	2.51	2.18
Recall Two – Recall One			
Autistic Partner R2-R1 – ADHD Partner R2-R1	Lower	0.49	0.86
	Upper	3.90	3.52
Autistic Partner R2-R1 – NT partner R2-R1	Lower	1.73	2.14
	Upper	5.31	4.92
ADHD Partner R2-R1 – NT Partner R2-R1	Lower	-0.40	-0.00
	Upper	3.10	2.68

Table 5.10: Comparison of singular marking usage in the directing phase (R1) by autistic participants across different partner neurotypes, with confidence intervals at the 95%, 80%, and 60% probability levels.

CrI ([0.04, 2.18]) spans only positive values for the difference in retention for autistic participants with partners with ADHD versus neurotypical partners. This means that there is some evidence that autistic participants retain more singular marking with ADHD partners than neurotypical partners, but we cannot be fully certain about the effect.

Finally, we turn to the difference between Recall One and Recall Two, to understand the change in the grammar from initial training. For the difference between autistic partners and ADHD partners, the CrIs at both levels of probability span only positive values (95% CrI: [0.49, 3.90]), indicating that autistic participants increase their use of the singular marker more from the first recall test to the second with autistic partners than partners with ADHD. A similar pattern emerges with the difference between autistic and neurotypical partners, with participants with autistic partners again increasing their use of the singular marker more with autistic partners than neurotypical partners (95% CrI: [1.73, 5.31]). There is, however much less certainty when considering the difference between partners with ADHD and neurotypical partners. The 95% and 80% CrIs contain both positive and negative values, albeit with more positive than negative probability mass. Thus, whilst the trend suggests that the change in grammar is greater with ADHD partners than neurotypical partners, we cannot be certain about this effect.

5.6.5 Neurominority identity mixing and matching in people with ADHD

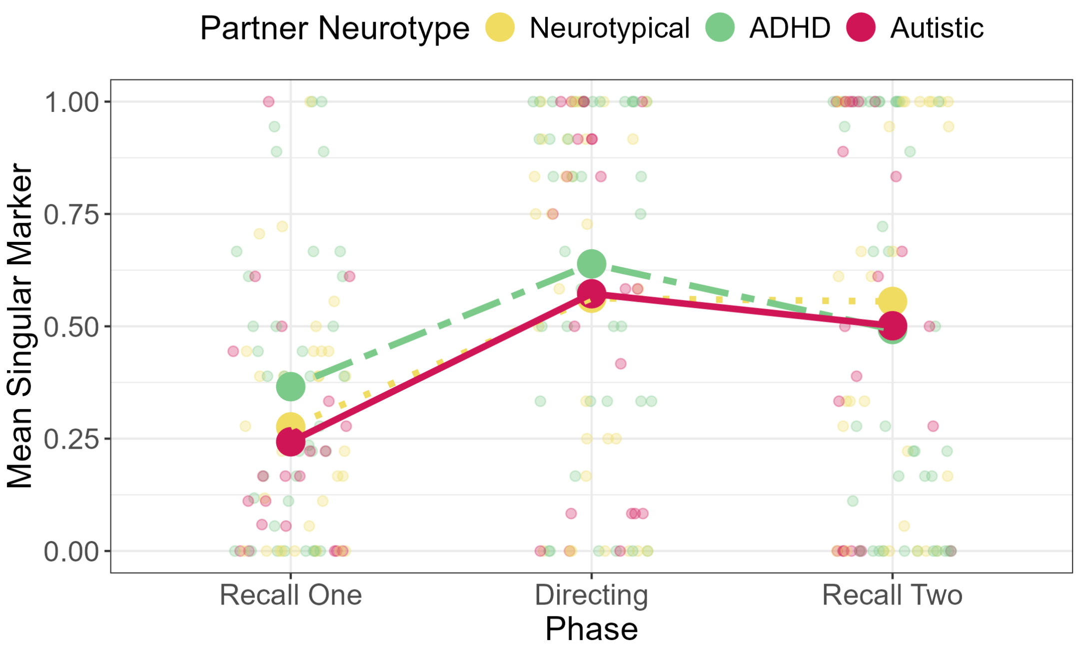


Figure 5.9: Mean of singular marker use for participants with ADHD in Experiment 2.

First, we consider the use of the singular marker in Recall Test One by indivduals with ADHD. As shown in Section 5.5.3, autistic participants used less singular marking in Recall One than allistic participants; we tested whether this also applied to participants with ADHD. Table 5.11 summarises the pairwise comparisons of the use of singular marking by each neurotype in Recall Test One (note that the use of the marker is averaged across all partner neurotype conditions, as this manipulation is not introduced at this stage). The 95% CrI for autistic (95% CrI: [-1.83, -0.45]) participants compared to neurotypical participants spans only negative values. Though the ADHD 95% CrI's lower bound does include 0 (95% CrI: [-1.46, -0.00]), the 80% CrI is fully negative (80% CrI: [-1.22, -0.27]). As such, our model suggests neurodivergent participants across the board use less singular marking in the first recall test than our neurotypical participants. Turning to the difference between autistic participants and participants with ADHD, both the 95% and 80% CrIs span both positive and negative values, though (particularly in the 80% CrI) most of the probability mass is positive (80% CrI: [-0.84, 0.02]). Thus, whilst it is possible that autistic participants use less singular marking than participants with ADHD in the first recall test, the evidence is too weak to be confident.

Comparison		95% CrI	80% CrI
ADHD vs. NT	Lower	-1.46	-1.22
	Upper	-0.00	-0.27
Autistic vs. ADHD	Lower	-1.08	-0.84
	Upper	0.25	0.02
Autistic vs. NT	Lower	-1.83	-1.60
	Upper	-0.45	-0.69

Table 5.11: Comparison of singular marking usage by different neurotypes in Recall Test One, showing credible intervals (CrI) at the 95% and 80% probability levels.

Table 5.12 summarises the comparisons of singular marker usage by participants with ADHD with different partner neurotypes in the Directing phase and Recall Test Two. Overall, there is no clear evidence that the neurotype of the partner impacted the behaviour of individuals with ADHD in the Directing Phase; the 95% CrIs for ADHD versus autistic partner ([-2.58, 0.32]), ADHD versus neurotypical partner ([-2.06, 1.16]) and neurotypical versus autistic partner ([-2.25, 0.87]) all span both positive and negative values. In Recall Test Two, a similar pattern emerges. There is no clear evidence that partner neurotype impacted the behaviour of participants with ADHD in Recall Test Two. The CrIs at both probability levels for ADHD versus autistic partners (95% CrI: [-1.60, 2.57]), ADHD versus neurotypical partners 95% CrI: [-1.61, 3.04]), and neurotypical versus autistic partners (95% CrI: [0.246, 2.03]) span a wide range of both positive and negative values, indicating that participants with ADHD were equally likely to use the singular marker in Recall Test Two regardless of their partner's neurotype.

Finally, we turn to the magnitude of change between the phases, and how this is impacted by partner neurotype for our participants with ADHD. The comparisons are summarised in Table 5.13. The majority of the CrIs for the comparisons span a wide range of both positive and negative values, indicating that there is no evidence for differences in changes between phases for different partner neurotypes. There are two exceptions; first, for the difference in change between Directing and Recall Test Two, the 95% CrI spans only positive values ([0.21, 3.02]. This suggests that the magnitude of change is greater when participants with ADHD had partners with ADHD, rather than autistic partners, indicating a positive effect of neurotype matching. Second, whilst there is some uncertainty in the 95% CrI, the 80% CrI for the difference in the magnitude of change between Recall Test One and Recall Test Two between autistic and neurotypical partners is fully positive (80% CrI: 1.91, 1.07]). This provides moderate evidence for a positive effect, such that people with ADHD increase their singular marker use from the beginning to the end of the experiment more when their partner is autistic than when their partner is neurotypical.

Comparison		95% CrI	80% CrI
Directing			
ADHD Partner vs. Autistic Partner	Lower	-2.58	-2.25
	Upper	0.32	0.01
ADHD Partner vs. NT Partner	Lower	-2.06	-1.71
	Upper	1.16	0.82
NT Partner vs. Autistic Partner	Lower	-2.25	-1.91
	Upper	0.87	0.53
Recall Two			
ADHD Partner vs. Autistic Partner	Lower	-1.60	-1.13
	Upper	2.57	2.12
ADHD Partner vs. NT Partner	Lower	-1.61	-1.12
	Upper	3.04	2.52
NT Partner vs. Autistic Partner	Lower	-2.46	-1.97
	Upper	2.03	1.55

Table 5.12: Comparisons of singular marking between ADHD, NT, and autistic partners for participants with ADHD, showing credible intervals at different probability levels.

5.6.6 Discussion

In Experiment 2, we expanded the paradigm in Experiment 2 to include a second neurominority group – individuals with ADHD – to understand how broader neurotype mixing impacts linguistic accommodation and change. First, our statistical model suggests that both autistic people and people with ADHD are more likely to regularise the grammar by reducing their use of the singular marker before interaction. There is also some evidence that this effect may be even stronger in autistic people than those with ADHD, but we cannot be very confident about this effect. Regardless, the increased regularisation by our neurodivergent groups was unexpected, but has interesting implications for the role of neurodivergent people in language change, as well as their own trajectories of language development.

Next, we turn to our more central questions around neurotype mixing. This is the first study that we are aware of that considers neurotype mixing beyond just autistic-allistic pairs by including another neurominority group. Our results suggest that autistic participants both accommodate most to other autistic participants, and retain more singular marking with autistic partners than partners of other neurotypes. However, there is some evidence – albeit with a degree of uncertainty – that autistic people are more likely to accommodate to and retain changes from partners with ADHD than neurotypical partners. In other words, there may be a gradient effect, such that autistic participants accommodate to and keep the resulting changes more with other neurodivergent people than neurotypical people, but the effect is still most pronounced in neurotype matched pairs with autistic partners.

Comparison		95% CrI	80% CrI
Directing – Recall One			
ADHD Partner D-R1 – Autistic Partner D-R1	Lower	-1.63	-1.37
	Upper	0.78	0.52
ADHD Partner D-R1 – NT Partner D-R1	Lower	-1.74	-1.44
	Upper	1.00	0.70
Autistic Partner D-R1 – NT Partner D–R1	Lower	-1.30	-0.99
	Upper	1.36	1.06
Recall Two – Directing			
ADHD Partner R2-D – Autistic Partner R2-D	Lower	0.21	0.54
	Upper	3.02	2.70
ADHD Partner R2-D – NT Partner R2-D	Lower	-0.45	-0.10
	Upper	2.77	2.40
Autistic Partner R2-D – NT Partner R2-D	Lower	-1.99	-1.66
	Upper	1.06	0.71
Recall Two – Recall One			
ADHD Partner R2-R1 – Autistic Partner R2-R1	Lower	-0.61	-0.19
	Upper	2.95	2.59
ADHD Partner R2-R1 – NT partner R2-R1	Lower	-1.25	-0.79
	Upper	2.76	2.34
Autistic Partner R2-R1 – NT Partner R2-R1	Lower	-2.35	1.91
	Upper	1.51	1.07

Table 5.13: Comparison of singular marking usage in the directing phase (R1) by autistic participants across different partner neurotypes, with confidence intervals at the 95%, 80%, and 60% probability levels.

For participants with ADHD, however, we find very little clear evidence that neurotype mixing or matching impacts their linguistic accommodation and change behaviours. There are two exceptions: first, people with ADHD retain more singular marking after interaction with partners with ADHD than autistic partners. Whilst this could be explained by appealing to the Double Empathy Problem, this does not seem conclusive, considering that there is no clear evidence of a difference in retention when you compare partners with ADHD to neurotypical partners. It is unclear why there would be a particular disadvantage for retention after interaction with autistic partners compared to partners with ADHD. The second exception is that participants with ADHD may see a greater overall change in their grammar when they interact with autistic, rather than neurotypical, partners. Whilst this may appear to indicate a positive effect of having a neurodivergent partner, this is not evident when considering other model parameters, as it does not predict a clear difference in change between partners with ADHD and neurotypical partner. Overall, we argue that our results suggest that neurotype mixing and matching do not have the same impact on linguistic accommodation behaviours in people with ADHD as they do for autistic people.

5.7 General Discussion

Previous literature suggests that one mechanism by which languages change is accommodation, but that accommodation is impacted both by linguistic features and by social variables such as gender identity. Accommodation is therefore one avenue for investigating the key question of *who* drives language change. In this study, we consider individuals of different neurotypes as potential drivers of change. We considered the relationship between accommodation, regularisation, and neurotype mixing and matching. We also presented the first study that we know of on accommodation by people who have ADHD, and of the impact of neurotype mixing within pairs where both members are neurodivergent but are of different neurotypes.

First, we investigated the impact of neurotype mixing and matching on linguistic behaviours in autistic and allistic individuals. Using Fehér et al.'s (2019) methodology, we taught both autistic and allistic participants an artificial language which used optional (33%) singular marking. Then, they interacted with a 'partner' that was either autistic or allistic. Crucially, that partner always used the singular marker; if accommodation occurs, we expected participants to increase their use of the singular marker compared to when they were trained. Finally, we tested participants after the interaction phase, to gain insight into potential longer-lasting effects of accommodation on the grammar. We found that autistic people accommodate *more* than allistic people in neurotype-matched pairs, and that the magnitude of accommodation is comparable in both allistic and autistic mixed pairs. Importantly in the context of previous literature, our results thus show that autistic people *do* accommodate, contrary to previous suggestions that autistic communication differences may be driven by reduced accommodation (Branigan, Tosi, & Gillespie-Smith, 2016; Kruyt & Beňuš, 2021). We also find that mixing impacts the trajectory of change in the grammar; mixed pairs are less likely to retain the changes from accommodation, and their final grammar is less different than their initial grammar than it is in matched pairs. This effect is particularly strong in autistic people, contrary to our hypothesis that neurotype mixing would impact both neurotypes equally.

Second, we considered cross-neurotype interactions more broadly by introducing a second neurodivergent group: people with ADHD. We did not have any strong hypothesis for how individuals with ADHD would behave, beyond that neurotype mixing would reduce accommodation. We did hypothesise, however, that pairs where both parties are neurodivergent in different ways may see more accommodation than neurodivergent-neurotypical pairs. We find evidence for the latter effect in autistic people; autistic people's accommodation and retention of the singular marker has something of a gradient effect, where they accommodate least to neurotypical partners, and most to autistic partners, with partners with

ADHD somewhere in between (though it is not clear whether they accommodate more to people with ADHD than neurotypical people, or to the same extent with partners with ADHD and autistic partners). We do note, however, that the gradient effect is clearer in the estimates for individual phases rather than in the magnitude of change between phases. On the other hand, there is no clear evidence that individuals with ADHD adjust their linguistic behaviours depending on their partner's reported neurotype, with the exception of retaining more of the singular marker after interaction with partners with ADHD than autistic partners, and potentially showing greater overall change from recall one to recall two with autistic partners than neurotypical partners.

Our results have broad implications for models of neurodiversity and language change. On the matter of language change, they contribute to the question of *who* drives language change, by demonstrating that different neurotypes may contribute to language change in different ways. First, both of our neurodivergent groups regularise more after initial training. Whilst this result was unexpected, it could suggest a role for neurodivergent individuals in reducing grammatical variation. Future work should continue to examine the regularisation behaviours of a broad range of neurodivergent people in different linguistic and social scenarios.

Second, our autistic group changed their linguistic behaviour depending on the perceived neurotype of their conversational partner. On the one hand, this means that autistic people may be less likely to adopt changes introduced by non-autistic people, which could help promote variation in the population-level grammar, particularly with the fact that allistic people were willing to accommodate to autistic people in mind. On the other hand, it concurs with evidence that autistic groups can introduce language change. For instance, many of the terms used by the neurodiversity paradigm were coined by autistic people through conversation with other autistic people, and those terms are now commonly used in public discourse as well as research settings. Just as other identity groups develop shared vocabulary and grammars, autistic people may do the same.

Turning to models of neurodiversity, our hypotheses were developed in line with theories, such as the Double Empathy Problem (D. Milton, 2012b) that argue that neurotype mixing can lead to difficulties in interaction due to individuals coming to the interaction with vastly different cognitive experiences and expectations (cf. also the Dialectal Misattunement Hypothesis (Bolis et al., 2017)). Such theories have previously been tested with respect to the success of information transfer (Crompton, Ropar, Evans-Williams, et al., 2020), but here we expand them to specific linguistic behaviours and consider a broader range of neruotypes. In this paper, we argued that the Double Empathy Problem and similar theories could be applied to cross-neurotype interactions beyond those of autistic and allistic people.

For autistic people, the gradient effect described is evidence that the Double Empathy Problem can be applied more broadly than to just autistic-allistic interactions. Given the wide co-occurrence of ADHD and autism, as well as the overlap in traits, autistic people may have more in common in terms of their cognitive experiences than they do with neurotypical people. Therefore, autistic people may find interaction with people with ADHD easier than neurotypical people. This opens up interesting avenues for future research on the Double Empathy Problem, considering autistic interactions with a greater array of neurotypes.

Another area of recent interest in autism research is the notion of autistic camouflaging (or ‘masking’). This refers to the broad range of behaviours that autistic people employ to appear more like allistic people, with the aim of avoiding stigma and other negative outcomes, such as mimicking non-autistic behaviours or suppressing stims (Hull, Petrides, Allison, Smith, Baron-Cohen, et al., 2017; Pearson & Rose, 2021; Miller et al., 2021a; Radulski, 2022b; Cook et al., 2023). Most relevant to this study is the idea that autistic people may purposefully imitate the speech of allistic people as part of camouflaging (Hull, Petrides, Allison, Smith, Baron-Cohen, et al., 2017; Miller et al., 2021a). Our results may, on first consideration, seem contradictory to the notion that autistic people camouflage using linguistic devices; if they were doing so, we might expect them to accommodate *more* to *allistic* people than autistic people, which is the opposite of the pattern that we find here. First, however, we note that camouflaging is not unique to autistic-allistic interactions; Funawatari, Sumiya, Iwabuchi, Nishimura, et al. (2024) actually find evidence that autistic people, when presented with hypothetical scenarios, might camouflage more with other autistic people than allistic people (though notably, this work does not involve an actual autistic-allistic or autistic-autistic interaction).

Second, the situation here is relatively ‘low stakes’ in terms of social engagement (there is no face-to-face interaction, nor material consequences for communicative breakdown), which may reduce the drive to camouflage to allistic people. Further, there are a range of competing pressures that drive one’s linguistic choices, including communication, learning, and production; as language users – including autistic language users – we are consistently navigating a complex environment with an array of available choices. For autistic people, this may be further complicated by simultaneously facing pressure to mask whilst their neurological functioning differs substantially from the very same allistic people that they are attempting to imitate. Whether masking or the effect of neurotype-mixing is more prominent in the resulting linguistic choices likely depends largely on the situation and social goals and pressures. Linguistic masking and reduced accommodation in neurotype-mixed pairs are not incompatible, but rather likely different explanations for different behaviours in different scenarios.

Contrary to our expectations, we do not see an effect of cross-neurotype interactions on linguistic behaviours in individuals with ADHD. As discussed above, it is difficult to appeal directly to the Double Empathy problem to explain the only exceptions to this overall trend; it does not seem that people with ADHD generally accommodate to or retain more singular marking with people with either their own neurotype or other neurodivergent people, and it is not clear whilst there would be less retention after interaction only with autistic partners and not neurotypical partners. Thus, we have little evidence that people with ADHD's linguistic behaviours are impacted by cross-neurotype interactions in the same way as autistic people, contrary to the predictions of the Double Empathy Hypothesis, which is broadly construed as resulting from a mismatch in cognitive experiences and expectations. On a practical level, this suggests that the social differences experienced by people with ADHD are not the result of neurotype mixing. On a more theoretical level, this calls into question the very broad construction of the Double Empathy Problem; if it is caused by only a mismatch in cognitive experiences, then we would expect its predictions to hold across neurodivergent neurotypes, and not just for autistic people (see Livingston et al., 2025, for a recent discussion and critique of the theoretical underpinnings of the Double Empathy Problem). Whilst it could be suggested that the Double Empathy Problem is thus unique to the autistic experience (though if this is the case, it would require significant conceptual narrowing), our results alone cannot support this conclusion, as we have only tested one alternate neurodivergent neurotype. Future work should continue to investigate various neurotypes in different cross-neurotype scenarios, to understand whether the Double Empathy Problem can be applied more broadly than to just autism, or whether there is perhaps something unique to the autistic cognitive profile that makes neurotype mismatching particularly difficult for both autistic and allistic people.

Alternatively, it is possible this paradigm is not sensitive enough to pick up differences in cross-neurotype interactions by people with ADHD; typically, people with ADHD do not face the same degree of social difference as autistic people do, and the effect may be more subtle and require face-to-face interaction. It may also not be visible in linguistic behaviours, but may be found in other measures, such as Crompton, Ropar, Evans-Williams, et al.'s (2020) communicative success. Finally, our unclear results may relate to our participants with ADHD's sense of identity in relation to being ADHD (specifically, their sense of neurominority identity). Whilst we did not quantitatively measure our participants' sense of ADHD identity, a preference for identity-first language has been shown to relate to autistic identity (Bury et al., 2023), and our participants conversely prefer person-first language. Additionally, the free-text responses to *'Are there any other ways of describing yourself/others with ADHD that you prefer?"* reveal many negative sentiments towards ADHD, and indeed the neurodiversity movement in general. In particular, these may prevent a positive effect of matching from occurring if participants have negative perceptions of their peers with ADHD. Future work should continue to probe whether people with ADHD are impacted by cross-neurotype interactions in alternative scenarios than the one presented here, and whether differences in cross-neurotype interactions are related to neurominority identity.

It's important to note that there are several potential limitations in our paradigm that present opportunities for future research. First, our experiment was conducted online, with text-based disclosure of neurotype for a pre-programmed partner, rather than an actual conversational partner. As a result, the partner neurotype disclosure and perception was not necessarily authentic; whilst some individuals may choose to disclose their neurotype in certain settings, this is unlikely to happen in many other settings, for reasons ranging from protecting one's privacy to stigma avoidance. However, this does not mean that there would be no effect of neurotype mixing without explicit disclosure, as research suggests that neurotypical people are less willing to interact with autistic people based on immediate observation

(Sasson et al., 2017b). Indeed, we suggested in Section 5.5.4 that it may in fact have a stronger effect if the neurotype mixing was naturalistic, as allistic people react more favourably to autistic people when the autistic label is explicitly given (Sasson & Morrison, 2019). Future work should be done to investigate the impact of neurotype mixing and matching in the lab in a more naturalistic setting.

Additionally, as discussed above, many of our participants reported that they were aware that their partner was not a real person, but rather a pre-programmed agent. As we noted in Section 5.5.1, the response to this question may be biased by asking the question at all; we would not expect to see a clear difference in linguistic behaviours based on the disclosure of neurotype if participants truly believed that the partner was a computer. However, even if some participants did believe their partner was a computer, previous research has shown that regularisation is strongest in human-human interaction and human-computer interaction where partners believe the partner is a human (Fehér et al., 2016). Thus, if anything, we expect the effects found in this experiment would be stronger when participants interact with human rather than computer partners.

The characteristics of our participants are also important to note. Autistic participants on Prolific only represent a subsection of the autistic community, and given the variability inherent to autism, these results may not be generalisable across the population. For instance, our participants are likely to be verbal (or at least are able to read and write English), not be intellectually disabled, and to require less day-to-day support (we do note, however, that we did not explicitly measure these aspects). Similar caveats apply to our participants with ADHD, as again, the Prolific participant pool represents only a section of the community, though it is unclear how the characteristics of this community of individuals with ADHD might differ from the overall profile of ADHD, and this is an important area for further research. Finally, we note that in Experiment 1, we did not explicitly screen for ADHD (or any other neurodivergent condition) in our autistic or allistic participants. Autism and ADHD are highly co-occurring, and thus is is likely that some of our autistic participants in Experiment 1 also have ADHD. In Experiment 2, we did not screen our participants for any neurodivergent condition other than ADHD and autism. As such, some of our participants may be multiply neurodivergent, or some members of the group that we have described as neurotypical may be neurodivergent in other ways. Notably, many participants with ADHD were excluded after pre-screening due to identifying as autistic and/or scoring high on the AQ-10. Future work should expand to consider a broader range of profiles of autistic people and people with ADHD, alongside considering the impact of being multiply neurodivergent or a member of other neurodivergent groups.

5.8 Conclusion

The phenomenon of linguistic accommodation is extensively documented, and has also been argued to be a potential mechanism of language change. Separately, recent research has developed new models of neurodiversity – in particular of autism – which argue that cross-neurotype interactions are less successful than neurotype-matched interactions, providing a non-deficit based explanation for neurodivergent communicative differences. In this study, we expand work in both of these areas by examining how cross-neurotype interactions can impact language learning and use in the context of accommodation and linguistic change. We find that neurotype mixing reduces accommodation and long-term change for autistic people, whilst the effect is less pronounced in neurotypical people, and there is no evidence for the effect in people with ADHD. Our results provide both a basis for a wider investigation of cross-neurotype interactions beyond autistic-allistic pairs, and insights into the key question of who causes language change.

6

General Discussion

“That curtain never came. The end credits should have run, but the days kept on happening, my alarm kept going off, and new challenges kept popping up."

– Sol Smith, 2025

6.1 Summary of findings

This thesis investigated the relationship between cognitive diversity and language evolution through the lens of autism and language change. In Chapter One, I outlined the neurodiversity paradigm and how it formed the backdrop framework for the thesis. I argued that work on neurodivergent groups should always be informed by a neurodiversity, non-pathologising approach, and in conjunction with members of those groups. In Chapter Two, I turned to the core questions of this thesis: *how* does language change happen, and *who* does it? For the former, I outlined previous research on language evolution and change that focuses on the cognitive system, but argued that these theories are generally built on the assumption of homogeneity within human minds that is not supported by the vast array of neurodiversity throughout the species. For the latter, I noted that various social factors have long been argued to be influential in language change, and that some research has even begun to account for individual differences in cognition. However, the field is yet to embrace the full spectrum of neurodiversity, or question how neurodiverse groups come together to form shared linguistic systems.

In Chapter Three, I presented the first study explicitly examining the relationship between neurodiversity and language change. Using an artificial language learning paradigm – which has not previously been employed with a specifically neurodivergent population – we investigated the key trade-off in the evolution of language between production ease and expressive capacity. I used the paradigm of G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) to investigate how both autistic and allistic populations trade-off these pressures under different social circumstances. In the absence of any social pressure, both autistic and allistic people with varying levels of autistic traits balance these pressures in similar ways; they put in extra effort when necessary to meet communicative need, but also reduce linguistic elements that are redundant to understanding. However, in the presence of a social pressure that encourages redundancy, our autistic learners were more likely to put in the extra effort to meet a social goal than the allistic learners. Ultimately, this could help preserve redundancy in language. These results show first that autistic people are also sensitive to the competing pressures of communication and production, and second that they – counter to social deficit narratives – may put in more effort to meet social goals.

Following up from this study, Chapter Four sought to further probe the reasons *why* people with higher autistic traits adhered more to the social bias. Two competing hypotheses were entertained in Chapter Three; first, that this was a result of high attention to detail (an oft-cited though conceptually elusive autistic trait); alternatively, that it was a result of autistic camouflaging behaviours, also known as 'masking'. To investigate these two competing hypotheses, we measured both in more detail than in Chapter Three. Furthermore, we changed the nature of the social biases introduced first by G. Roberts & Fedzechkina (2018) and Fedzechkina et al. (2022) to more closely resemble the social pressures faced by autistic people. The results from this study indicated that camouflaging is likely the main mechanism at play in autistic people's increase in redundant case usage to meet a social goal, though notably an increase in camouflaging traits was only associated with an increase in redundant case usage in autistic people, not allistic people. This contributes to a previously suggested but not clearly evidenced possibility of autistic camouflaging being in some way qualitatively different than allistic camouflaging; whilst both groups engage in these sorts of social behaviours, for autistic people there seems to be some quality that is different.

In Chapter Five, the thesis turned from the communicative efficiency trade-off to considering linguistic accommodation as a mechanism of language change. In this experiment, I tested the accommodation behaviours of people of various neurotypes in neurotype mixed and matched pairs, to gain insight into how neurodiverse groups can reach shared linguistic systems. The results show that autistic people are impacted by neurotype mixing, accommodating and retaining linguistic variants most from other autistic people, followed by people with ADHD, and then allistic people. For allistic people and people with ADHD, however, there appears to be either less or no effect. I discussed reasons for why neurotype mixing did not impact people with non-autistic neurotypes, including the nature of explicit diagnostic disclosure. These results contribute both to questions about how language change happens and who does it, and to more general questions about linguistic accommodation and communicative success in neurodiverse settings.

6.2 General conclusion

Taken as a whole, the results in this thesis underscore the importance of considering diverse populations when asking questions on how language changes and who does it. Whilst the field has begun to consider individual differences in cognition, it is necessary both for full scientific understanding and for ethical reasons to consider human cognition outside of the neurotypical norm. This thesis suggests that neurodivergent people can contribute to language evolution in unique ways, particularly when social factors are involved. Neurodivergent, particularly autistic, people may contribute to the retention of redundancy when social goals are involved. The different behaviours of autistic people in mixed and matched neurotype pairs may help contribute to variation in language.

Additionally, our results provide backing for theories of autism and neurodiversity more broadly, away from language evolution. First, we contribute to debates about social motivation in autism; whilst it is often claimed that autistic people universally lack social motivation, autistic testimony and recent research has challenged this idea (Jaswal & Akhtar, 2019a), and our results add to this, by showing that autistic people are willing to put in extra linguistic production effort to meet a social goal. They also contribute to current debates about the conceptualisation of autistic camouflaging, and in what ways it qualitatively differs from general impression management; we find that autistic people may use linguistic behaviours to camouflage in different ways than allistic people. Finally, an emerging area of research has considered the impact of mixed and matched neurotype interactions under the Double Empathy Problem (DEP). This thesis expands this work in two ways: first, it shows the impact of the DEP in the area of linguistic behaviour, expanding previous work on rapport and information transfer; second, this thesis conducts the first known study that applies the DEP more broadly than just to autistic-allistic interactions, and considers the relevance of other neurodivergent neurotypes.

6.3 Future directions

Whilst I have summarised the conclusions and implications of the thesis above, there are many avenues for future work in this area. As variation in cognitive traits is only just beginning to be considered in language evolution research, the impact of neurodiversity is ripe for examination, both in the form of direct follow-ups to this work, and the relationship between neurodiversity and language more broadly.

6.3.1 Other cognitive biases and language evolution

A large body of work exists that examines how weak cognitive biases, amplified over time by cultural transmission, that contribute to why languages look the way that they do (e.g., Culbertson, 2012; Futrell et al., 2015; Baronchelli et al., 2015). In this thesis, I consider only morphological/word order phenomena, and even then, it is only a subsection of the potential biases that might be present in learning in these areas. Learning biases have been demonstrated across linguistic domains, including phonology (e.g., White, 2014), semantics (e.g., Chemla et al., 2019b), and syntax (e.g., Culbertson & Newport, 2015).

We know little about whether neurodivergent people have different cognitive biases that can shape language. Whilst when we tested communicative efficiency, both autistic and allistic people behaved comparably in the absence of a social bias, there is no guarantee that this would also be the case for other biases. Given the strong sensory-perceptual differences associated with, for instance, autism

(Robertson & Baron-Cohen, 2017), it would perhaps be surprising if this had no impact on language. Future work is needed to test different types of cognitive biases, ranging from those hinging more on perceptual phenomena (e.g., Kurumada & Grimm, 2019), to those relating to event structure (e.g., Goldin-Meadow et al., 2008). For instance, as discussed in Chapter Two, while there are six logically possible basic word orders, SOV and OSV are wildly over-represented in the world's languages. This has been argued to be the result of underlying cognitive and learning biases in favour of SOV and SVO (Goldin-Meadow et al., 2008; Futrell et al., 2015; Tily et al., 2011; Tabullo et al., 2012). There are a variety of theories as to what exactly this bias is, such as the salience (Kirton et al., 2021) and animacy (I. Meir et al., 2017) of agents. Evidence suggests, however, that autistic people may consider different stimuli more salient than allistic people (e.g. Matyjek et al., 2025; Federici et al., 2020). Thus, they may display different preferences for basic word order, which could contribute to the remaining degree of variation both between and within languages.

Along similar lines, future research could also consider ALL tasks that have different requirements, to understand how other aspects of the autistic cognitive profile impact language. All of the studies in this thesis involve learning and regularising languages. However, they do not involve generalising, extrapolating, or improvising. Specifically, in these studies, participants are provided with an already-created language and are trained on the full language before testing, with no need to generalise to new items (though there is irregularity in the grammar which allows for regularisation). As argued by Holtz (2024), these different types of language learning and creation tasks may show evidence of different types of cognitive biases (known as the Scale of Innovation). Importantly, some accounts of autism suggest that autistic people may behave differently in these different types of tasks. For instance, one Bayesian account of autism argues that autistic people have strongly informative priors and thus have trouble generalising to new stimuli (Van de Cruys et al., 2014). Previous research commonly shows that some autistic people have difficulty generalising or generalise in different ways than allistic people (see Church et al., 2015, for discussion). It thus seems plausible that when given a linguistic generalisation task, autistic people may perform differently than allistic people. Additionally, our experiments do not tell us about how autistic people may create languages 'from scratch', and what these might look like; paradigms such as silent gesture would be useful in investigating the improvisation of linguistic systems by autistic people.

Additionally, my focus in this thesis has been broadly on socio-cognitive factors, rather than cognition that is less related to the social domain. For instance, as discussed in Chapter Two and Three, autistic people can display many differences in executive functioning (Kenny et al., 2024). Executive functions, particularly working memory, have been implicated in the evolution of language, providing a bottleneck that shapes language structure (Christiansen & Chater, 2016; Futrell et al., 2015; Keogh et al., 2024). Working memory is one of the executive functions that may be different in autism (Kercood et al., 2014), and thus autistic people may restructure language differently in the face of working memory pressures.

6.3.2 Moving forward within autism

As I have noted throughout this thesis, I have only considered a subsection of the autistic community in the studies reported here. Given the fact that our participants are likely independently online, and are at least able to use written language, I have broadly assumed that they are likely to be speaking autistic people with lower support needs. This may not be a valid assumption in all cases; for instance, our experiments did not actually require participants to be able to use verbal language, and thus some may be minimally speaking. Further, whilst there is often an assumption that minimally speaking autistic people have limited cognitive capabilities, the correlation between language and other cognitive skills is unclear (cf. Courchesne et al., 2015; Joseph et al., 2005; Kapp, 2023), and likely very heterogeneous in the autistic population (Ellis Weismer et al., 2018). Since we did not ask our participants about their support needs, whether they were speaking, used alternative or assisted communication methods, or measure various cognitive abilities beyond language, it is impossible to be definitive about the profile of our participants.

Therefore, moving forward, research on autism and language practices should pay more attention to these factors. Additionally, it should make a concerted effort to take into account the views and practices of minimally speaking autistic people, including examining how they use alternative communication systems in their linguistic practice. One avenue of research of potential interest to language evolution more specifically is the use of sign language or sign-based communication systems by autistic people. For minimally speaking individuals, sign-like systems such as Makaton[1] are a common form of alternative communication, and both minimally speaking and speaking autistic people report using natural sign languages such as American Sign Language (ASL) to communicate (Zisk & Dalton, 2019). Whilst both spoken and signed languages are systematic and contain common elements, such as syntax or phonology, the difference in expressive modality clearly plays a role in autistic language practices. This raises the question of *why* autistic people may find sign language easier to communicate with than spoken language. It would thus be interesting to investigate how both speaking and minimally or non-speaking autistic people learn and adapt novel sign languages, and whether this differs from how allistic people do the same. This could be achieved using paradigms such as silent gesture, where participants develop shared systematic sign systems in the lab (Motamedi et al., 2019).

1. It is important to note that whilst Makaton is not a natural sign language, its creators did appropriate signs from British Sign Language (BSL), with English word order imposed on top (Sheehy & Duffy, 2009). This process did not acknowledge the contributions of Deaf people, who consider Makaton an instance of the suppression of BSL (British Deaf Association, 2022).

6.3.3 Broadening to other types of neurodiversity

Language evolution research is only just beginning to appreciate the impact of individual differences. As I have argued, these individual differences are a reflection of neurodiversity. Thus, when considering a broader range of neurodiversity, we should continue to examine individual differences within the general population, and how they might contribute to the variation within the world's languages.

However, my primary focus is on neurodiversity outside of that typical range. As discussed, I used autism as a case study, given its well-documented connection to language and communication. A full study of neurodiversity and language evolution, however, must broaden to other forms of neurodivergence. Whilst I take a step towards this, considering the language use of people with ADHD in Chapter Five, this remains a largely unexplored area. This is despite the fact that many neurodivergent neurotypes are associated with differences in language, including very common differences such as dyslexia and DLD (see Section 2.5 for discussion). Manalili et al. (2023a) argues that it is necessary to examine the full spectrum of neurodiversity to gain a full picture of cognition, and I argue that this is true for language as well. Future work should continue to examine the role of all neurodivergent language users in shaping language.

Further, many people are neurodivergent in more than one way, and these co-occurrences could have further impacts on how language is used. Even within autism, this thesis cannot capture the full range of autistic experiences; we do not explicitly examine multiply neurodivergent autistic people or those who use alternative methods of communication. Future work should specifically consider the impact of being neurodivergent in different ways on language use. Further, we must acknowledge that even when we believe participants to be neurotypical, this is not always the case (Manalili et al., 2023a), and we need to move beyond an assumption of neurotypicality.

6.3.4 Non-English-speaking populations

Just as it is necessary to examine a broader range of neurotypes, it is also important that we consider cross-cultural and cross-linguistic differences within and between neurotypes. In this thesis, all the participants are self-reported English native speakers, a decision taken to reduce confounds of prior linguistic experience between participants. However, research on language, and in Cognitive Science as a whole, is dominated by both English-speaking researchers and English-speaking participants (Blasi et al., 2022; Majid, 2023). Research within the neurodiversity paradigm has also been overwhelmingly conducted with white, anglophone communities (Nair et al., 2024), including autism research (O'Dell et al., 2016). It is crucial that neurodiversity research incorporates the perspectives of both neurodivergent scholars and individuals from the Global South and marginalised populations in the Global North. This is not just a matter of ethics, but also of scientific merit; in language evolution, previous work has demonstrated how a reliance on English speakers may lead to the illusion of a cognitive bias that is actually driven by language experience (Martin & Culbertson, 2020), though some proposed biases appear robust regardless of native language (Martin et al., 2024). Sociolinguistics too has highlighted the importance of intersectionality when discussing the impact of social variables on language (Bucholtz

& Miles-Hercules, 2021; Levon, 2011), With respect to language differences in neurodivergent people, Leonard (2022) shows that these can manifest differently in different languages. Future work should, in partnership with people from these groups, consider the relationship between neurodiversity and language outside of an anglophone lens.

6.3.5 The intersection between neurodiversity and development

Many conditions that are considered neurodivergent are referred to as 'neurodevelopmental' conditions, and yet we tend to know relatively little about them across the lifespan, particularly with respect to language. For instance, almost all of our work on language and autism is done with children, and often only at one time point, reducing our ability to draw conclusions about the developmental trajectory for autistic people and language. This becomes particularly interesting in the context of language change, considering sociolinguistic work that ties language change to different points of the lifespan, particularly to childhood and adolescence (Cournane, 2019; Hudson Kam & Newport, 2009; Kerswill, 1996; Kerswill et al., 2013; J. Rickford & Price, 2013; Sanz-Sánchez & Moyna, 2023; Tagliamonte & D'Arcy, 2009). Replicating the experiments in this thesis with younger autistic people would not only contribute to our understanding of language and language change in this population, but also to our understanding of other issues, such as the developmental trajectory of camouflaging and autistic sociality.

6.3.6 Change over time and neurodiversity

The work in this thesis is based on artificial language learning, but only done at one point in time (participants learn and are tested on the language in the same setting, and there is no direct transmission of the language across generations). Future work should consider the impact of neurodiversity in the *trajectory* of language change, as well as the immediate learning and use. For instance, continuing to take inspiration from the DEP, work could examine how linguistic features change in transmission chains that consist of either mixed or matched neurotypes (similar to Crompton, Ropar, Evans-Williams, et al.'s (2020) study of the transmission of information, but focusing specifically on language). This would allow us to gain a greater understanding of how neurodiverse groups come together to create shared linguistic systems, and understand which (if any) features of neurodivergent language use might persist across chains. Such paradigms should also be done with explicit social pressures, in order to expand on the work done in this thesis that considers the impact of social biases on language use in neurodivergent people.

Separately, it could also be fruitful to examine *in situ* examples of language change driven by neurodivergent people. Whilst out of the scope of this thesis, potential areas for examination include the introduction and propagation of tone markers in internet discourse, examining the diffusion of these features and how it relates to users' self-reported autistic status based on corpus data. Using similar methods, it would also be possible to examine the propagation of terms relating to the neurodiversity movement, to understand how these terms have moved from autism-specific forums to being used in public discourse. Studies such as these would provide more naturalistic evidence of language change driven by neurodivergent people.

6.3.7 Realistic social situations and moving into the lab

An important limitation of the work conducted in this thesis is that it is conducted online using artificially constructed social situations. Whilst I have discussed the benefits of the online space for conducting research with autistic populations, it also inevitably comes with some drawbacks. First, the demands of online, highly structured tasks may be easier for some autistic cognitive profiles than language learning and use would be in day-to-day life (Kenny et al., 2024). This may impact how autistic people behave throughout our experiments

Consider, for instance, the experiment in Chapter Five, where we explicitly disclosed autistic neurotype, rather than allowing people to make their own inferences. Diagnostic disclosure has been shown to impact how people react to autistic people (Heasman & Gillespie, 2019; DeBrabander et al., 2019). This is one potential reason why our allistic participants are not as affected by neurotype mixing as our autistic participants, and thus it is important to replicate similar studies in a lab-based setting where explicit diagnostic exposure is not required, to better understand whether this is a true effect or an artifact of an online experiment. Similarly, it could also be the case that participants with ADHD may behave differently in the lab than they did online, so future work is needed to confirm the finding that neurotype mixing does not impact linguistic accommodation in this population.

Turning to camouflaging, as discussed in Chapter Five, there is some evidence that camouflaging is used less frequently online than in-person (Jedrzejewska & Dewey, 2022; Koteyko et al., 2024). In-person work could lead to a greater impact of camouflaging on language use, though this needs to be done in an ethically sensitive way, as increasing camouflaging behaviours could have a negative effect on autistic people (Bernardin, Lewis, et al., 2021; Ai et al., 2024a; Cage & Troxell-Whitman, 2019; Cage et al., 2018; Hull, Levy, et al., 2021; Somerville et al., 2024).

6.3.8 Natural neurodivergent language data

Finally, in Chapter Two I highlighted the importance of combining real-world natural language data and artificial language learning in order to gain a full understanding of language use and change. The same applies to neurodivergent language use. There is a dearth of realistic neurodivergent language data, particularly in adolescents, adults, and older adults. Whilst this data can be obtained online, there are important ethical caveats associated with this sort of data collection. Whilst there are a variety of suggestions for ethical large-data collection from social media (Benton et al., 2017; Fiesler & Proferes, 2018; M. L. Williams et al., 2017), there are additional considerations around the collection of the data of marginalised groups (e.g. Klassen & Fiesler, 2022), including autistic people (e.g. Jaiswal & Washington, 2024).

Another avenue is the collection of natural data via traditional methods such as interviews, used in sociolinguistics, as well as more modern methods such as virtual data collection (Heini & and Kredens, 2024) or so-called 'citizen sociolinguistics' (Svendsen, 2018). Additionally, tasks in the lab could provide language data that is closer to natural. For instance, participants could be tasked with solving a puzzle, and their language use recorded, which would allow the researcher to manipulate variables such as neurotype mixing/matching whilst still having relatively natural conversational data.

Finally, natural neurodivergent language data must include *all* neurodivergent people, including those who use alternative communication systems. Of particular interest would be scenarios where people who make use of different types of linguistic systems communicate with each other, to understand how they come together and negotiate meaning with their different repertoires (cf. Kusters et al., 2017; Moriarty & and Kusters, 2021, for discussion on semiotic resources and calibration within the Deaf community).

6.4 "Academic, Activist, or Advocate?"

This is the most personal section of the thesis, and as such takes a different tone than the rest. Whilst this section may not have the same 'objective' rigour typically expected of an empirical thesis in the psychological sciences, I believe it is important that the diverse community of autistic academics continues to use their voice in every available capacity to help improve our conditions and the conditions for those who follow us.

6.4.1 Advocacy or research?

The title of this section is borrowed from Botha (2021), whose words sum up my experience far more eloquently than I likely ever could. This section is undoubtedly heavily inspired by Botha's article and I would strongly recommend reading it, for both autistic and allistic researchers alike. It certainly provides something of a framework for how I describe my personal experiences below.

Throughout the process of this research, I have found myself constantly feeling obligated to act as an autism advocate. The work outlined in this thesis spans two disciplines which are close neighbours but do not interact as often as one might expect – language evolution and developmental psychology. I find it somewhat (perhaps naively) surprising that these two fields have such little overlap with each other, despite the clear theoretical reliance of current language evolution research on development and learning.

Yet, where they have met each other, the outcomes have rarely been positive for the autistic community, as discussed in Chapter Two. A literature search for *language evolution and autism* provides results that make for uncomfortable reading as an autistic person. Names that were ubiquitous in my undergraduate study – linguists whom I personally looked up to – are next to dehumanising, and at times frankly insulting, comments about autistic children (and, by extension, autistic adults). Informal conversations with language evolution researchers do not do much to instill confidence that those attitudes have changed; one senior researcher confided that he had often heard conversations at conferences about autism and language evolution in a similar vein to the claims above. On a personal note, a motivating event for me to begin this programme of study was an incident during the first language evolution course I took, in which both the course tutor and the students seemed to unquestioningly accept the idea that autistic people have no theory of mind, and as such were happy to directly compare autistic people to monkeys and apes. Those around me likely had no or little idea that there was at least one autistic person in the room, but the fact that they were happy to entertain this idea at all speaks to how the field has treated autism.

Deep-seated narratives of autistic deficits remain embedded in the thought of psychology and linguistics researchers, likely the result of both society-level prejudice and what we are taught in the undergraduate classroom. Botha (2021) sums up the experience of undergraduate study of neurodevelopmental ‘disorders’ well. All I can add is that, as a linguistic undergrad and master’s student, I was only explicitly allowed to consider autism and language in my ‘language disorders’ course. I often wanted to link what I was being taught to my own linguistic experiences, which were intrinsically tied to being autistic. Indeed, the first line of my undergraduate personal statement was that I went from ‘or to oration’ as soon as I started talking. I spent much of my time studying language acquisition, in the hope of perhaps understanding a little bit more about how that was possible. But when I brought up autism outside of dedicated courses, it was often considered eccentric at best.

With this in mind, it often feels that half (or rather, 80%) of the battle in presenting research with autistic people in language evolution spaces is convincing those around me that the research is worth conducting in the first place. Not because of the academic merit of the research, but because of the population studied. Common objections levied include that the autistic population is too small to make any meaningful difference on language change, or that our language is ‘too disordered’ to be relevant. Neurodivergent people in general are never considered in the sense that they can *contribute* to language change in their own right, just as neurotypicals do. Rather, we are considered when researchers want to investigate what they can learn about ‘earlier stages’ of language from our ‘deficits’.

As a result, it feels necessary to spend a good proportion of any presentation and poster time simply explaining *what autism is*, and why we should not dismiss it out of hand. I have spent much preparation time bracing myself for clumsy (at best) questions about what it means to be autistic. My colleagues are generally *surprised* when I disclose being autistic, because their view of autism does not include someone like me. Almost without fail, I am confronted with the statement that ‘oh, you don’t look autistic!’[2] when I disclose that part of my motivation is being autistic myself. Or, perhaps worse, I am told that my autism must be ‘mild’ if I am able to talk as I do and do research. I spend as much time

2. A favourite alternative, ‘you don’t act anything like my nine year old autistic son!’.

trying to dispel myths about autism and inform people about how autistic people view autism as I do explaining my own research. I am strangely expected to be – in Botha’s (2021) words – an academic, activist, and advocate, all at once. This is juggled alongside the difficulties that being autistic can create for public speaking and presentation, and the exhaustion of masking for long conference days.

This is not to say that I do not take pride in helping to spread better information about being autistic. If even just one person I have spoken to over the last four years has come out of that interaction with a slightly different, hopefully more positive and tolerant, perspective about autism, then that alone is a success. But I did not set out to do a PhD in order to become an autism advocate. When I begun this PhD, I was newly (officially) diagnosed and only just starting to really understand and acknowledge how being autistic was a part of myself. I hoped to leave that important advocacy work to other autistic people much more capable at it than I, from whom I have learned so much about myself. Unfortunately, it feels somewhat of an inevitability that an autistic researcher working on autism must be both an academic and an advocate.

6.4.2 Objectivity and positivism

As a once passionate student of philosophy, Botha’s (2021) discussion of positivism within academic research struck a particular chord. Not just because of its connections to a subject I found particularly interesting, but because of the personal resonance. When I began to approach autism research seriously, I believed that being objective was the gold standard (as most researchers also do). I tried to not let my own experiences ‘cloud’ my judgment too much. The existing literature was gospel. In the earliest proposals and drafts of my work, phrases like ‘Autism Spectrum Disorder’ and ‘pragmatic deficits’ were commonplace. In order to be taken seriously, I believed it was important to write like other autism researchers, even when the terms used made me uncomfortable.

I am fortunate to be doing my PhD at a time when autism research is evolving significantly. Bottini et al. (2024) show that whilst most articles are still using medical-based terminology, the likelihood of finding affirming language increases the more recent the article. Many researchers, autistic and allistic allies alike, have published papers arguing for the importance of considering autistic perspectives and opinions. Work has begun to acknowledge that allistic people also contribute to the difficulties autistic people can face in communication. This new paradigm of autistic research has made it feel possible for me to adopt the language choices that I, and my community, prefer. It has given me the confidence to be able to stand up and say, yes, we are worthy of consideration in linguistics outside of just pinpointing our ‘deficits’.

Nonetheless, academic culture changes slowly. I still receive comments on my papers which patronisingly promote those pathologising narratives of autism that I reject in my work. I still feel the need to placate ‘both sides’ of the argument around the status of autism. And more than once, I have chastised myself for being ‘too emotional’ about the topic or taking certain claims about autism ‘too personally’. After all, if these claims are published in reputable journals, with tests showing statistical significance, who am I to question them?

It has taken much internal reflection, and the help of other researchers who work to dispel these ‘facts’ (Gernsbacher & Yergeau, 2019a), to really come to terms with the idea that science is simply not infallible. This is something I have always been logically aware of, but it is emotionally hard to accept. Positivism and objectivity promote the idea that scientific results do not have moral value. But science does have moral value, and our research has moral consequences. Our research is inherently framed by our own perspectives. If one only views autistic people as ‘broken’ and needing to be cured, then one will only research areas that fit with that viewpoint. Knowledge is simply not created in a moral vacuum.

Practically speaking, it remains necessary at times to remind myself to display a veneer of ‘objectivity’ in order to remain credible in the eyes of my audience. I could write an entire thesis on my personal experiences of being autistic in academia, but that is not what a ‘proper’ researcher does. Even this section in this thesis is likely toeing the edge of what is acceptable, if not outright crossing it. Whilst I have acknowledged the flaws in objectivity and positivism, I am not immune to them. Most of this thesis remains necessarily couched in academic tradition, and I can imagine that I will have edited it many times before anyone else reads it in order to portray a more academic facade. All I can hope for is that this section has shed some light on the frustrations of being an autistic person in autism research, and that perhaps it can provide some comfort to future autistic researchers that they are not alone.

Appendix A

Chapter 3 Appendices

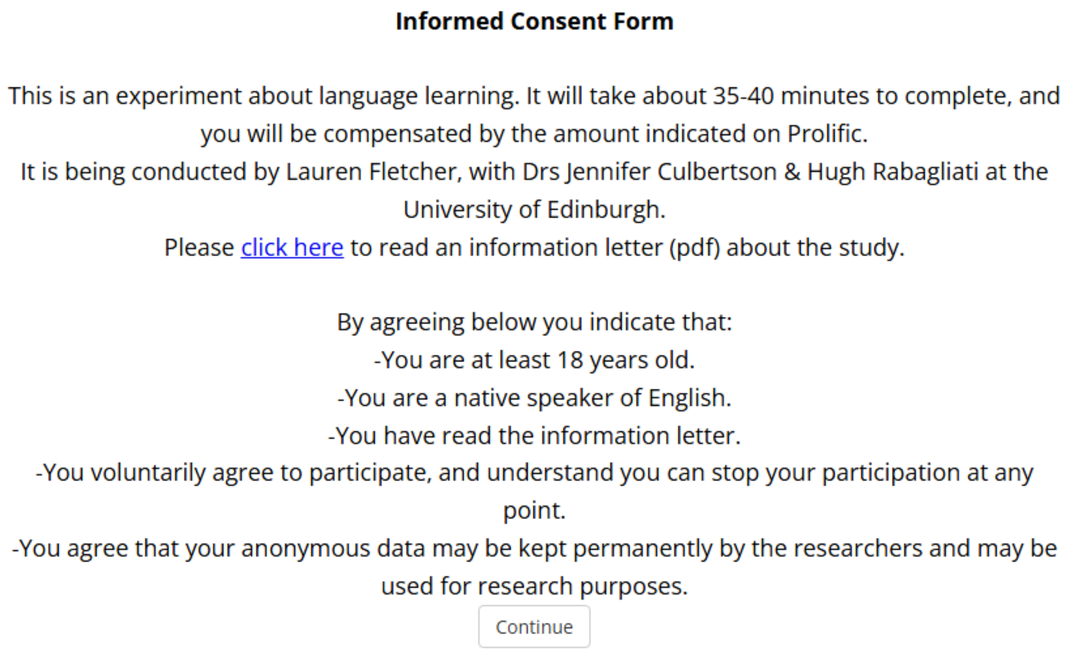
The appendices below contain supplementary information and further analyses for Chapter Three. Appendix A.2 presents an analysis of the relationship between AQ-10 score and autistic identity, autistic diagnosis, and family history of autism. This was performed in order to understand the link between AQ-10 and autism status in both the autistic and non-autistic population on Prolific. Appendix A.3 provides a Bayesian analysis of the data presented in Chapter Three, in order to more closely align with the overall analysis framework of the thesis, and to better relate it to the follow-up results in Chapter Four, which are analysed with a Bayesian framework.

A.1 Consent and instructions provided to participants

A.1.1 Consent information

As described in the manuscript above, participants gave consent via button press on an initial consent screen (see Figure A.1).

Additionally, participants were provided with an information sheet in pdf format that gave further details about the study, including how their data would be used and protected. The full text of this form is given on the next page.



Informed Consent Form

This is an experiment about language learning. It will take about 35-40 minutes to complete, and you will be compensated by the amount indicated on Prolific.
It is being conducted by Lauren Fletcher, with Drs Jennifer Culbertson & Hugh Rabagliati at the University of Edinburgh.
Please click here to read an information letter (pdf) about the study.

By agreeing below you indicate that:
-You are at least 18 years old.
-You are a native speaker of English.
-You have read the information letter.
-You voluntarily agree to participate, and understand you can stop your participation at any point.
-You agree that your anonymous data may be kept permanently by the researchers and may be used for research purposes.

Continue

Figure A.1: Consent page presented to participants.

[pages=-,pagecommand=,scale=1]chapter3/consent$_{s}b_{o}riginal_{1}pg.pdf$

A.1.2 Instructions

The instructions were largely identical between the two experiments, with changes only in the initial instructions, where the aliens were introduced.

Initial instructions (Experiment 1, No Bias):

> You are part of a mission to an alien planet. There are two groups of aliens living on the planet; the blue and orange aliens (pictured below).
> You will be learning the language of the aliens as part of the process of forming trade relations with the aliens. The language used by the two groups is slightly different.
> We are keen to trade with both groups of the aliens. They seem to be on our side, and they have important resources. You should try to impress them.

Initial instructions (Experiment 2, Bias For No Informative case):

> You are part of a mission to an alien planet. There are two groups of aliens living on the planet; the blue and orange aliens (pictured below).
> You will be learning the language of the aliens as part of the process of forming trade relations with the aliens. The language used by the two groups is slightly different.
> **We are especially keen to trade with the blue aliens. They seem to be on our side, and they have important resources. We should try to impress these blue aliens in particular. The orange aliens are not so friendly, and they don't have much to offer us.**

Initial instructions (Experiment 2, Bias For Redundant Case):

> You are part of a mission to an alien planet. There are two groups of aliens living on the planet; the blue and orange aliens (pictured below).
> You will be learning the language of the aliens as part of the process of forming trade relations with the aliens. The language used by the two groups is slightly different.
> **We are especially keen to trade with the orange aliens. They seem to be on our side, and they have important resources. We should try to impress these orange aliens in particular. The blue aliens are not so friendly, and they don't have much to offer us.**

Noun exposure instructions:

> First, you are going to learn some of the words that the aliens use in their language. Both groups of aliens use the same words.
> You will now be shown a picture and the word that describes it. Please press next when you are confident that you know the meaning of the word, to move to the next words.

Noun comprehension instructions:

> Now, you are going to be tested on your ability to understand the words in the alien language. You will be shown a set of pictures, as well as one of the words you saw before. Please click on the picture that corresponds to the word.

Noun production instructions:

> Now, you are going to be tested on your ability to name pictures in the alien language. You are going to be shown one picture, and given the selection of all the words used by the groups of aliens.
> Please click on the word that describes the picture.

Bias attention check (Experiment 2 only):

> Before we continue, please click the alien that we are keen to trade with, and that have more to offer us.

Following correct response to bias check:

> Correct! We wish to trade with the [blue/orange] aliens, as they have important resources and are on our side.

Following incorrect response to bias check:

> That is not correct; we wish to trade with the [blue/orange] aliens, as they have important resources and are not on our side.

Sentence exposure instructions:

> In the next part of the study, you are going to be learning the grammar of the language the aliens use. The two groups of aliens have slightly different grammars, so the sentences that they use will be different. You will be shown a picture and a sentence that describes it. The alien that uses that sentence will be shown on the screen.
> Please press next when you are confident to move to the next sentence.

Sentence comprehension instructions:

> Next, we are going to test your understanding of the language. You will see two pictures and a sentence spoken by one of the aliens that describes one of the pictures.
> Please choose the picture that corresponds to the sentence by clicking on the picture.

Sentence production instructions:

> Finally, we are going to test your ability to speak this alien language.
> Please click the words in order to create a sentence that describes the picture.
> You are able to reset your sentence by clicking 'reset'.

Pre-questionnaire questions:

> Great work!
> Now, we are going to ask a few questions about your experiences in everyday life and your language experience.

Post-questionnaire questions:

> Thank you for your answers. Please click "next" below to save your data; there may be a short delay before the experiment progresses to the final stage, which will redirect you back to Prolific. Please do not close the page during this delay.

Ending instructions:

> Thank you for participating in this study!
> Please make sure you click the button below, rather than closing the page. You will be automatically returned to Prolific.

A.2 Language background

In Experiment 1, participants overwhelmingly reported their native language as English (as was required when giving consent for the study). One participant reported their native languages as English and German, one as English and Spanish, and one as English and Zulu. 4 participants reported a native language other than English whilst not also reporting English; 1 reported Polish, 1 Spanish, 1 Afrikaans and 1 Xhosa.

Participants reported experience in a range of other languages. Many participants noted that they did not consider themselves fluent in these other languages. Some noted that they could only read/write in other languages, others that they were heritage language speakers who were exposed to a second language but did not fully acquire it. Many participants identified experience with more than one language other than English.

As in Experiment 1, in Experiment 2 participants also overwhelmingly report their native language to be English. 172 participants reported their only native language as English, whilst 7 reported having 1 or more other native languages (Sepedi, Tamil, Polish, Konkani, Hungarian, Setswana, and German). 1 participant reported Xhosa as their native language, and one Setswana.

Again, as in Experiment 1, participants reported a wide range of other language experiences. Some participants noted that they had experience in a language but did not consider themselves fluent, whilst others noted that they had had at least some experience with as many as 10 languages.

Language	No. of Participants	Language	No. of Participants
No other experience	110	British Sign Language	1
French	19	Norwegian	1
Italian	6	Dutch	1
Other experience not specified	6	Welsh	1
Spanish	9	Japanese	3
German	12	Irish	4
Arabic	2	Latin	3
Mandarin	1	Hrvartski (Croatian)	1
Catalan	1	Swedish	1
Afrikaans	3	Somali	1
Zulu	1	Mirpuri (Pahari-Pothwari)	1
Xhosa	1	Portuguese	1
Persian	1	Russian	1

Table A.1: Number of participants who report experience with various languages in Experiment 1. Note that there are more more participants reported here than took part in the experiment, as some participants reported experience in more than one language.

A.3 Bayesian analysis of data presented in Chapter Three

Since the following chapter follows up on work done in this chapter, but uses Bayesian rather than frequentist analysis, Bayesian re-analysis of the data from Chapter Three is provided here to support consistent interpretation of results across chapters. Both the models reported used weakly regularising priors.

First, I consider the data from Experiment One. This experiment considered the trade-off between communicative accuracy and production effort without consideration of social biases. We taught participants two artificial languages, one which had a fixed word order, and one which had a redundant word order. In both languages, they also saw object case marking 50% of the time. In the fixed word order condition, this case was redundant, whereas in the flexible word order condition, case was informative. We further investigated whether AQ-10 scores impacted this trade-off. I fit a Bayesian linear regression model with Bernoulli likelihood and a logit function to analyse this data, of the structure Case Marker $\sim$ Condition * AQ-10. AQ-10 score was standardised using z-score standardisation. Condition was sum-coded (Redundant Case +1, Informative Case -1). Table A.3 summarises the output of the model.

Recall that in our frequentist analysis, we found that participants in the redundant case condition used case at a rate significantly below chance. Here, the model estimates with high certainty that the use of redundant case is lower than the grand mean (95% CrI: [-1.26, -0.32]), supporting the conclusion that participants, overall, reduce their use of redundant case. To better understand the relative usage of redundant and informative case, I extracted the posterior draws of the model and computed condition-specific estimates and Credible Intervals (see Table A.4[1]). Whilst the model is confident that case

1. Note that the estimate for Redundant Case differs than that above as this estimate represents the uncertainty of the condition overall, rather than the difference from the grand mean

Language	No. of Participants	Language	No. of Participants
No other experience	100	British Sign Language	1
French	30	Dutch	1
Italian	6	Welsh	6
Other experience not specified	9	Japanese	7
Spanish	12	Irish	3
German	9	Latin	2
Arabic	2	Setswara	1
Urdu	1	Sethoso	2
Afrikaans	2	Hungarian	2
Zulu	3	Somali	1
Dutch	3	Korean	1
Sepedi	1	Portuguese	1
		Danish	1

Table A.2: Number of participants who report experience with various languages in Experiment 2. Note that there are more more participants reported here than took part in the experiment, as some participants reported experience in more than one language.

Parameter	Posterior Mean	95% CrI Lower %	95% CrI Upper
Intercept	-0.44	-0.92	0.06
Redundant Case	-0.78	-1.26	-0.32
Standardised AQ-10	-0.08	-0.56	0.41
Redundant Case:Standardised AQ-10	-0.23	-0.73	0.26

Table A.3: Posterior means and 95% Credible Intervals from a model estimating the influence on case marker usage by condition and standardised AQ-10 score.

is used less in the redundant case condition (95% CrI: [-1.90, -0.54]), whilst it is less confident with respect to informative case, with the 95% CrI including 0 (95% CrI: [-0.34, 1.02]). These results accord with our earlier frequentist analysis, which found that participants in the redundant case condition used case at a rate significantly below chance, but that in the informative case condition, case use was not significantly above chance.

Condition	Posterior Mean	95% CrI Lower	95% CrI Upper
Redundant Case	-1.22	-1.90	-0.54
Informative Case	0.35	-0.34	1.02

Table A.4: 95% Credible Intervals for estimates of the effect of both conditions on case marker usage, calculated from the model's posterior draws.

Turning back to the impact of the AQ-10, there is no clear evidence for an effect of AQ-10 score on case marking overall (95% CrI: [-0.56, 0.41]) or in interaction with the redundant case (95% CrI: [-0.73, 0.26]). I also calculated the slopes for the relationship between AQ-10 and each condition using the posterior draws (Table A.5), which similarly shows no clear effect of AQ-10 score on either condition. This is again in accordance with our original results in the frequentist analysis.

Condition	Slope Mean	95% CrI Lower %	95% CrI Upper
Redundant Case	-0.313	-0.968	0.349
Informative Case	0.153	-0.569	0.876

Table A.5: Posterior mean slopes and 95% credible intervals for the effect of standardized AQ-10 on case marker use, by condition.

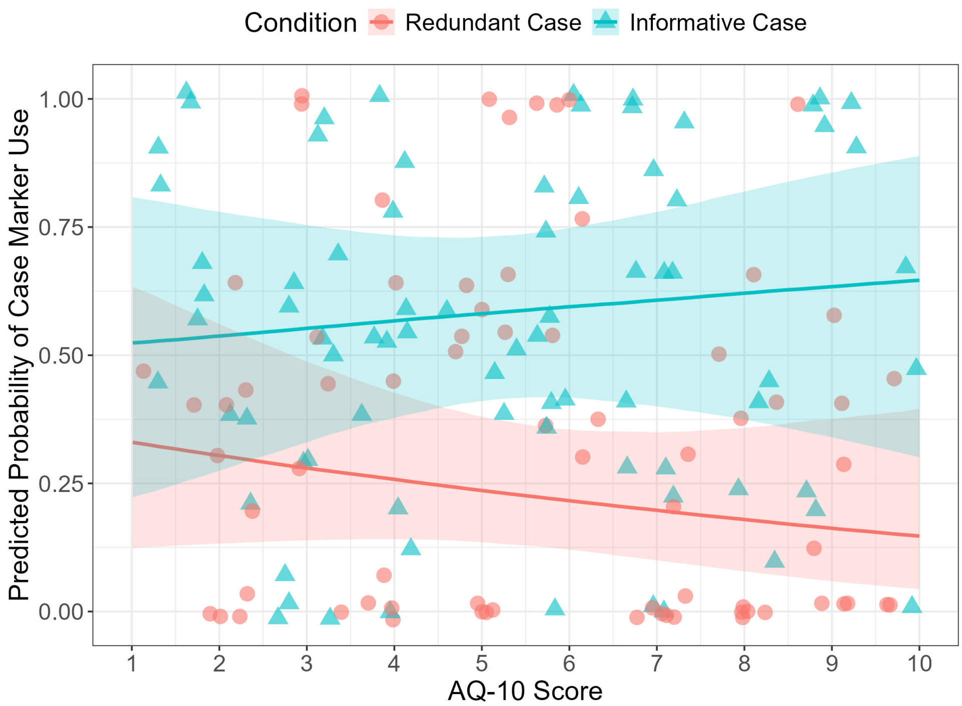


Figure A.2: Estimated relationship between AQ-10 scores and the predicted probability of case marker usage mediated by condition in Experiment One. Solid lines represent the model's estimated probabilities, whilst shaded ribbons indicate the 95% Credible Intervals. Individual points show the observed average of each participant by AQ-10 score and condition.

Turning to Experiment Two, recall that the key difference from Experiment One was that we introduced social biases to participants in both the redundant and informative case conditions. Importantly, these biases went *against* how participants usually act in response to fixed/flexible word order and optional case marking. In the redundant case condition, the bias was *in favour* of the group that used redundant case, whilst in the informative case condition, the bias was *against* the group that used informative case. In other words, both biases were designed to encourage participants to be less communicatively efficient. I again fit a Bayesian linear regression model with Bernoulli likelihood and a logit function, with a similar structure to Experiment One: Case marker $\sim$ Bias * AQ-10. Again, AQ-10 score was standardised using z-score standardisation, and bias was sum-coded (Bias for Redundant Case +1, Bias For No Informative Case -1).

In Experiment 2, we found that participants biased in favour of redundant case were significantly more likely to use redundant case than predicted by chance, whilst those biased against informative case were significantly less likely to use it than predicted by chance. Additionally, we found that higher autistic traits, measured by the AQ-10, led participants to produce even more redundant case in the presence of a social bias. Table A.6 summarises the Bayesian model's posterior estimates, which accord with the pattern found using frequentist analysis. Specifically, the 95% CrIs for the bias for redundant case are fully positive (95% CrI: [1.94, 3.04]), providing strong evidence of a positive effect of this bias on case marker usage. Additionally, the probability mass of the interaction between the bias for redundant case and AQ-10 scores is also fully positive (95% CrI: [0.11, 1.14]), which aligns with the key finding of the relationship between AQ-10 scores and the bias for redundant case reported in the manuscript above. These findings are visualised in Figure A.3.

Parameter	Posterior Mean	95% CrI Lower	95% CrI Upper
Intercept	1.15	0.65	1.67
Bias for Redundant Case	2.46	1.94	3.04
Standardised AQ-10	0.29	-0.21	0.80
Bias For Redundant Case:Standardised AQ-10	0.62	0.11	1.14

Table A.6: Posterior means and 95% Credible Intervals from a model estimating the influence on case marker usage by bias condition and standardised AQ-10 score in Experiment 2.

Further, using the posterior draws of the model as done above for Experiment One, Table A.7 shows the condition-specific estimates and their 95% CrIs, which allows us to examine the use of informative case. The 95% CrI for the bias for no informative case is fully negative (95% CrI: [-2.05, -0.63]), corresponding with the frequentist analysis showing that the bias leads to participants using less informative case.

Condition	Posterior Mean	95% CrI Lower	95% CrI Upper
Bias For Redundant Case	3.61	2.86	4.44
Bias For No Informative Case	-1.32	-2.05	-0.63

Table A.7: 95% Credible Intervals for estimates of the effect of both bias conditions on case marker usage, calculated from the model's posterior draws.

The slopes for the relationship between AQ-10 and bias, calculated from the posterior draws, align with the original result that the interaction between bias for no informative case and AQ-10 score did not have a clear effect on case marker usage, with the 95% CrIs including 0 (95% CrI: [-0.99, 0.34]). Notably, the posterior distribution is skewed towards negative values, suggesting a possible negative effect of AQ-10 score on case marker usage in this condition. Indeed, the proportion of samples where the slope is less than 0 is around 83%. However, there remains substantial uncertainty.

Condition	Slope Mean	95% CrI Lower	95% CrI Upper
Bias For Redundant Case	0.91	0.17	1.70
Bias For No Informative Case	-0.33	-0.99	0.34

Table A.8: Posterior mean slopes and 95% credible intervals for the effect of standardized AQ-10 on case marker use by bias condition in Experiment Two.

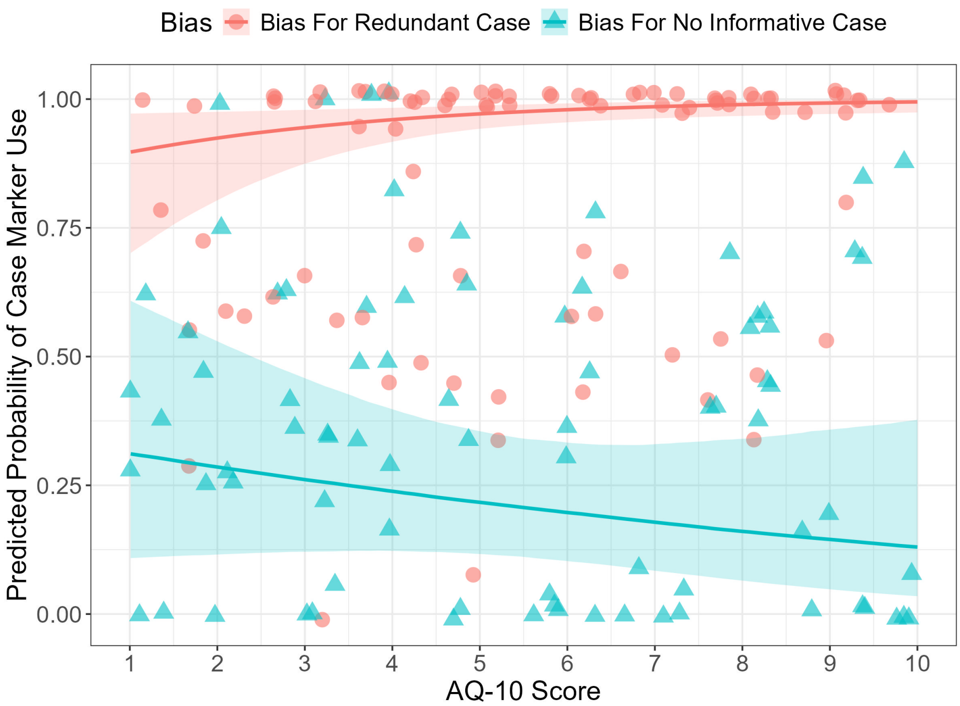


Figure A.3: Estimated relationship between AQ-10 scores and the predicted probability of case marker usage mediated by bias condition in Experiment Two. Solid lines represent the model's estimated probabilities, whilst shaded ribbons indicate the 95% Credible Intervals. Individual points show the observed average of each participant by AQ-10 score and condition.

Finally, I considered the relationship between autism diagnosis, autism identity, and family history on case marker usage in both conditions. Recall that in the manuscript above, we found that being diagnosed as or identifying as autistic was not significantly associated with using more redundant case marking. The Bayesian approach allows us to make more nuanced inferences by quantifying uncertainty, rather than only rejecting the null hypothesis. I ran models with autistic identity and autistic diagnosis as predicts on case marker usage, as well as their interaction with the bias conditions.

The posterior estimates of the model for autism identity can be found in Table A.9, while the marginal effects for each condition were computed using the draws, and can be seen in Table A.10. In all cases, the model shows uncertainty; the 95% CrIs all contain 0. However, the posterior estiamte for the interaction between the bias for redundant case and identifying as autistic is mostly negative (95% CrI: [-0.12, 0.91]), providing some evidence – though uncertain – that autistic identity may further increase the use of redundant case in this condition. Additionally, the estimates from the draws suggest that identifying as autistic may also reduce the use of informative case to meet the bias since most of the probability mass is negative (95% CrI: [-1.18, 0.27]), but we cannot be certain in this effect.

Parameter	Posterior Mean	95% CrI Lower	95% CrI Upper
Intercept	1.13	0.62	1.67
Bias For Redundant Case	2.42	1.89	2.99
Autistic Identity	-0.06	-0.58	0.46
Bias For Redundant Case:Autistic Identity	0.39	-0.12	0.91

Table A.9: Posterior means and 95% Credible Intervals from a model estimating the influence on case marker usage of bias condition and autistic identity in Experiment 2.

Parameter	Posterior Mean	95% CrI Lower	95% CrI Upper
Bias For Redundant Case:Autistic Identity	0.33	-0.40	1.05
Bias For No Informative Case: Autistic Identity	-0.46	-1.18	0.27

Table A.10: Posterior means and 95% Credible Intervals from a model estimating the influence on case marker usage of bias condition and autistic identity in Experiment 2.

Overall, the Bayesian re-analysis of the data from Chapter Three corresponds to the results obtained via frequentist methods, reinforcing the original findings. Importantly, this re-analysis allows for clearer comparisons between the results in this chapter and the next, as I specified the models in this appendix closely to how they are specified in the next chapter.

Appendix B

Chapter 4 Appendices

B.1 Outline

This appendix contains information on consent and the instructions provided to participants. Additionally, I provide further demographic information, and more detailed information about participants' scores on various standardised tests.

B.2 Consent and instructions provided to participants

B.2.1 Consent information

As described in the manuscript above, participants gave consent via button press on an initial consent screen before progressing to the main experiment (see Figure B.1).

Participants were also provided with an information sheet, in pdf format, that gave further details about the nature of the study, including how their data would be used and protected. The full text of this form is given on the next page.

Informed Consent Form

This is an experiment about language learning. It will take about 35-40 minutes to complete, and you will be compensated by the amount indicated on Prolific.
It is being conducted by Lauren Fletcher, with Profs Jennifer Culbertson & Hugh Rabagliati at the University of Edinburgh.
Please click here to read an information letter (pdf) about the study.

By agreeing below you indicate that:
-You are at least 18 years old.
-You are a native speaker of English.
-You have read the information letter.
-You voluntarily agree to participate, and understand you can stop your participation at any point.
-You agree that your anonymous data may be kept permanently by the researchers and may be used for research purposes.

Continue

Figure B.1: Consent page presented to participants.

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B.3 Instructions

As in Chapter Three, the instructions were very similar across the two bias conditions, with the exceptions of the initial instructions (where the biases were introduced) and the attention check.

Initial instructions (positive bias):

> You are part of a mission to an alien planet. You will be learning the language of the aliens living there, pictured below.

> The aliens are very friendly, and they are clearly excited about working with us. They see opportunity in our differences, and embrace them. We need their resources and help in order to survive our expedition. They are already on our side, and willing to provide us with what we need.

Initial instructions (negative bias):

> You are part of a mission to an alien planet. You will be learning the language of the aliens living there, pictured below.
>
> 
>
> The aliens are hostile to us, and they clearly dislike that we are different than them. They are difficult to work with and present a threat. But, we need their resources and help in order to survive our expedition. We need to impress them and try and make them come round to our side.

Noun exposure instructions:

> First, you are going to learn some of the words that the aliens use in their language.
> You will be shown a picture and the word that describes it. Please press next when you are confident that you know the meaning of the word, and you will see the next word.

Noun comprehension instructions:

> Now, you are going to be tested on your ability to understand the words in the alien language. You will see a set of pictures, as well as one of the words you saw before. Please click on the picture that corresponds to the word.

Noun production instructions:

> Great work so far! Next, you are going to be tested on your ability to use the words in the alien language. You will see a picture. Please pick the word that describes the picture.

Attention check instructions:

> Before we continue, please click on the option below that best reflects how the aliens feel about us.

Attention check feedback (correct, positive bias):

> Good job! The aliens are **very friendly**, **excited about working with us**, and see **opportunity in our differences**. They seem happy to provide the important resources we need to survive.

Attention check feedback (incorrect, positive bias):

> Incorrect. The aliens are **very friendly**, **excited about working with us**, and see **opportunity in our differences**. We need their resources, but they seem happy to provide them.

Attention check feedback (correct, negative bias):

> Good job! The aliens are **very hostile** towards us, and they **dislike that we are different** from them, and they **present a threat**. But we need them in order to survive, so we have to try and impress them and bring them around to our side.

Attention check feedback (incorrect, negative bias):

Incorrect. The aliens are actually **very hostile**, they **dislike that we are different** from them, and they **present a threat**. But we really need their resources to survive, so we need to try and impress them and bring them around to our side.

Sentence exposure instructions:

In the next part of the study, you are going to be learning the grammar of the language that the aliens use. You will see a picture and a sentence that describes it. Please press next when you are confident to move to the next sentence.

Sentence comprehension instructions:

Next, we are going to test your understanding of the alien language. You will see two pictures and a sentence spoken by one of the aliens that we are meeting with. Please choose the picture that corresponds to the sentence by clicking on that picture.

Sentence production instructions:

Finally, the aliens want to test your ability to speak their language. You will be shown a picture. Please click the words in order to create a sentence that describes the picture. You can reset your choices by clicking “reset".

Pre-psychometric test instructions:

Great work! Your language learning really impressed the aliens, who are now going to trade with us to help make our expedition a success. Now, we are going to ask you some questions about your experiences in everyday life. Please answer honestly; there are no right or wrong answers!

Language and autism background question instructions:

Thank you for all your answers so far. We are finally going to ask some short questions about your language experience and your history of autism.

Ending instructions:

Thank you for participating in this study!
Please make sure that you click the button below, rather than closing the page. You will be automatically directed to Prolific.

B.4 Language background

We asked participants to provide further background about their language background. The majority of participants reported their native language as English (150); some reported more than one native language alongside English (1 Tshivenda, 1 Gujarati and Hindi, 1 Hungarian, 1 French, and 1 Swahili). A handful of participants reported a native language other than English (1 Urdu, 1 French, 1 Sepedi, 1 Spanish, and 1 Zulu).

Participants reported a variety of other language experiences. Some participants noted not considering themselves fluent in all of the languages they mentioned. Many participants identified experience with more than one language other than English.

Language	No. of Participants	Language	No. of Participants
No other experience	90	French	13
Other experience not specified	12	Spanish	12
German	7	Afrikaans	2
Sotho	2	Arabic	1
Bengali	1	Chinese	2
Swedish	2	Gaelic	1
Hungarian	1	Gujarati	2
Japanese	2	Polish	2
Portuguese	1	Romanian	2
Sepedi	2	Xhosa	2
Ndbele	1	Shona	1
Tsonga	1	Setswana	3
Dutch	2	Italian	2
Swahili	1	Urdu	1
Welsh	1	Sureth/Assyrian	1
Zulu	1	Punjabi	1
Greek	1	Latin	1

Table B.1: Number of participants who report experience with various languages. Note that there are more more participants reported here than took part in the experiment, as some participants reported experience in more than one language.

Appendix C

Chapter 5 Appendices

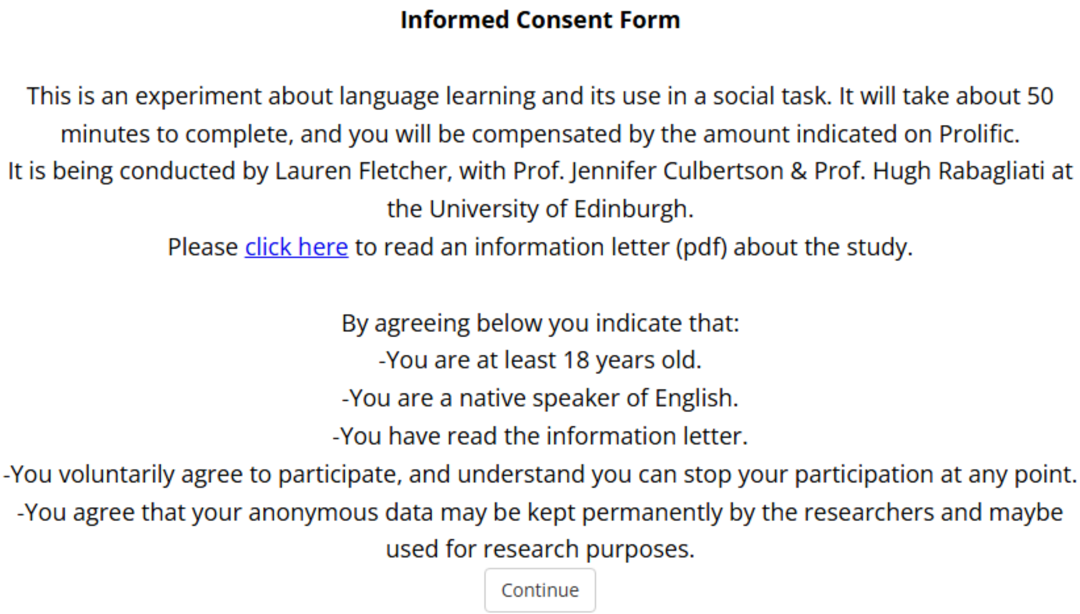
C.1 Outline

This appendix contains supplementary information and analyses for chapter five. First, I provide the consent information and instructions that were given to participants. Then, I summarise the language backgrounds of our participants. Following this, I discuss our results with respect to the language preferences of our participants with ADHD, and consider whether there are group differences between ADHD-only and ADHD and autistic participants. Finally, I provide an exploratory analysis of the rapport data gathered for both experiments.

C.2 Consent and participant instructions

C.2.1 Consent information

Participants were required to give their consent by button press before beginning the main experiment (see Figure C.1). Additionally, they were provided with a full information letter, providing further details about how their data would be used and what the study would entail.



Informed Consent Form

This is an experiment about language learning and its use in a social task. It will take about 50 minutes to complete, and you will be compensated by the amount indicated on Prolific.
It is being conducted by Lauren Fletcher, with Prof. Jennifer Culbertson & Prof. Hugh Rabagliati at the University of Edinburgh.
Please click here to read an information letter (pdf) about the study.

By agreeing below you indicate that:
-You are at least 18 years old.
-You are a native speaker of English.
-You have read the information letter.
-You voluntarily agree to participate, and understand you can stop your participation at any point.
-You agree that your anonymous data may be kept permanently by the researchers and maybe used for research purposes.

Continue

Figure C.1: Consent page presented to participants for the main experiments reported in Chapter Five.

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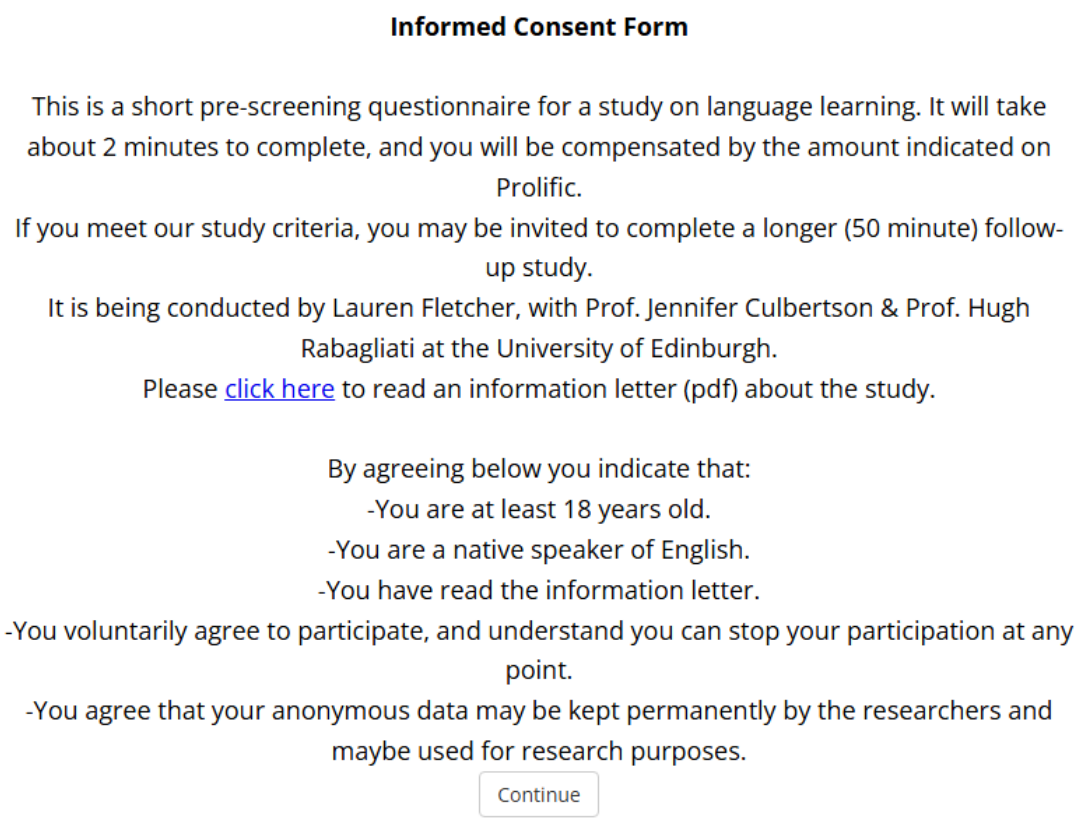
Similarly, for the pre-screening before the main study, participants were required to indicate their consent by button press (see Figure C.2, and were also provided with an information sheet with further details about the study



Informed Consent Form

This is a short pre-screening questionnaire for a study on language learning. It will take about 2 minutes to complete, and you will be compensated by the amount indicated on Prolific.
If you meet our study criteria, you may be invited to complete a longer (50 minute) follow-up study.
It is being conducted by Lauren Fletcher, with Prof. Jennifer Culbertson & Prof. Hugh Rabagliati at the University of Edinburgh.
Please click here to read an information letter (pdf) about the study.

By agreeing below you indicate that:
-You are at least 18 years old.
-You are a native speaker of English.
-You have read the information letter.
-You voluntarily agree to participate, and understand you can stop your participation at any point.
-You agree that your anonymous data may be kept permanently by the researchers and maybe used for research purposes.

Continue

Figure C.2: Consent page presented to participants for pre-screening for the experiments reported in Chapter Five.

[pages=-,pagecommand=,scale=1]chapter5/pre$_{s}creening_{c}onsent_{A}A_{e}dit.pdf$

C.2.2 Instructions

For both experiments, the instructions provided to participants were similar, changing only for the manipulation of participants' beliefs about their partner's neurotype.

Noun training instructions:

> Today, you will be learning part of a new language. After learning the language, you will be paired up with a partner and play a game with them where you will use the language. First, you are going to learn some of the words of this new language. You will first be shown a picture, and the word that describes it. Then, you will be asked to pick from a set of words which word describes the picture.

Noun testing instructions:

> Now, you are going to be shown a picture, and asked to pick the word to describe it. You will be told if your choice is right or wrong.

Sentence training instructions

Now that you have learnt the words in this language, you are going to be shown some sentences in the language that describe different scenes.
You will first be shown a picture and the sentence that describes it. You will then be asked to re-create the sentence that you saw.

Recall test one instructions:

You will now be asked to create sentences that describe a given image. Please form a sentence by clicking the words in the order that they should go. You can click the reset button to reset your choices.

Interaction preamble:

Great work so far in learning the language!
Now, you will be paired up with another learner, and play a game together using the language.

Request for a description to be sent to the 'partner':

While the system finds you a partner, please type a short message that greets them, describes two things that you like to do, and then something that is important to you. Please do not include any information that could identify you (such as your real name, ethnicity, political affiliation, etc.).

Partner description introduction:

We have found a partner for you to play the game with in the language.
You will first be shown an image, and asked to create a sentence that describes the picture. It will be your partner's job to pick the image that you were describing. Both you and your partner will be told if your partner is able to guess correctly from your sentence.
Then, it'll be your partner's turn to describe an image, and yours to pick an image based on their description. Both you and your partner will be told if you are able to correctly guess the image based on your partner's description.
Before we start, your short description will be passed to your partner, and you will seen the description of themselves that your partner wrote for you.

Partner description options (given in bold are the different neurotype disclosures (autistic, ADHD, none), which were given dependent on condition):

Hello. I like to cook and listen to music. One thing that is important to me is **I am autistic/I have ADHD/my family/my pets**.
Hello. I like to go running and watch movies. One thing that is important to me is **I am autistic/I have ADHD/my family/my pets**.

End of interaction:

Great work so far. Now, you will be disconnected from your partner.
Before we get to our final questions, you will be asked to create sentences that describe images again. Please form a sentence by clicking the words in the order that they should go.

Questionnaire instructions:

> Thank you for taking the time to complete the study so far. Before we finish, we have a few questions about what you thought about the study and your partner, your language background, your history of autism, and some questions about your preferences in specific situations.
> First, we will ask you some questions about your partner that you played the game with earlier. They won't be told about your answers (which will remain anonymous), so please be completely honest.

Post questionnaire instructions:

> Thank you for all of your answers. Please click next below to save your data; there may be a short delay before the experiment progresses to the final page. Please do not close the tab during this delay, or your data may not be saved and you may receive no/partial payment.
> Thank you for participating in this study!
> Please make sure you click the button below, rather than closing the page. You will be automatically directed to Prolific.

C.3 Language background

In Experiment 1, 148 participants reported their native language as English. Some participants reported being native in more than one language (1 Slovenian, 1 Polish, 2 Shona, 1 Greek, 1 Chinese, 1 Nepali, 1 Setswana). 11 participants reported native languages other than English (2 Polish, 1 Dutch, 1 Finnish, 2 French, 1 Xhosa, 1 Portuguese, 1 Shona, 1 Swahili, 1 Swedish). They also reported experience in a range of other languages, summarised in Table C.1. Some participants noted that they did not consider themselves fluent in their reported languages, others reported being fluent or intermediate in one language but less advanced in another.

In Experiment 2, all participants reported their native language as English. Some participants reported being native in more than one language (1 Persian (Farsi), 1 Russian, 1 Yiddish, 1 Cantonese, 1 Serbian, and 1 Singlish, Hokkien, and Mandarin). Participants also reported experience in a range of other languages (summarised in Table C.2, though some noted that they did not consider themselves fluent in these languages.

Language	No. of Participants	Language	No. of Participants
No other experience	72	Other experience not specified	15
French	31	German	12
Spanish	12	Ukrainian	2
Welsh	2	Polish	1
Afrikaans	2	Sesotho	1
Zulu	4	Croatian	1
Greek	1	Italian	6
Norwegian	2	Japanese	3
Irish	3	Mandarin	1
Arabic	1	Xhosa	1
Korean	2	Finnish	1
Czech	1	Portuguese	1
BSL	1	Turkish	2
Swedish	1	Tamil	1
Thai	1	Ulster Scots	1
Venda	1	Kernowek	1
Maori	1	Tagalog	1

Table C.1: Number of participants who report experience with various languages in Experiment 1 (Chapter 5). Note that there are more more participants reported here than took part in the experiment, as some participants reported experience in more than one language.

C.4 Language preferences of individuals with ADHD

Recent research has consistently demonstrated a preference for identity-first language amongst autistic people (Bury et al., 2020; Geelhand et al., 2023; Keates et al., 2024; Keating et al., 2023; Kenny et al., 2016a), and thus we refer to autistic people in this preferred manner. However, we know of no comparable research with the ADHD community. Thus, we asked the participants in our ADHD group how they preferred to be referred to. The majority of pre-screened participants who reported having ADHD (1622, 1027 ADHD only, 595 autistic and ADHD) successfully completed a likert-style survey on ADHD language preferences.

Participants were presented with 6 options, plus an optional free-text answer, which captured both person-first and identity-first preferences, as well as a recently-proposed term for ADHD that is parallel with describing oneself as autistic (“kinetic"). Participants were asked to rank each option on a scale of 1-10, with 1 being the least preferred and 10 the most preferred. Each option was framed both in the first and third person, but for the visualisation purposes, only the first person frames are presented in Figure C.3.

For the sake of simplicity, here we treat endorsement of a term as rating it 7 or above on the likert scale. Overall, the language preferences of people with ADHD look strikingly different than of autistic people; 84% of participants endorsed *I/they have ADHD* constructions, whilst 69% endorsed the similar *I am/they are a person with ADHD* construction. In contrast, Kenny et al. (2016b) found that only 28% of autistic adults endorsed the comparative phrases “has autism" and “with autism". On the other

Language	No. of Participants	Language	No. of Participants
No other experience	77	French	18
German	14	Not specified other experience	6
Spanish	11	Danish	1
Japanese	3	Korean	1
Turkish	1	Chinese (Not specified)	1
Mandarin	4	Cantonese	1
Swedish	1	Farsi	1
Italian	2	Hindi	1
Russian	2	Ikwerre	1
Norwegian	1	Haitian Creole	1
Welsh	2	Assyrian	1

Table C.2: Number of participants who report experience with various languages in Experiment 2 (Chapter 5). Note that there are more more participants reported here than took part in the experiment, as some participants reported experience in more than one language.

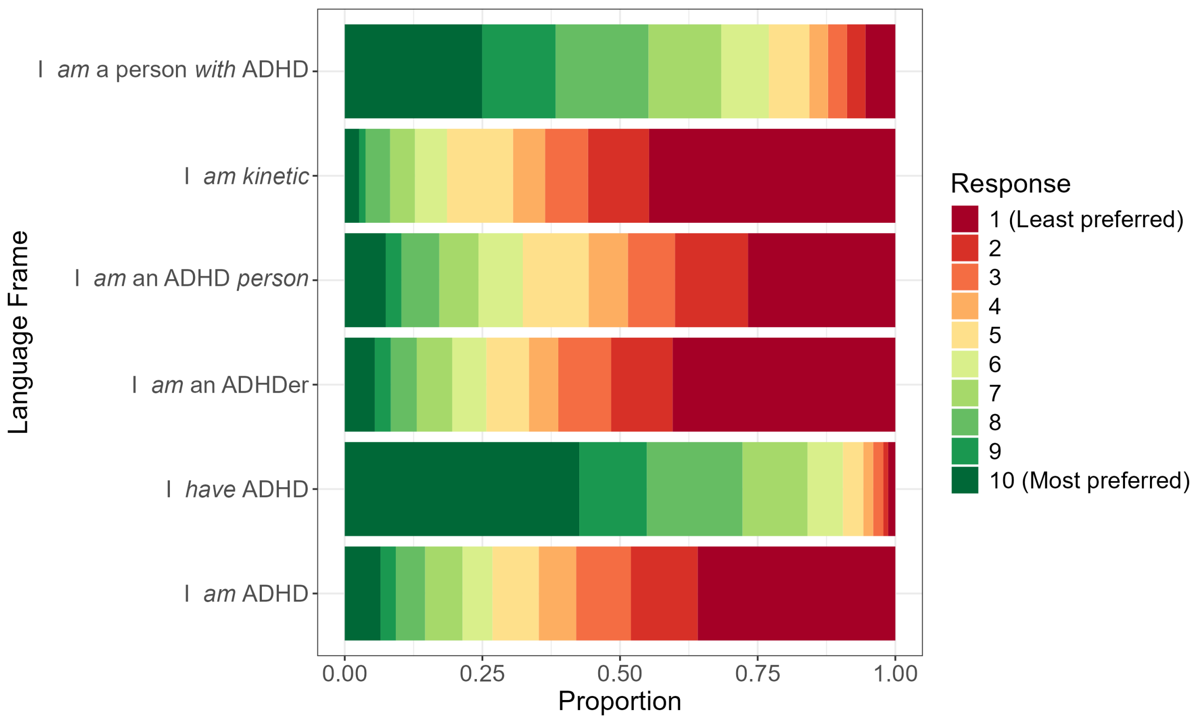


Figure C.3: Likert-style response data for language preferences of people with ADHD.

hand, endorsement of identity-first language was much lower than is found in autistic people: 21% of participants endorsed *I am/they are ADHD*, 20% *I am/they are an ADHDer*, 13% *I am/they are kinetic*, and 24% *I am/they are an ADHD person*. In autistic people, some 61% endorse “is autistic" or simply “autistic" (Kenny et al., 2016b).

Considering the pre-existing evidence around autistic people's preferences for terminology to describe autism, we considered whether our participants who identified as both having ADHD *and* being autistic differed in their language preferences. Our hypothesis here was that autistic people with ADHD may prefer identity-first language more than people who only have ADHD.

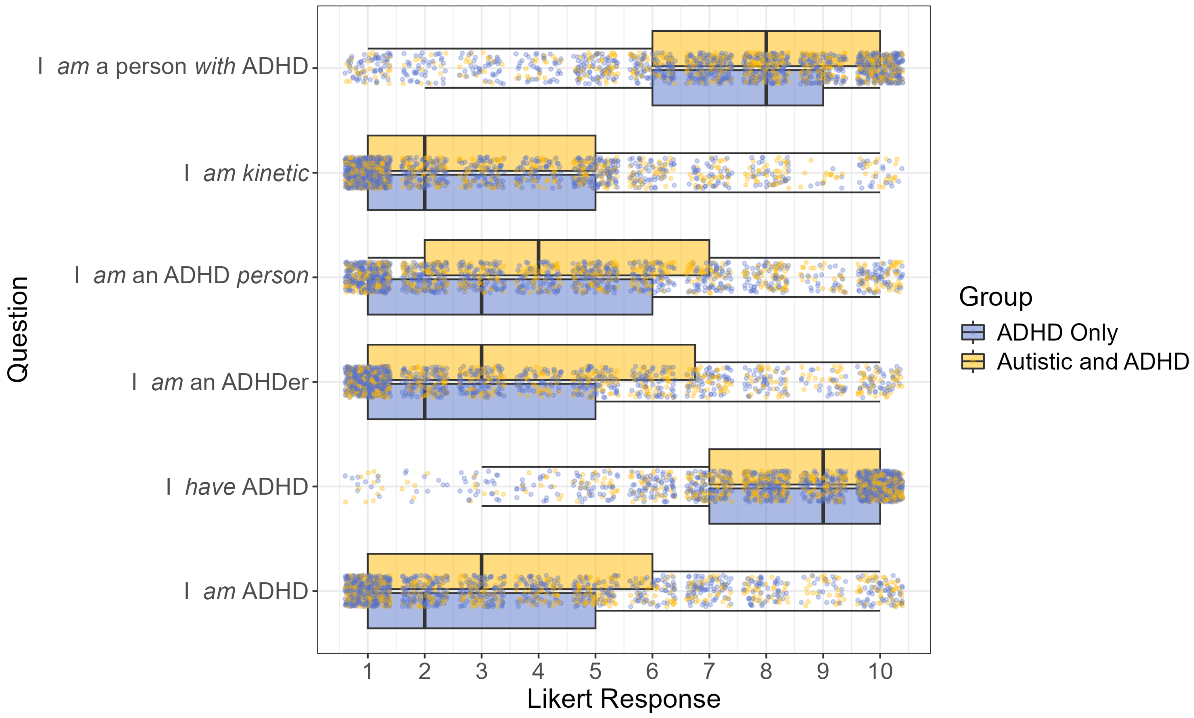


Figure C.4: Boxplot showing the comparison between autistic people with ADHD and people with ADHD only on likert-style responses to various ADHD terminology. Boxplots show the median and interquartile ranges for responses to each question by group, and individual participant responses are overlaid as jittered points.

A comparison between the two groups is shown in Figure C.4. It is immediately clear that there is significant variability in endorsement of terms across all participants; even terms that are generally endorsed at high rates have some participants who reject them. Turning to group differences, the boxplots suggest some subtle differences, particularly with respect to identity-first language (see Table C.3 for summary statistics for each of the groups). Further, I also conducted Mann-Whitney U tests[1] for each question, with the response as the dependent variable and group membership (ADHD only versus autistic and ADHD) as the independent variable. Results for these tests can be found in Table C.4. All

1. Whilst Bayesian modelling was attempted for this data, the models did not converge, potentially due to the low number of responses in the middle range of the likert scale.

of the p-values are significant save for the *I have ADHD* question, suggesting that people who are both autistic and have ADHD overall have significantly different preferences with respect to how they prefer their ADHD to be described. They do seem to endorse identity-first language more, such as *I am ADHD* or *I am an ADHDer*.[2]

Question	Group	Median	Mean	IQR
I am ADHD	ADHD Only	2	3.50	4
	Autistic and ADHD	3	4.13	5
I have ADHD	ADHD Only	9	8.34	3
	Autistic and ADHD	9	8.26	3
I am an ADHDer	ADHD Only	2	3.30	4
	Autistic and ADHD	3	4.00	5.75
I am an ADHD person	ADHD Only	3	4.00	5
	Autistic and ADHD	4	4.60	5
I am kinetic	ADHD Only	2	2.90	4
	Autistic and ADHD	2	3.50	4
I am a person with ADHD	ADHD Only	8	7.10	3
	Autistic and ADHD	8	7.43	4

Table C.3: Medians, means, and interquartile ranges of likert-style responses measuring preference of terminology around ADHD, comparing people with ADHD only to autistic people with ADHD.

Question	p-value
I am ADHD	3.06×10^{-5}
I have ADHD	0.327
I am an ADHDer	5.53×10^{-6}
I am an ADHD person	1.42×10^{-4}
I am kinetic	3.71×10^{-5}
I am a person with ADHD	0.0287

Table C.4: Wilcoxon test p-values for group differences in likert-style preference responses to different ADHD terminology.

2. Anecdotally speaking, the phrase “ADHDer" is common in the online discourse of the autistic community. Additionally, the phrase ‘kinetic’ is also seen within the online autistic community. It is possible that autistic people with ADHD prefer these phrases more than those with only ADHD simply because they have been exposed to them, whilst those outside of autistic circles may not have been.

Note however that, whilst these differences may be significant, the summary statistics show that autistic people with ADHD do not come close to overwhelmingly preferring identity-first language to describe ADHD. For example, the median ratings for *I am ADHD* and *I am an ADHDer*, which are both highly significant, are only 3, though the IQRs are large, suggesting a great deal of variability. Further, the difference between the two groups in rating *I have ADHD* is non-significant, and the summary statistics also suggest little difference, with this being both groups' most endorsed term, despite being person-first.

These results suggest that our ADHD only participants prefer person-first constructions such as *I am a person with ADHD* and *I have ADHD*, whilst they generally disprefer framings such as *I am ADHD*. As this was the group included in the study (participants who reported both having ADHD and being autistic were excluded from further data collection), we use these terms to refer to ADHD, in line with their preferences.

A limitation of our data is that we did not ask autistic participants with ADHD their preferences around language and autism (since the goal was to fill the gap of research with language around ADHD), meaning that we cannot determine if the autistic participants with ADHD who prefer person-first language for ADHD also prefer person-first language to describe their autistic identity. Further, there are potentially more foundational issues with Likert scale data collection with autistic people, who report that Likert scales can be difficult to respond to (Stacey & Cage, 2023).

C.5 National identity mixing/matching data

We were interested in whether the results from Experiment 1 reflected something about *being autistic* and having autistic identity, or if community membership more broadly would impact linguistic accommodation. To that end, we conducted a very similar experiment but with national identity mixing, rather than neurotype mixing. Specifically, we recruited participants who described their nationality as Scottish, and paired them with a 'partner' who either also disclosed a Scottish identity, or disclosed an English identity. This element of identity was chosen as it is linguistically relevant, and also allowed us to produce a specific *match* condition for neurotypical people, which had previously been difficult to naturally introduce. As in Experiment 1, we predicted that there would be less accommodation, and less retention of the accommodated variant, in national identity mixed pairs (Scot-Eng) than national identity matched pairs (Scot-Scot).

Ultimately, however, this dataset was not included in the final version of the manuscript provided above. All three authors agreed that they somewhat detracted from the central focus of the paper, and the results themselves did not provide enough clarity to clearly answer our questions about whether the important angle was autistic identity, or just community membership more broadly. They are presented here to offer a fuller picture of the experimental process and results.

C.5.1 Participants

104 participants were recruited via Prolific. Participants were self-reported native speakers of English, 18 years or older, and also reported their national identity as Scottish and current country of residence as Scotland. Participants were compensated £7.50 for their participation. After exclusions (following the same procedure outlined in the manuscript above), 40 participants remained in the Scot-Eng mixed condition, whilst 35 remained in the Scot-Scot matched condition.

C.5.2 Methods and analysis

The methods were the same as described in the manuscript above, with the exception of the partner description. For this, we introduced the partner with one of two options (chosen randomly by participant): 1) *Hello. I like to cook and listen to music. One thing that is important to me is that I am Scottish/English*; 2) *Hello. I like to go running and watch movies. One thing that is important to me is that I am Scottish/English*.

I fit a Bayesian linear regression model with Bernoulli likelihood and a logit function. Prior predictive checks indicated that weakly regularising priors were appropriate. Condition was sum coded (mixed -1, matched +1). Phase was treatment coded (reflecting the chronological order of the phases), with the levels Phase (2-1) (the difference between phase 1, the first recall test, and phase 2, the director-matcher phase) and Phase (3-2) (the difference between phase 2, the director-matcher phase, and phase 3, the second recall test). The model contained random intercepts and random slopes for each phase within each subject. The model was specified as Singular Marker $\sim$ Condition * Phase + (Phase|Subject)[3]. Posterior predictive checks indicated a good model fit to the data, and the model converged with all Rhats = 1.00.

C.5.3 Results

Parameter	Posterior Mean	95% CrI Lower	95% CrI Upper
Intercept	0.38	-0.47	1.23
Scot-Scot (Matched)	-0.61	-1.48	0.25
Phase (2-1)	0.29	-0.71	1.33
Phase (3-2)	-2.55	-3.80	-1.33
Scot-Scot (Matched):Phase (2-1)	0.13	-0.90	1.13
Scot-Scot (Matched):Phase (3-2)	0.18	-1.06	1.47

Table C.5: Posterior means and 95% Credible Intervals for the model considering the impact of phase and condition on singular marker usage for the national identity mixing/matching conditions.

The output of the model is reported in Table C.5. The model's output is visualised in Figure, whilst Figure shows the raw data. The model estimates a negative effect of Phase (3-2), such that singular marker usage decreases after interaction, as also found in the experiments reported in the manuscript above (95% CrI: [-3.80, -1.33]). However, as for condition, there are no clear effects; the 95% CrIs for both condition and for the interactions between condition and phase all include 0, indicating a good degree of uncertainty about the direction of the effect. However, if anything, the model suggests that matching might actually *decrease* the use of the singular marker; the credible intervals for the matched condition contain a majority of negative probability mass (95% Cr: [-1.48, 0.25]), though it is again important to highlight that this effect is not certain.

C.5.4 Discussion

Whilst we collected this data with the goal of understanding how a different dimension of identity impacts linguistic accommodation, the results offer no clear evidence that national identity mixing affects accommodation. There is uncertainty in all of the estimates related to condition, particularly in the interaction between condition and phase.

One possible explanation is that something of a 'non-native' effect occurring. Previous work on accommodation found that speakers of American English were *more* likely to accommodate to speakers of other accents (Korean and Indian) that they were to speakers with American English accents (Chun et al., 2016). Suffill et al. (2021) similarly found that people lexically accommodate more to non-native

3. The analysis of this data was conducted before the decision was taken to analysis the rest of the data using an indexing approach without an Intercept.

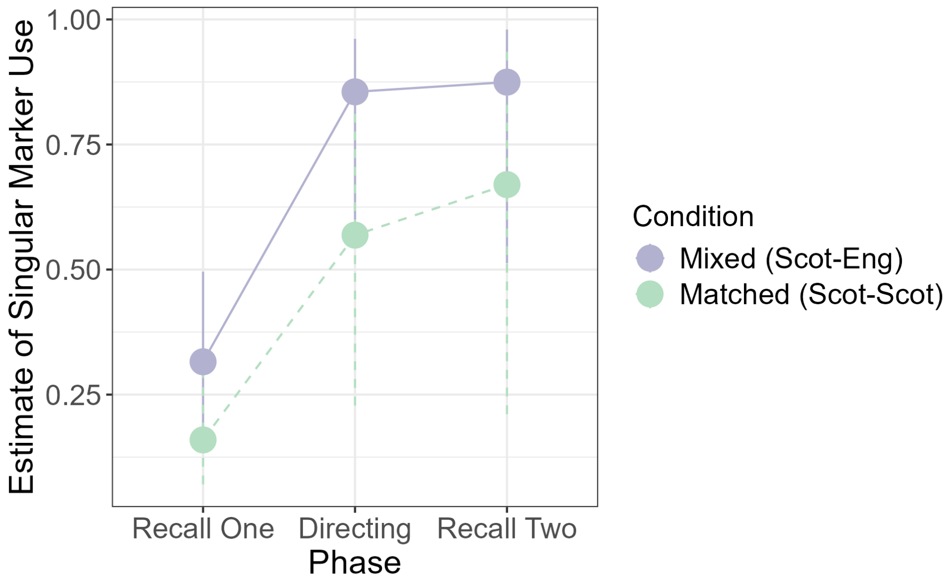


Figure C.5: Estimated use of singular marker across each phase by condition. Vertical lines represent the credible intervals around the estimated effects.

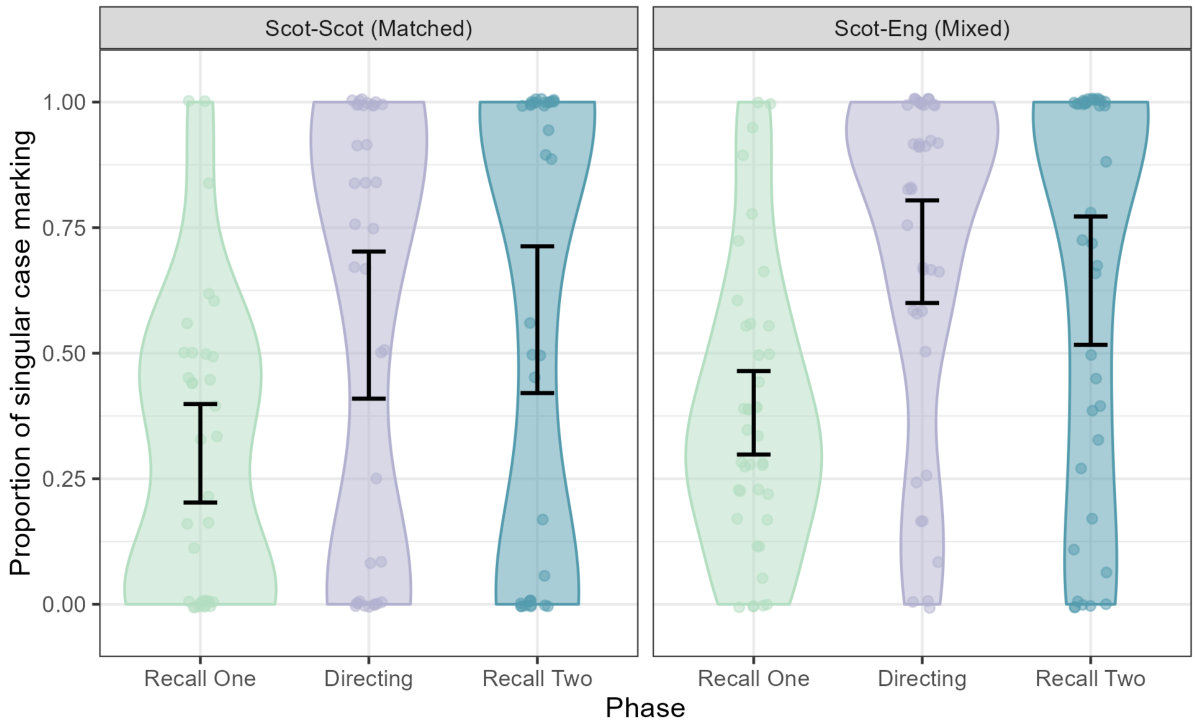


Figure C.6: Violin plot of singular marker usage in different phases, faceted by condition, with bootstrapped 95% confidence interval errors. Individual points indicate individual participants' means.

partners who use dispreferred terms than they are to native partners who do the same. Whilst Scottish and English English are both native dialects, it is possible that the Scottish participants perceived their English partners as specifically a linguistic other, rather than just members of a different community who share the same language.

That said, the evidence for this effect is not strong, as there is a good degree of uncertainty in the estimate that matched pairs accommodated less than mixed pairs. Ultimately, it remains unclear why national identity mixing did not impact accommodation in this experimental setting; further work is needed to understand if there is truly no effect, or if this is an artifact of our experimental design.

C.6 Exploratory analysis of rapport questions

In both Experiments 1 and 2 in this chapter, we additionally asked participants a set of 'rapport' questions. These questions were based on those found in (Heasman & Gillespie, 2019), and the goal was to understand if rapport was impacted by group, match condition, or the interaction between the two. After completing the main experiment, participants were required to rate various statements regarding both themselves and their partner on a 6-point likert scale, where 1 indicated that they strongly disagreed with the statement, and 6 that they strongly agreed. The list of questions is in Table C.6.

To understand whether rapport scores differed by group and match condition, I fit Bayesian cumulative logit mixed-effects models. I used weakly regularising priors, including Student-t priors for the Intercept and the random effects, to allow for more extreme values than typically permitted by a normal distribution. I fit two models; one contained the responses to prompts regarding perception of the partner, and the other responses to prompts regarding the perception of self. The models were of the structure Response $\sim$ Group * Match * Question + (1|Subject). In both models, group (+1 autistic, -1 allistic) and match condition (+1 matched, -1 mixed) were sum-coded. The Likert scale responses were treated as ordinal. Both models converged, with all Rhats = 1.00. Posterior predictive checks indicated good fit to the data.

Prompt	Short Name
Prompts regarding the perception of the partner	
I found my partner's description, given before the game started, useful.	Partner Description
I found my partner helpful in playing the game	Partner Helpful
I found my partner frustrating when playing the game	Partner Frustration
I found my partner to act intelligently when playing the game	Partner Intelligence
I believe that my partner had a good grasp of the language that we were using to play the game	Partner Language Knowledge
My partner's answers were predictable throughout the game	Partner Predictable
My partner showed a lot of variation in their answers throughout the game	Partner Variation
Did you have a positive impression of your partner?	Partner Positive
Prompts regarding the perception of self	
I believe that my partner would have found my description, given before the game started, useful.	Self Description
I believe that I was helpful to my partner in the game	Self Helpful
I believe that my partner found it frustrating to play the game with me	Self Frustration
I believe that I acted in an intelligent way when playing the game	Self Intelligence
I believe that I had a good grasp of the language that we were using to play the game	Self Language Knowledge
Do you think that your partner had a positive impression of you?	Self Positive

Table C.6: Set of prompts, relating to partner rapport and participants' own self-perception, that participants were asked to rate on a 1-6 Likert Scale after completing Experiments 1 and 2 in Chapter Five. 'Short name' refers to the name by which each prompt will be referred to when reporting models.

First, turning to the self-ratings, there are few notable trends in the model (see Table C.7 and Figure C.7). Generally, participants were more likely to rate themselves favourably and less likely to rate themselves unfavourably, based on the Intercept parameters. The model estimates a negative effect of being autistic, such that they generally rated themselves less favourably (95% CrI: [-0.52, -0.04]). Interestingly, however, whilst participants generally rate their self frustration level lower than the other questions (as to be expected if participants generally rate themselves favourably), autistic participants rate themselves as *more frustrating* to their partner (95% CrI: [0.14, 0.82]). There are no clear effects of match condition, or of three-way interactions between group, match condition, and prompt, though the interactions between autistic and matched and self language knowledge and self positive both trend in a positive direction, with some uncertainty.

Turning to partner ratings (see Table C.8 and Figure C.8), we similarly see, based on the Intercepts, that participants were generally more likely to rate their partner more favourably than less favourably. Autistic participants overall rated their participants less favourably (95% CrI: [-0.60, -0.15]), and this is notably not driven by the frustration prompt, which autistic participants actually rate their partners higher

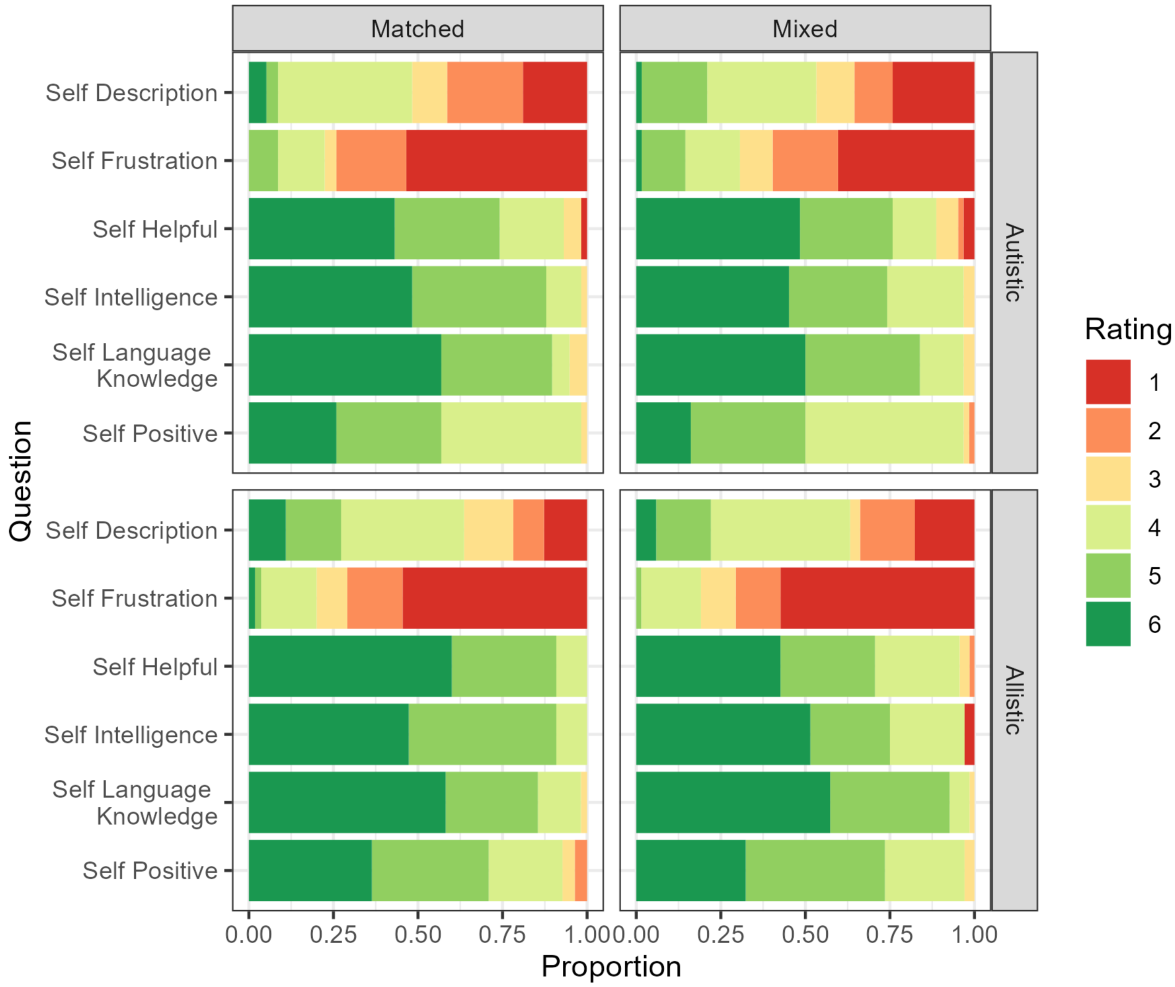


Figure C.7: Likert-type stacked bar chart showing proportion of responses to each self rating question. The columns are faceted by match condition, and the rows by neurotype.

on (95% CrI: [0.15, 0.88]). Autistic participants were also more likely to report that their partners were more predictable (95% CrI: [0.39, 1.04]). The effect of matched pairs trends higher, but the CrIs still include 0, meaning we cannot be certain about the effect (95% CrI: [-.09, 0.36]). Overall, there are few clear effects of matching or the interaction between matching and group on any of the prompts.

Taken together, there are only a handful of instances where the model predicted rapport scores to be impacted by group or match condition. Visually examining the results also suggests that they were generally fairly uniform across condition and group (see Figures C.8 and C.7), with the exception of the fact that autistic people seem to generally rate lower on the scale than allistic people. This may be the result of different interpretations of the Likert scale, rather than actual differences in rapport. Given the lack of rapport differences, I argue that it is unlikely that these questions are 'tapping into' the mechanism that lead to differences in accommodation based on neurotype mixing in Chapter Five.

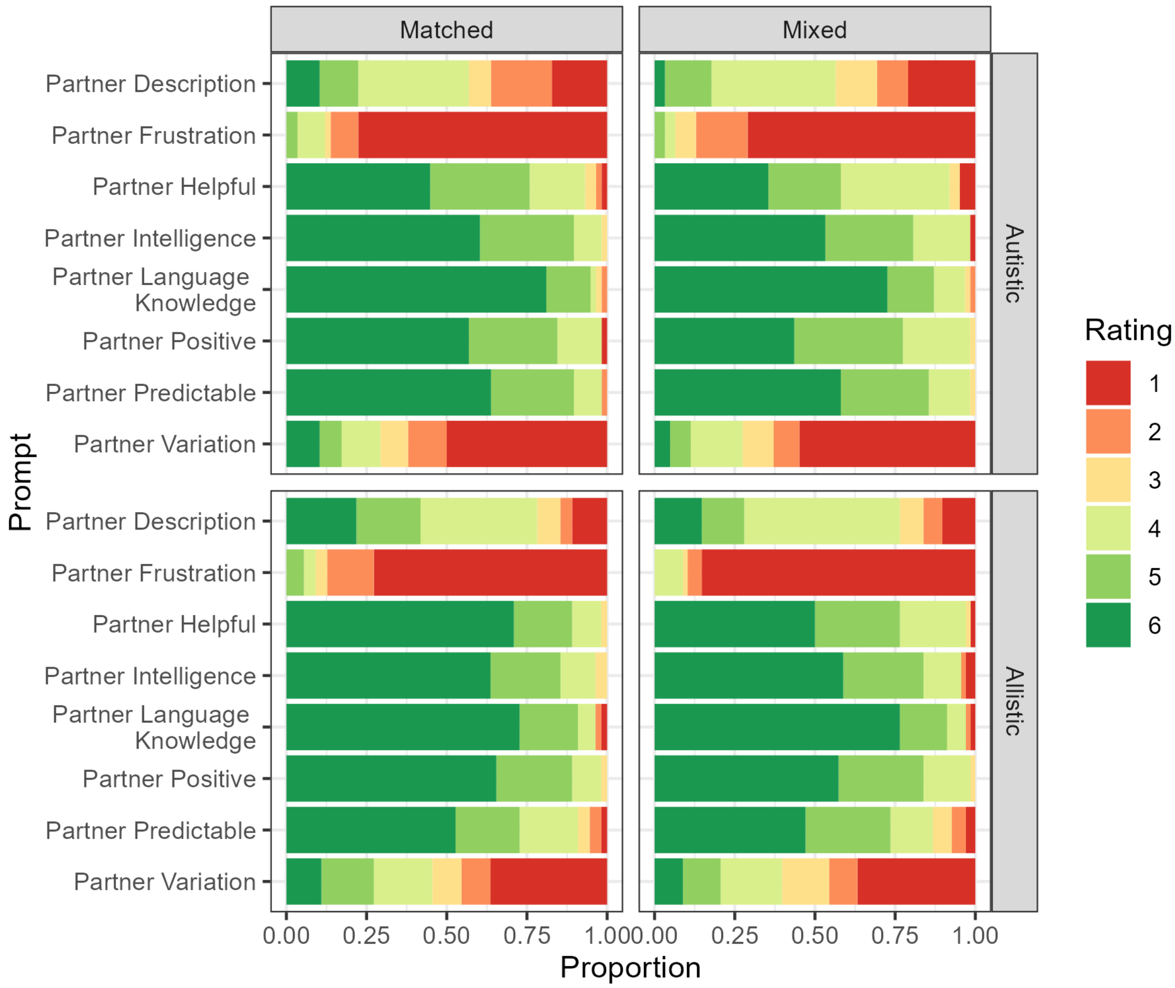


Figure C.8: Likert-type stacked bar chart showing proportion of responses to each partner rapport question. The columns are faceted by match condition, and the rows by neurotype.

Parameter	Posterior Mean	95% CrI Lower	95% CrI Upper
Intercepts and non-interactions			
Intercept[1]	-1.78	-2.08	-1.49
Intercept[2]	-1.04	-1.31	-0.78
Intercept[3]	-0.50	-0.76	-0.24
Intercept[4]	1.40	1.13	1.67
Intercept[5]	3.08	2.78	3.40
Autistic	-0.28	-0.52	-0.04
Matched	0.02	-0.22	0.26
Self Frustration	-1.81	-2.17	-1.46
Self Helpful	2.88	2.52	3.24
Self Intelligence	2.98	2.63	3.34
Self Language Knowledge	3.32	2.94	3.70
Self Positive	2.07	1.74	2.41
Interactions			
Autistic:Matched	-0.13	-0.37	0.11
Autistic:Self Frustration	0.48	0.14	0.82
Autistic:Self Helpful	0.09	-0.24	0.42
Autistic:Self Intelligence	0.21	-0.11	0.54
Autistic:Self Language Knowledge	0.17	-0.16	0.51
Autistic:Self Positive	-0.05	-0.36	0.27
Matched:Self Frustration	-0.16	-0.49	0.18
Matched:Self Helpful	0.19	-0.13	0.51
Matched:Self Intelligence	0.12	-0.20	0.45
Matched:Self Language Knowledge	0.03	-0.30	0.36
Matched:Self Positive	0.07	-0.24	0.38
Autistic:Matched:Self Frustration	-0.05	-0.39	0.28
Autistic:Matched:Self Helpful	-0.13	-0.46	0.19
Autistic:Matched:Self Intelligence	0.17	-0.15	0.49
Autistic:Matched:Self Language Knowledge	0.24	-0.09	0.58
Autistic:Matched:Self Positive	0.23	-0.09	0.54

Table C.7: Posterior means and 95% Credible Intervals from a model estimating the relationship between Likert-scale response on self-rating questions, neurotype, and match condition.

Parameter	Posterior Mean	95% CrI Lower	95% CrI Upper
Intercepts and non-interactions			
Intercept[1]	-1.82	-2.09	-1.55
Intercept[2]	-1.27	-1.52	-1.01
Intercept[3]	-0.80	-1.04	-0.56
Intercept[4]	0.73	0.49	0.97
Intercept[5]	2.02	1.76	2.28
Autistic	-0.38	-0.60	-0.15
Matched	0.14	-0.09	0.36
Partner Frustration	-3.10	-3.50	-2.71
Partner Helpful	2.02	1.70	2.37
Partner Intelligence	2.44	2.10	2.79
Partner Language Knowledge	3.17	2.80	3.57
Partner Positive	2.34	2.00	2.68
Partner Predictable	2.22	1.88	2.56
Partner Variation	-1.32	-1.64	-0.99
Interactions			
Autistic:Matched	-0.04	-0.27	0.18
Autistic:Partner Frustration	0.52	0.15	0.88
Autistic:Partner Helpful	-0.07	-0.40	0.25
Autistic:Partner Intelligence	0.32	-0.01	0.65
Autistic:Partner Language Knowledge	0.44	0.07	0.80
Autistic:Partner Positive	0.17	-0.16	0.50
Autistic:Partner Predictable	0.71	0.39	1.04
Autistic:Partner Variation	-0.03	-0.36	0.29
Matched:Partner Frustration	-0.02	-0.38	0.35
Matched:Partner Helpful	0.23	-0.09	0.56
Matched:Partner Intelligence	0.00	-0.32	0.32
Matched:Partner Language Knowledge	-0.05	-0.41	0.31
Matched:Partner Positive	0.07	-0.26	0.38
Matched:Partner Predictable	-0.02	-0.34	0.31
Matched:Partner Variation	-0.02	-0.34	0.31
Autistic:Matched:Partner Frustration	-0.21	-0.57	0.16
Autistic:Matched:Partner Helpful	-0.04	-0.36	0.28
Autistic:Matched:Partner Intelligence	0.09	-0.23	0.41
Autistic:Matched:Partner Language Knowledge	0.23	-0.13	0.59
Autistic:Matched:Partner Positive	0.08	-0.24	0.41
Autistic:Matched:Partner Predictable	0.07	-0.25	0.39
Autistic:Matched:Partner Variation	0.07	-0.25	0.39

Table C.8: Posterior means and 95% Credible Intervals from a model estimating the relationship between Likert-scale response on partner rapport questions, neurotype, and match condition.

Bibliography

Ai, W., Cunningham, W. A., & Lai, M.-C. (2022). Reconsidering autistic 'camouflaging' as transactional impression management. *Trends in Cognitive Sciences*, *26*, 631–645. doi: 10.1016/J.TICS.2022.05.002

Ai, W., Cunningham, W. A., & Lai, M.-C. (2024a, November). Camouflaging, internalized stigma, and mental health in the general population. *International Journal of Social Psychiatry*, *70*(7), 1239–1253. doi: 10.1177/00207640241260020

Ai, W., Cunningham, W. A., & Lai, M. C. (2024b). The dimensional structure of the Camouflaging Autistic Traits Questionnaire (CAT-Q) and predictors of camouflaging in a representative general population sample. *Comprehensive Psychiatry*, *128*, 152434–152434. doi: 10.1016/J.COMPPSYCH.2023.152434

Alhusayni, A., Sheppard, E., Mitchell, P., & Marsh, L. (2024). How Do Autistic Students Do in the Eyes of Their Peers? Non-Autistic Judgments About the Academic Experiences of Autistic and Non-Autistic University Students, Based on Brief Samples of Behavior. *Autism in Adulthood*. doi: 10.1089/aut.2023.0049

Alkhaldi, R. S., Sheppard, E., Burdett, E., & Mitchell, P. (2021). Do Neurotypical People Like or Dislike Autistic People? *Autism in Adulthood*, *3*(3), 275–279. doi: 10.1089/aut.2020.0059

Alkhaldi, R. S., Sheppard, E., & Mitchell, P. (2019). Is There a Link Between Autistic People Being Perceived Unfavorably and Having a Mind That Is Difficult to Read? *Journal of Autism and Developmental Disorders*, *49*(10), 3973–3982. doi: 10.1007/s10803-019-04101-1

Allen, M. L., Haywood, S., Rajendran, G., & Branigan, H. (2011). Evidence for syntactic alignment in children with autism. *Developmental Science*, *14*(3), 540–548. doi: 10.1111/j.1467-7687.2010.01001.x

Allison, C., Auyeung, B., & Baron-Cohen, S. (2012). Toward brief "red flags" for autism screening: the short autism spectrum quotient and the short quantitative checklist for autism in toddlers in 1,000 cases and 3,000 controls [corrected]. *Journal of the American Academy of Child and Adolescent Psychiatry*, *51*, 202–212. doi: 10.1016/j.jaac.2011.11.003

Alvares, G. A., Bebbington, K., Cleary, D., Evans, K., Glasson, E. J., Maybery, M. T., ... Whitehouse, A. J. (2020). The misnomer of 'high functioning autism': Intelligence is an imprecise predictor of functional abilities at diagnosis. *Autism*, *24*(1), 221–232. doi: 10.1177/1362361319852831

American Psychiatric Association, D. T. F. (2013). *Diagnostic and statistical manual of mental disorders: Dsm-5*. Arlington, VA: American Psychiatric Association.

Aquino, A., Haddock, G., Maio, G. R., Wolf, L. J., & Alparone, F. R. (2016, June). The Role of Affective and Cognitive Individual Differences in Social Perception. *Personality and Social Psychology Bulletin*, *42*(6), 798–810. doi: 10.1177/0146167216643936

Aylward, B. S., Gal-Szabo, D. E., & Taraman, S. (2021). Racial, Ethnic, and Sociodemographic Disparities in Diagnosis of Children with Autism Spectrum Disorder. *Journal of Developmental and Behavioral Pediatrics*, *42*(8), 682–689. doi: 10.1097/DBP.0000000000000996

Aylward, B. S., Gal-Szabo, D. E., & Taraman, S. (2021). Racial, ethnic, and sociodemographic disparities in diagnosis of children with autism spectrum disorder. *Journal of Developmental and Behavioral Pediatrics*, *42*(8), 682–689. doi: 10.1097/DBP.0000000000000996

Barnes, E. (2016). The Value-Neutral Model. In E. Barnes (Ed.), *The Minority Body: A Theory of Disability* (p. 0). Oxford University Press. doi: 10.1093/acprof:oso/9780198732587.003.0004

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985, October). Does the autistic child have a "theory of mind" ? *Cognition*, *21*(1), 37–46. doi: 10.1016/0010-0277(85)90022-8

Baronchelli, A., Loreto, V., & Puglisi, A. (2015). Individual Biases, Cultural Evolution, and the Statistical Nature of Language Universals: The Case of Colour Naming Systems. *PLOS ONE*, *10*(5), e0125019. doi: 10.1371/journal.pone.0125019

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The autism-spectrum quotient (aq): Evidence from asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. *Journal of Autism and Developmental Disorders*, *31*, 5–17. doi: 10.1023/A:1005653411471/METRICS

Bates, D., Machler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*, 1–48. doi: 10.18637/jss.v067.i01

Beck, T. J. (2024, September). Neurodivergent culture and embodied knowledge beyond neoliberal identity politics. *Culture & Psychology*, *30*(3), 736–756. doi: 10.1177/1354067X231191489

Belcher, H. L., Uglik-Marucha, N., Vitoratou, S., Ford, R. M., & Morein-Zamir, S. (2023). Gender bias in autism screening: Measurement invariance of different model frameworks of the Autism Spectrum Quotient. *BJPsych Open*, *9*(5), e173. doi: 10.1192/bjo.2023.562

Ben-Sasson, A., Gal, E., Fluss, R., Katz-Zetler, N., & Cermak, S. A. (2019, December). Update of a Meta-analysis of Sensory Symptoms in ASD: A New Decade of Research. *Journal of Autism and Developmental Disorders*, *49*(12), 4974–4996. doi: 10.1007/s10803-019-04180-0

Benítez-Burraco, A., Lattanzi, W., & Murphy, E. (2016). Language Impairments in ASD Resulting from a Failed Domestication of the Human Brain. *Frontiers in Neuroscience*, *10*, 373. doi: 10.3389/fnins.2016.00373

Benítez-Burraco, A., & Murphy, E. (2016). The Oscillopathic Nature of Language Deficits in Autism: From Genes to Language Evolution. *Frontiers in Human Neuroscience*, *10*. doi: 10.3389/fnhum.2016.00120

Benítez-Burraco, A., & Progovac, L. (2021, March). Language evolution: Examining the link between cross-modality and aggression through the lens of disorders. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *376*(1824), 20200188. doi: 10.1098/rstb.2020.0188

Benton, A., Coppersmith, G., & Dredze, M. (2017, April). Ethical Research Protocols for Social Media Health Research. In D. Hovy, S. Spruit, M. Mitchell, E. M. Bender, M. Strube, & H. Wallach (Eds.), *Proceedings of the First ACL Workshop on Ethics in Natural Language Processing* (pp. 94–102). Valencia, Spain: Association for Computational Linguistics. doi: 10.18653/v1/W17-1612

Bentz, C., Dediu, D., Verkerk, A., & Jäger, G. (2018, November). The evolution of language families is shaped by the environment beyond neutral drift. *Nature Human Behaviour*, *2*(11), 816–821. doi: 10.1038/s41562-018-0457-6

Bentz, C., Verkerk, A., Kiela, D., Hill, F., & Buttery, P. (2015, June). Adaptive Communication: Languages with More Non-Native Speakers Tend to Have Fewer Word Forms. *PLOS ONE*, *10*(6), e0128254. doi: 10.1371/journal.pone.0128254

Bernardin, C. J., Lewis, T., Bell, D., & Kanne, S. (2021, August). Associations between social camouflaging and internalizing symptoms in autistic and non-autistic adolescents. *Autism*, *25*(6), 1580–1591. doi: 10.1177/1362361321997284/ASSET/IMAGES/LARGE/10.1177_1362361321997284-FIG1.JPEG

Bernardin, C. J., Mason, E., Lewis, T., & Kanne, S. (2021). "You Must Become a Chameleon to Survive": Adolescent Experiences of Camouflaging. *Journal of autism and developmental disorders*, *51*(12), 4422–4435. doi: 10.1007/S10803-021-04912-1

Bertilsdotter-Rosqvist, H., Botha, M., Hens, K., O'Donoghue, S., Pearson, A., & Stenning, A. (2023). Being, knowing, and doing: Importing theoretical toolboxes for autism studies. *Autism in Adulthood*, *5*, 15–23. doi: 10.1089/AUT.2022.0021

Betta, A. M. D., & Romani, C. (2006, May). Lexical learning and dysgraphia in a group of adults with developmental dyslexia. *Cognitive Neuropsychology*, *23*(3), 376–400. doi: 10.1080/02643290442000545

Blasi, D. E., Henrich, J., Adamou, E., Kemmerer, D., & Majid, A. (2022). Over-reliance on English hinders cognitive science. *Trends in Cognitive Sciences*, *26*(12), 1153–1170. doi: 10.1016/j.tics.2022.09.015

Blume, H. (1997). *Autistics, freed from face-to-face encounters, are communicating in cyberspace.* Retrieved 2024-07-31, from `www.nytimes.com/1997/06/30/business/autistics-freed-from-face-to-face-encounters-are-communicating-in-cyberspace.html`

Blume, H. (1998). *Neurodiversity.* Retrieved 2024-07-31, from www.theatlantic.com/magazine/archive/1998/09/neurodiversity/305909/

Bolis, D., Balsters, J., Wenderoth, N., Becchio, C., & Schilbach, L. (2017). Beyond Autism: Introducing the Dialectical Misattunement Hypothesis and a Bayesian Account of Intersubjectivity. *Psychopathology*, *50*(6), 355–372. doi: 10.1159/000484353

Bolis, D., Lahnakoski, J. M., Seidel, D., Tamm, J., & Schilbach, L. (2021, January). Interpersonal similarity of autistic traits predicts friendship quality. *Social Cognitive and Affective Neuroscience*, *16*(1-2), 222–231. doi: 10.1093/scan/nsaa147

Bonello, C. (2017). *We need to stop saying "we're all a little autistic".* Retrieved 2025-04-21, from https://autisticnotweird.com/stop-saying/ (Blog post)

Booth, R. D. L., & Happé, F. G. E. (2018, April). Evidence of Reduced Global Processing in Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, *48*(4), 1397–1408. doi: 10.1007/s10803-016-2724-6

Bora, E., & Pantelis, C. (2016, March). Meta-analysis of social cognition in attention-deficit/hyperactivity disorder (ADHD): Comparison with healthy controls and autistic spectrum disorder. *Psychological Medicine*, *46*(4), 699–716. doi: 10.1017/S0033291715002573

Botha, M. (2021). Academic, Activist, or Advocate? Angry, Entangled, and Emerging: A Critical Reflection on Autism Knowledge Production. *Frontiers in Psychology*, *12*. doi: 10.3389/fpsyg.2021.727542

Botha, M., Chapman, R., Giwa Onaiwu, M., Kapp, S. K., Stannard Ashley, A., & Walker, N. (2024). The neurodiversity concept was developed collectively: An overdue correction on the origins of neurodiversity theory. *Autism*, *28*(6), 1591–1594. doi: 10.1177/13623613241237871

Botha, M., & Gillespie-Lynch, K. (2022). Come as You Are: Examining Autistic Identity Development and the Neurodiversity Movement through an Intersectional Lens. *Human Development*, *66*(2), 93–112. doi: 10.1159/000524123

Botha, M., Hanlon, J., & Williams, G. L. (2021). Does language matter? Identity-First versus person-first language use in autism research: A response to Vivanti [Journal Article]. *Journal of autism and developmental disorders*, 1–9. doi: 10.1007/s10803-020-04858-w

Bottema-Beutel, K., Kapp, S. K., Lester, J. N., Sasson, N. J., & Hand, B. N. (2021). Avoiding Ableist Language: Suggestions for Autism Researchers. *Autism in Adulthood: Challenges and Management*, *3*(1), 18–29. doi: 10.1089/aut.2020.0014

Bottema-Beutel, K., Zisk, A. H., Zimmerman, J., & Yu, B. (2025, April). Conceptualizing and describing autistic language: Moving on from 'verbal', 'minimally verbal' and 'nonverbal'. *Autism*, 13623613251332573. doi: 10.1177/13623613251332573

Botting, N. (2020). Language, literacy and cognitive skills of young adults with developmental language disorder (DLD). *International Journal of Language & Communication Disorders*, *55*(2), 255–265. doi: 10.1111/1460-6984.12518

Bottini, S. B., Morton, H. E., Buchanan, K. A., & Gould, K. (2024). Moving from Disorder to Difference: A Systematic Review of Recent Language Use in Autism Research. *Autism in Adulthood*, *6*(2), 128–140. doi: 10.1089/aut.2023.0030

Boucher, T. Q., Lukacs, J. N., Scheerer, N. E., & Iarocci, G. (2023). Negative first impression judgements of autistic children by non-autistic adults. *Frontiers in Psychiatry*, *14*. doi: 10.3389/fpsyt.2023.1241584

Branigan, H. P., Pickering, M. J., Pearson, J., & McLean, J. F. (2010). Linguistic alignment between people and computers. *Journal of Pragmatics*, *42*(9), 2355–2368. doi: 10.1016/j.pragma.2009.12.012

Branigan, H. P., Pickering, M. J., Pearson, J., McLean, J. F., & Brown, A. (2011). The role of beliefs in lexical alignment: Evidence from dialogs with humans and computers. *Cognition*, *121*(1), 41–57. doi: 10.1016/j.cognition.2011.05.011

Branigan, H. P., Tosi, A., & Gillespie-Smith, K. (2016). Spontaneous lexical alignment in children with an autistic spectrum disorder and their typically developing peers. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *42*, 1821–1831. doi: 10.1037/xlm0000272

Branigan, H. P., Tosi, A., & Gillespie-Smith, K. (2016). Spontaneous lexical alignment in children with an autistic spectrum disorder and their typically developing peers. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *42*, 1821–1831. doi: 10.1037/xlm0000272

Brentari, D., Ergin, R., Senghas, A., Cho, P. W., Owens, E., & Coppola, M. (2021, November). Community interactions and phonemic inventories in emerging sign languages. *Phonology*, *38*(4), 571–609. doi: 10.1017/S0952675721000336

British Deaf Association. (2022, June). *BDA statement on "sign systems" and the oppression of BSL.* https://bda.org.uk/bda-statement-sign-systems/.

British Dyslexia Association. (2025). *Dyslexia.* https://www.bdadyslexia.org.uk/dyslexia.

Brown, J., Aczel, B., Jiménez, L., Kaufman, S. B., & Grant, K. P. (2010, September). Intact implicit learning in autism spectrum conditions. *Quarterly Journal of Experimental Psychology*, *63*(9), 1789–1812. doi: 10.1080/17470210903536910

Bucholtz, M., & Hall, K. (2005, October). Identity and interaction: A sociocultural linguistic approach. *Discourse Studies*, *7*(4-5), 585–614. doi: 10.1177/1461445605054407

Bucholtz, M., & Miles-Hercules, d. (2021, October). The displacement of race in language and gender studies. *Gender and Language*, *15*(3), 414–422. doi: 10.1558/genl.20882

Bürkner, P.-C. (2017). brms: An R package for Bayesian multilevel models using Stan. *Journal of Statistical Software*, *80*(1), 1–28. doi: 10.18637/jss.v080.i01

Bürkner, P.-C. (2018). Advanced Bayesian multilevel modeling with the R package brms. *The R Journal*, *10*(1), 395–411. doi: 10.32614/RJ-2018-017

Bury, S. M., Jellett, R., Haschek, A., Wenzel, M., Hedley, D., & Spoor, J. R. (2023). Understanding language preference: Autism knowledge, experience of stigma and autism identity. *Autism*, *27*(6), 1588–1600. doi: 10.1177/13623613221142383

Bury, S. M., Jellett, R., Spoor, J. R., & Hedley, D. (2020). “It Defines Who I Am" or “It's Something I Have": What language do [autistic] australian adults [on the autism spectrum] prefer? [Journal Article]. *J Autism Dev Disord*. doi: 10.1007/s10803-020-04425-3

Bürkner, P.-C., Gabry, J., Kay, M., & Vehtari, A. (2024). *posterior: Tools for working with posterior distributions.* Retrieved from `https://mc-stan.org/posterior/` (R package version 1.6.0)

Cage, E., Di Monaco, J., & Newell, V. (2018, February). Experiences of Autism Acceptance and Mental Health in Autistic Adults. *Journal of autism and developmental disorders*, *48*(2), 473–484. doi: 10.1007/S10803-017-3342-7

Cage, E., & Troxell-Whitman, Z. (2019). Understanding the Reasons, Contexts and Costs of Camouflaging for Autistic Adults. *Journal of autism and developmental disorders*, *49*(5), 1899–1911. doi: 10.1007/S10803-018-03878-X

Cai, Z. G., Sun, Z., & Zhao, N. (2021). Interlocutor modelling in lexical alignment: The role of linguistic competence. *Journal of Memory and Language*, *121*, 104278. doi: 10.1016/j.jml.2021.104278

Cammaerts, B. (2022, November). The abnormalisation of social justice: The ‘anti-woke culture war’ discourse in the UK. *Discourse & Society*, *33*(6), 730–743. doi: 10.1177/09579265221095407

Carruthers, S., Kinnaird, E., Rudra, A., Smith, P., Allison, C., Auyeung, B., ... Hoekstra, R. A. (2018). A cross-cultural study of autistic traits across India, Japan and the UK. *Molecular Autism*, *9*, 52. doi: 10.1186/s13229-018-0235-3

Carruthers, S., Taylor, L., Sadiq, H., & Tripp, G. (2022). The profile of pragmatic language impairments in children with ADHD: A systematic review. *Development and Psychopathology*, *34*(5), 1938–1960. doi: 10.1017/S0954579421000328

Champagne-Lavau, M., & Stip, E. (2010, May). Pragmatic and executive dysfunction in schizophrenia. *Journal of Neurolinguistics*, *23*(3), 285–296. doi: 10.1016/j.jneuroling.2009.08.009

Chandler, J., & Shapiro, D. (2016). Conducting Clinical Research Using Crowdsourced Convenience Samples. *Annual Review of Clinical Psychology*, *12*(Volume 12, 2016), 53–81. doi: 10.1146/annurev-clinpsy-021815-093623

Chapman, R. (2020). Defining neurodiversity for research and practice. In *Neurodiversity Studies.* Routledge.

Chapple, M., & Worsley, J. D. (2021). Commentary: Considering nomenclature for autism – aligning with the language preferences of the autistic community – a commentary on Kehinde et al. (2021). *Child and Adolescent Mental Health*, *26*(3), 284–285. doi: 10.1111/camh.12490

Cheang, R. T., Skjevling, M., Blakemore, A. I., Kumari, V., & Puzzo, I. (2024). Do you feel me? Autism, empathic accuracy and the double empathy problem. *Autism*, 13623613241252320. doi: 10.1177/13623613241252320

Chemla, E., Buccola, B., & Dautriche, I. (2019a). Connecting content and logical words. *Journal of Semantics*, *36*, 531–547. doi: 10.1093/jos/ffz001

Chemla, E., Buccola, B., & Dautriche, I. (2019b). Connecting Content and Logical Words. *Journal of Semantics*, *36*(3), 531–547. doi: 10.1093/jos/ffz001

Chen, Q., Lian, F., Lian, X., Chen, S., & Zhang, Q. (2024). The impact of first impression on non-autistic children's willingness to interact with autistic peers. *International Journal of Developmental Disabilities*.

Chen, Y.-L., Senande, L. L., Thorsen, M., & Patten, K. (2021). Peer preferences and characteristics of same-group and cross-group social interactions among autistic and non-autistic adolescents. *Autism*, *25*(7), 1885–1900. doi: 10.1177/13623613211005918

Cheung, C.-Y., Kirby, S., & Raviv, L. (2024). The role of gender, personality traits, and social biases in shaping linguistic accommodation: An experimental approach. In *The Evolution of Language: Proceedings of the 15th International Conference (Evolang XV).* Madison, WI. doi: 10.17617/2.3587960

Chisango, T., Maunganidze, L., Maseko, M., Muchena, B., Ncube, S., Hombarume, L., & Matanga, A. A. (2023, May). Racial misconceptions of the theory of evolution predict opposition to the theory and science in general among a sample of Zimbabwean university students. *Heliyon*, *9*(6), e16783. doi: 10.1016/j.heliyon.2023.e16783

Chomsky, N. (1956, September). Three models for the description of language. *IRE Transactions on Information Theory*, *2*(3), 113–124. doi: 10.1109/TIT.1956.1056813

Chomsky, N. (1965). *Aspects of the theory of syntax*. Oxford, England: M.I.T. Press.

Chown, N., Robinson, J., Beardon, L., Downing, J., Hughes, L., Leatherland, J., ... MacGregor, D. (2017). Improving research about us, with us: A draft framework for inclusive autism research. *Disability & Society*, *32*(5), 720–734. doi: 10.1080/09687599.2017.1320273

Christiansen, M. H., & Chater, N. (2016, January). The Now-or-Never bottleneck: A fundamental constraint on language. *The Behavioral and Brain Sciences*, *39*, e62. doi: 10.1017/S0140525X1500031X

Chun, E., Barrow, J., & Kaan, E. (2016). Native English speakers' structural alignment mediated by foreign-accented speech. *Linguistics Vanguard*, *2*(s1). doi: 10.1515/lingvan-2016-0027

Church, B. A., Rice, C. L., Dovgopoly, A., Lopata, C. J., Thomeer, M. L., Nelson, A., & Mercado, E. (2015, October). Learning, plasticity, and atypical generalization in children with autism. *Psychonomic Bulletin & Review*, *22*(5), 1342–1348. doi: 10.3758/s13423-014-0797-9

Clark, H. H. (1996). *Using Language*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511620539

Clark, T. H., Meister, C., Pimentel, T., Hahn, M., Cotterell, R., Futrell, R., & Levy, R. (2023, August). A Cross-Linguistic Pressure for Uniform Information Density in Word Order. *Transactions of the Association for Computational Linguistics*, *11*, 1048–1065. doi: 10.1162/tacl_a_00589

Clegg, J., Hollis, C., Mawhood, L., & Rutter, M. (2005, February). Developmental language disorders– a follow-up in later adult life. Cognitive, language and psychosocial outcomes. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *46*(2), 128–149. doi: 10.1111/j.1469-7610.2004.00342.x

Cohen, S. R., Joseph, K., Levinson, S., Blacher, J., & Eisenhower, A. (2022, December). "My Autism Is My Own": Autistic Identity and Intersectionality in the School Context. *Autism in Adulthood*, *4*(4), 315–327. doi: 10.1089/aut.2021.0087

Cole, E. J., Slocombe, K. E., & Barraclough, N. E. (2018, May). Abilities to Explicitly and Implicitly Infer Intentions from Actions in Adults with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, *48*(5), 1712–1726. doi: 10.1007/s10803-017-3425-5

Conway, B. R., Ratnasingam, S., Jara-Ettinger, J., Futrell, R., & Gibson, E. (2020, February). Communication efficiency of color naming across languages provides a new framework for the evolution of color terms. *Cognition*, *195*, 104086. doi: 10.1016/j.cognition.2019.104086

Cook, J., Crane, L., Hull, L., Bourne, L., & Mandy, W. (2022, February). Self-reported camouflaging behaviours used by autistic adults during everyday social interactions. *Autism*, *26*(2), 406–421. doi: 10.1177/13623613211026754

Cook, J., Crane, L., & Mandy, W. (2023). Dropping the mask: It takes two. *Autism*. doi: 10.1177/13623613231183059

Cook, J., Hull, L., Crane, L., & Mandy, W. (2021). Camouflaging in autism: A systematic review. *Clinical Psychology Review*, *89*, 102080. doi: 10.1016/J.CPR.2021.102080

Cooper, R., Cooper, K., Russell, A. J., & Smith, L. G. E. (2021, February). "I'm Proud to be a Little Bit Different": The Effects of Autistic Individuals' Perceptions of Autism and Autism Social Identity on Their Collective Self-esteem. *Journal of Autism and Developmental Disorders*, *51*(2), 704–714. doi: 10.1007/s10803-020-04575-4

Courchesne, V., Meilleur, A.-A. S., Poulin-Lord, M.-P., Dawson, M., & Soulières, I. (2015, March). Autistic children at risk of being underestimated: School-based pilot study of a strength-informed assessment. *Molecular Autism*, *6*(1), 12. doi: 10.1186/s13229-015-0006-3

Cournane, A. (2019). A developmental view on incrementation in language change. *Theoretical Linguistics*, *45*(3-4), 127–150. doi: 10.1515/tl-2019-0010

Crompton, C. J., Hallett, S., Ropar, D., Flynn, E., & Fletcher-Watson, S. (2020). 'I never realised everybody felt as happy as I do when I am around autistic people': A thematic analysis of autistic adults' relationships with autistic and neurotypical friends and family. *Autism*, *24*(6), 1438–1448. doi: 10.1177/1362361320908976

Crompton, C. J., Ropar, D., Evans-Williams, C. V., Flynn, E. G., & Fletcher-Watson, S. (2020, October). Autistic peer-to-peer information transfer is highly effective. *Autism*, *24*(7), 1704–1712. doi: 10.1177/1362361320919286

Crompton, C. J., Ropar, D., Evans-Williams, C. V., Flynn, E. G., & Fletcher-Watson, S. (2020). Autistic peer-to-peer information transfer is highly effective. *Autism*, *24*, 1704–1712. doi: https://doi.org/10.1177/1362361320919286

Crompton, C. J., Sharp, M., Axbey, H., Fletcher-Watson, S., Flynn, E. G., & Ropar, D. (2020). Neurotype-Matching, but Not Being Autistic, Influences Self and Observer Ratings of Interpersonal Rapport. *Frontiers in Psychology*, *11*.

Crow, T. J. (1997, December). Is schizophrenia the price that *Homo sapiens* pays for language? *Schizophrenia Research*, *28*(2), 127–141. doi: 10.1016/S0920-9964(97)00110-2

Culbertson, J. (2012). Typological Universals as Reflections of Biased Learning: Evidence from Artificial Language Learning. *Language and Linguistics Compass*, *6*(5), 310–329. doi: 10.1002/lnc3.338

Culbertson, J. (2023, March). Artificial language learning. In J. Sprouse (Ed.), *The Oxford Handbook of Experimental Syntax* (p. 0). Oxford University Press. doi: 10.1093/oxfordhb/9780198797722.013.9

Culbertson, J., Compostella, A., & Kirby, S. (2024, November). Language structure reflects biases in pattern learning across domains and modalities. *Quarterly Journal of Experimental Psychology*, 17470218241282404. doi: 10.1177/17470218241282404

Culbertson, J., & Newport, E. L. (2015). Harmonic biases in child learners: In support of language universals. *Cognition*, *139*, 71–82. doi: 10.1016/j.cognition.2015.02.007

Cummins, C., Pellicano, E., & Crane, L. (2020). Autistic adults' views of their communication skills and needs. *International Journal of Language & Communication Disorders*, *55*, 678–689. doi: 10.1111/1460-6984.12552

Czech, H. (2018). Hans Asperger, National Socialism, and "race hygiene" in Nazi-era Vienna. *Molecular Autism*, *9*(1), 29. doi: 10.1186/s13229-018-0208-6

Dale, R., & Lupyan, G. (2012, May). Understanding the origins of morphological diversity: The linguistic niche hypothesis. *Advances in Complex Systems*, *15*(03n04), 1150017. doi: 10.1142/S0219525911500172

Daud, P. F., Setti, V., Khafif, T. C., Rocca, C. C., & Serafim, A. d. P. (2020, November). Pragmatic Language and Schizophrenia: Interpretation of Metaphors. *Archives of Clinical Psychiatry*, *47*(6), 209–212. doi: 10.1590/0101-60830000000263

Davidson, J. (2008). Autistic culture online: Virtual communication and cultural expression on the spectrum. *Social & Cultural Geography*, *9*(7), 791–806. doi: 10.1080/14649360802382586

Davies, J., Cooper, K., Killick, E., Sam, E., Healy, M., Thompson, G., . . . Crane, L. (2024). Autistic identity: A systematic review of quantitative research. *Autism Research*, *17*(5), 874–897. doi: 10.1002/aur.3105

Davis, A. M., Smith, E., Yang, X., & Wright, R. (2024, December). Exploring Racial Discrimination, Disability Discrimination, and Perception of the Future Among Black-Identifying Emerging Adults with and without Autism in the United States: A Mixed-Methods Descriptive Study. *Journal of Child & Adolescent Trauma*, *17*(4), 1019–1034. doi: 10.1007/s40653-024-00624-7

Dawson, M., & Cowen, T. (2019, January). Autistics appear different, but also are different, and this should be valued. *Behavioral and Brain Sciences*, *42*, e85. doi: 10.1017/S0140525X18002467

de Boer, A., & Pijl, S. J. (2016). The acceptance and rejection of peers with ADHD and ASD in general secondary education. *The Journal of Educational Research*, *109*(3), 325–332. doi: 10.1080/00220671.2014.958812

de Boer, J. N., Brederoo, S. G., Voppel, A. E., & Sommer, I. E. C. (2020, May). Anomalies in language as a biomarker for schizophrenia. *Current Opinion in Psychiatry*, *33*(3), 212. doi: 10.1097/YCO.0000000000000595

de Villiers, J. (2007). The Interface of Language and Theory of Mind. *Lingua. International review of general linguistics. Revue internationale de linguistique generale*, *117*(11), 1858–1878. doi: 10.1016/j.lingua.2006.11.006

de Villiers, J., Fine, J., Ginsberg, G., Vaccarella, L., & Szatmari, P. (2007, August). Brief Report: A Scale for Rating Conversational Impairment in Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, *37*(7), 1375–1380. doi: 10.1007/s10803-006-0264-1

DeBrabander, K. M., Morrison, K. E., Jones, D. R., Faso, D. J., Chmielewski, M., & Sasson, N. J. (2019). Do First Impressions of Autistic Adults Differ Between Autistic and Nonautistic Observers? *Autism in Adulthood*, *1*(4), 250–257. doi: 10.1089/aut.2019.0018

Dębska, A., Łuniewska, M., Zubek, J., Chyl, K., Dynak, A., Dzięgiel-Fivet, G., . . . Grabowska, A. (2022). The cognitive basis of dyslexia in school-aged children: A multiple case study in a transparent orthography. *Developmental Science*, *25*(2), e13173. doi: 10.1111/desc.13173

Dekker, M. (2023a). *A correction on the origin of the term 'neurodiversity'.* Retrieved 2025-11-24, from `https://www.inlv.org/2023/07/13/neurodiversity-origin.html` (Blog post)

Dekker, M. (2023b). *Was neurodiversity really judy singer's original idea? a little history lesson.* Retrieved 2025-11-24, from `https://www.inlv.org/2023/06/29/neurodiversity.html` (Blog post)

de Leeuw, J. R. (2015). jsPsych: a JavaScript library for creating behavioral experiments in a Web browser. *Behavior Research Methods*, *47*, 1–12. doi: 10.3758/s13428-014-0458-y

den Houting, J. (2019). Neurodiversity: An insider's perspective. *Autism*, *23*(2), 271–273. doi: 10.1177/1362361318820762

De Vos, C. (2012). *Sign-spatiality in Kata Kolok: How a village sign language in Bali inscribes its signing space* (Unpublished doctoral dissertation). Radboud University Nijmegen Nijmegen.

Diamond, A. (2013). Executive Functions. *Annual review of psychology*, *64*, 135–168. doi: 10.1146/annurev-psych-113011-143750

Donnellan, A. M., Hill, D. A., & Leary, M. R. (2013, January). Rethinking autism: Implications of sensory and movement differences for understanding and support. *Frontiers in Integrative Neuroscience*, *6*, 124. doi: 10.3389/fnint.2012.00124

Douglas, B. D., Ewell, P. J., & Brauer, M. (2023). Data quality in online human-subjects research: Comparisons between MTurk, Prolific, CloudResearch, Qualtrics, and SONA. *PLOS ONE*, *18*(3), e0279720. doi: 10.1371/journal.pone.0279720

Doyle, N. (2020). Neurodiversity at work: A biopsychosocial model and the impact on working adults. *British Medical Bulletin*, *135*(1), 108–125. doi: 10.1093/bmb/ldaa021

Dryer, M. S. (2013a). Coding of nominal plurality (v2020.4) [Data set]. In M. S. Dryer & M. Haspelmath (Eds.), *The world atlas of language structures online.* Zenodo. Retrieved from `https://doi.org/10.5281/zenodo.13950591` doi: 10.5281/zenodo.13950591

Dryer, M. S. (2013b). Order of subject, object and verb (v2020.4) [Data set]. In M. S. Dryer & M. Haspelmath (Eds.), *The world atlas of language structures online.* Zenodo. Retrieved from `https://doi.org/10.5281/zenodo.13950591` doi: 10.5281/zenodo.13950591

Dunbar, A., King, S., & Vaughn, C. (2024). Dialect on Trial: An Experimental Examination of Raciolinguistic Ideologies and Character Judgments. *Race and Justice*, 21533687241258772. doi: 10.1177/21533687241258772

Dunn, M., G., Hilary, & and Sebastian, M. J. (1996, August). Prototypicality of responses of autistic, language disordered, and normal children in a word fluency task. *Child Neuropsychology*, *2*(2), 99–108. doi: 10.1080/09297049608401355

Duranovic, M., Tinjak, S., & Turbic-Hadzagic, A. (2014, December). Morphological knowledge in children with dyslexia. *Journal of Psycholinguistic Research*, *43*(6), 699–713. doi: 10.1007/s10936-013-9274-2

Dwyer, P. (2022). The neurodiversity approach(es): What are they and what do they mean for researchers? *Human Development*, *66*, 73–92. doi: 10.1159/000523723

Dwyer, P., Gurba, A. N., Kapp, S. K., Kilgallon, E., Hersh, L. H., Chang, D. S., . . . Gillespie-Lynch, K. (2024). Community views of neurodiversity, models of disability and autism intervention: Mixed methods reveal shared goals and key tensions. *Autism*, 13623613241273029. doi: 10.1177/13623613241273029

Dye, M., Milin, P., Futrell, R., & Ramscar, M. (2017, January). A Functional Theory of Gender Paradigms. In (chap. Perspectives on Morphological Organization). Brill. doi: 10.1163/9789004342934_011

Eckert, P. (2008). Variation and the indexical field. *Journal of Sociolinguistics*, *12*(4), 453–476. doi: 10.1111/j.1467-9841.2008.00374.x

Eckert, P. (2012). Three waves of variation study: The emergence of meaning in the study of sociolinguistic variation. *Annual Review of Anthropology*, *41*, 87–100. doi: 10.1146/annurev-anthro-092611-145828

Edey, R., Cook, J., Brewer, R., Johnson, M. H., Bird, G., & Press, C. (2016). Interaction takes two: Typical adults exhibit mind-blindness towards those with autism spectrum disorder. *Journal of Abnormal Psychology*, *125*(7), 879–885. doi: 10.1037/abn0000199

Egner, J. (2022, March). #ActuallyAutistic: Using Twitter to Construct Individual and Collective Identity Narratives. *Studies in Social Justice*, *16*(2), 349–369. doi: 10.26522/ssj.v16i2.2675

Eigsti, I.-M., Bennetto, L., & Dadlani, M. B. (2007, July). Beyond pragmatics: Morphosyntactic development in autism. *Journal of Autism and Developmental Disorders*, *37*(6), 1007–1023. doi: 10.1007/s10803-006-0239-2

Eigsti, I.-M., Marchena, A. B., Schuh, J. M., & Kelley, E. (2011). Language acquisition in autism spectrum disorders: a developmental review. *Research in Autism Spectrum Disorders*, *5*, 681–691. doi: 10.1016/j.rasd.2010.09.001

Elliott, J. G., & Grigorenko, E. L. (2024, October). Dyslexia in the twenty-first century: A commentary on the IDA definition of dyslexia. *Annals of Dyslexia*, *74*(3), 363–377. doi: 10.1007/s11881-024-00311-0

Ellis Weismer, S., Kaushanskaya, M., Larson, C., Mathée, J., & Bolt, D. (2018, November). Executive Function Skills in School-Age Children With Autism Spectrum Disorder: Association With Language Abilities. *Journal of Speech, Language, and Hearing Research*, *61*(11), 2641–2658. doi: 10.1044/2018_JSLHR-L-RSAUT-18-0026

Ettlinger, M., Morgan-Short, K., Faretta-Stutenberg, M., & Wong, P. C. (2016). The Relationship Between Artificial and Second Language Learning. *Cognitive Science*, *40*(4), 822–847. doi: 10.1111/cogs.12257

Evans, N., & Levinson, S. C. (2009). The myth of language universals: Language diversity and its importance for cognitive science. *Behavioral and Brain Sciences*, *32*(5), 429–448. doi: 10.1017/S0140525X0999094X

Fasoli, F., Maass, A., Paladino, M. P., & Sulpizio, S. (2017). Gay- and Lesbian-Sounding Auditory Cues Elicit Stereotyping and Discrimination. *Archives of Sexual Behavior*, *46*(5), 1261–1277. doi: 10.1007/s10508-017-0962-0

Fay, N., & Ellison, T. M. (2013, August). The Cultural Evolution of Human Communication Systems in Different Sized Populations: Usability Trumps Learnability. *PLOS ONE*, *8*(8), e71781. doi: 10.1371/journal.pone.0071781

Federici, A., Parma, V., Vicovaro, M., Radassao, L., Casartelli, L., & Ronconi, L. (2020, March). Anomalous Perception of Biological Motion in Autism: A Conceptual Review and Meta-Analysis. *Scientific Reports*, *10*(1), 4576. doi: 10.1038/s41598-020-61252-3

Fedzechkina, M., Chu, B., & Florian Jaeger, T. (2018, January). Human Information Processing Shapes Language Change. *Psychological Science*, *29*(1), 72–82. doi: 10.1177/0956797617728726

Fedzechkina, M., Hartley, L. H., & Roberts, G. (2022). Social biases can lead to less communicatively efficient languages. *Language Acquisition*, *30*. doi: 10.1080/10489223.2022.2057229

Fedzechkina, M., & Jaeger, T. F. (2020). Production efficiency can cause grammatical change: Learners deviate from the input to better balance efficiency against robust message transmission. *Cognition*, *196*, 104115. doi: 10.1016/J.COGNITION.2019.104115

Fedzechkina, M., Jaeger, T. F., & Newport, E. L. (2012). Language learners restructure their input to facilitate efficient communication. *Proceedings of the National Academy of Sciences of the United States of America*, *109*, 17897–17902. doi: 10.1073/PNAS.1215776109

Fedzechkina, M., Newport, E., & Jaeger, T. F. (2016b, January). Miniature artificial language learning as a complement to typological data. In *The Usage-Based Study of Language Learning and Multilingualism* (pp. 211–232). Georgetown University Press.

Fedzechkina, M., Newport, E. L., & Jaeger, T. F. (2016a). Balancing effort and information transmission during language acquisition: Evidence from word order and case marking. *Cognitive Science*, *41*, 416–446. doi: 10.1111/COGS.12346

Fedzechkina, M., Newport, E. L., & Jaeger, T. F. (2017, MAR). Balancing effort and information transmission during language acquisition: Evidence from word order and case marking. *COGNITIVE SCIENCE*, *41*(2), 416–446. doi: 10.1111/cogs.12346

Fedzechkina, M., & Roberts, G. (2020). Learners sacrifice robust communication as a result of a social bias. In *Proceedings of the 42nd annual conference of the cognitive science society.* Austin, TX: Cognitive Science Society.

Fehér, O., Ritt, N., & Smith, K. (2019). Asymmetric accommodation during interaction leads to the regularisation of linguistic variants. *Journal of Memory and Language*, *109*. doi: 10.1016/j.jml.2019.104036

Fehér, O., Wonnacott, E., & Smith, K. (2016). Structural priming in artificial languages and the regularisation of unpredictable variation. *Journal of Memory and Language*, *91*, 158–180. doi: 10.1016/j.jml.2016.06.002

Ferdinand, V., Kirby, S., & Smith, K. (2019, March). The cognitive roots of regularization in language. *Cognition*, *184*, 53–68. doi: 10.1016/j.cognition.2018.12.002

Ferreira, G. J., Getten, J., & Pesonen, H. (2024, April). Strengths-Based Approaches to Autism Language and Communications Research: Where Are We? *Review Journal of Autism and Developmental Disorders*. doi: 10.1007/s40489-024-00455-0

Fiesler, C., & Proferes, N. (2018, January). “Participant” Perceptions of Twitter Research Ethics. *Social Media + Society*, *4*(1), 2056305118763366. doi: 10.1177/2056305118763366

Finn, M., Flower, R. L., Leong, H. M., & Hedley, D. (2023, October). ‘If I’m just me, I doubt I’d get the job’: A qualitative exploration of autistic people’s experiences in job interviews. *Autism*, *27*(7), 2086–2097. doi: 10.1177/13623613231153480

Fitch, W. T. (2018, June). What animals can teach us about human language: The phonological continuity hypothesis. *Current Opinion in Behavioral Sciences*, *21*, 68–75. doi: 10.1016/j.cobeha.2018.01.014

Fitch, W. T., Arbib, M. A., & Donald, M. (2010). A Molecular Genetic Framework for Testing Hypotheses About Language Evolution. In A. D. M. Smith, M. Schouwstra, B. DeBoer, & K. Smith (Eds.), *EVOLUTION OF LANGUAGE, PROCEEDINGS* (p. 137-+). Singapore: World Scientific Publ Co Pte Ltd.

Fletcher, L., Rabaglati, H., & Culbertson, J. (2024). Autistic traits, communicative efficiency, and social biases shape language learning in autistic and allistic learners. *Cognitive Science*.

Fletcher, L., Rabagliati, H., & Culbertson, J. (2024). Autistic Traits, Communicative Efficiency, and Social Biases Shape Language Learning in Autistic and Allistic Learners. *Cognitive Science*, *48*(11), e70007. doi: 10.1111/cogs.70007

Fletcher-Watson, S. (2024). What's in a name? The costs and benefits of a formal autism diagnosis. *Autism*, *28*(2), 257–262. doi: 10.1177/13623613231213300

Fletcher-Watson, S., Adams, J., Brook, K., Charman, T., Crane, L., Cusack, J., ... Pellicano, E. (2019). Making the future together: Shaping autism research through meaningful participation. *Autism: The International Journal of Research and Practice*, *23*(4), 943–953. doi: 10.1177/1362361318786721

Fletcher-Watson, S., & Crompton, C. J. (2019, January). Autistic people may lack social motivation, without being any less human. *Behavioral and Brain Sciences*, *42*, e88. doi: 10.1017/S0140525X18002406

Folgerø, P. O., Johansson, C., & Stokkedal, L. H. (2021, May). The Superior Visual Perception Hypothesis: Neuroaesthetics of Cave Art. *Behavioral Sciences (Basel, Switzerland)*, *11*(6), 81. doi: 10.3390/bs11060081

Foster, S. J., Ackerman, R. A., Wilks, C. E., Dodd, M., Calderon, R., Ropar, D., ... Sasson, N. J. (2025). Rapport in same and mixed neurotype groups of autistic and non-autistic adults. *Autism*, 13623613251320444. doi: 10.1177/13623613251320444

Franklin, A., Sowden, P., Notman, L., Gonzalez-Dixon, M., West, D., Alexander, I., ... White, A. (2010). Reduced chromatic discrimination in children with autism spectrum disorders. *Developmental Science*, *13*(1), 188–200. doi: 10.1111/j.1467-7687.2009.00869.x

Freeth, M., Sheppard, E., Ramachandran, R., & Milne, E. (2013). A cross-cultural comparison of autistic traits in the UK, India and Malaysia. *Journal of Autism and Developmental Disorders*, *43*(11), 2569–2583. doi: 10.1007/s10803-013-1808-9

Friederici, A. D., Steinhauer, K., & Pfeifer, E. (2002, January). Brain signatures of artificial language processing: Evidence challenging the critical period hypothesis. *Proceedings of the National Academy of Sciences*, *99*(1), 529–534. doi: 10.1073/pnas.012611199

Friedman, L., & Sterling, A. (2019). A Review of Language, Executive Function, and Intervention in Autism Spectrum Disorder. *Seminars in Speech and Language*, *40*, 291–304. doi: 10.1055/s-0039-1692964

Friedman, N. P., & Miyake, A. (2017, January). Unity and diversity of executive functions: Individual differences as a window on cognitive structure. *Cortex; a Journal Devoted to the Study of the Nervous System and Behavior*, *86*, 186–204. doi: 10.1016/j.cortex.2016.04.023

Friedner, M., & and Block, P. (2017, September). Deaf studies meets autistic studies. *The Senses and Society*, *12*(3), 282–300. doi: 10.1080/17458927.2017.1369716

Frith, U. (2001, December). Mind blindness and the brain in autism. *Neuron*, *32*(6), 969–979. doi: 10.1016/s0896-6273(01)00552-9

Fuermaier, A. B. M., Tucha, L., Guo, N., Mette, C., Müller, B. W., Scherbaum, N., & Tucha, O. (2022). It Takes Time: Vigilance and Sustained Attention Assessment in Adults with ADHD. *International Journal of Environmental Research and Public Health*, *19*(9), 5216. doi: 10.3390/ijerph19095216

Funawatari, R., Sumiya, M., Iwabuchi, T., Nishimura, T., Komeda, H., & Senju, A. (2024, July). Camouflaging in Autistic Adults is Modulated by Autistic and Neurotypical Characteristics of Interaction Partners. *Journal of Autism and Developmental Disorders*. doi: 10.1007/s10803-024-06481-5

Funawatari, R., Sumiya, M., Iwabuchi, T., & Senju, A. (2024, October). Double-Edged Effects of Social Strategies on the Well-Being of Autistic People: Impact of Self-Perceived Effort and Efficacy. *Brain Sciences*, *14*(10), 962. doi: 10.3390/brainsci14100962

Fusaroli, R., Bahrami, B., Olsen, K., Roepstorff, A., Rees, G., Frith, C., & Tylén, K. (2012). Coming to Terms: Quantifying the Benefits of Linguistic Coordination. *Psychological Science*, *23*(8), 931–939. doi: 10.1177/0956797612436816

Fusaroli, R., & Tylén, K. (2016). Investigating Conversational Dynamics: Interactive Alignment, Interpersonal Synergy, and Collective Task Performance. *Cognitive Science*, *40*(1), 145–171. doi: 10.1111/cogs.12251

Fusaroli, R., Weed, E., Rocca, R., Fein, D., & Naigles, L. (2023). Repeat After Me? Both Children With and Without Autism Commonly Align Their Language With That of Their Caregivers. *Cognitive Science*, *47*(11), e13369. doi: 10.1111/cogs.13369

Futrell, R., Hickey, T., Lee, A., Lim, E., Luchkina, E., & Gibson, E. (2015). Cross-linguistic gestures reflect typological universals: A subject-initial, verb-final bias in speakers of diverse languages. *Cognition*, *136*, 215–221. doi: 10.1016/j.cognition.2014.11.022

Galantucci, B., Garrod, S., & Roberts, G. (2012). Experimental Semiotics. *Language and Linguistics Compass*, *6*(8), 477–493. doi: 10.1002/lnc3.351

Geelhand, P., Papastamou, F., Belenger, M., Clin, E., Hickman, L., Keating, C. T., & Sowden, S. (2023). Autism-Related Language Preferences of French-Speaking Autistic Adults: An Online Survey. *Autism in Adulthood*, *5*(3), 275–288. doi: 10.1089/aut.2022.0056

Geelhand, P., Papastamou, F., Jaspard, S., & Kissine, M. (2024). Autistic adults display different verbal behavior only in mixed-neurotype interactions: Evidence from a referential communication task. *Autism*, 13623613241298376. doi: 10.1177/13623613241298376

Gegg-Harrison, W., & Quarterman, C. (2024). AI Detection's High False Positive Rates and the Psychological and Material Impacts on Students. In *Academic Integrity in the Age of Artificial Intelligence* (pp. 199–219). IGI Global. doi: 10.4018/979-8-3693-0240-8.ch011

Gernsbacher, M. A. (2007, February). On Not Being Human. *APS observer*, *20*(2), 5–32.

Gernsbacher, M. A. (2010, November). Stigma From Psychological Science: Group Differences, Not Deficits—Introduction to Stigma Special Section. *Perspectives on Psychological Science*, *5*(6), 687–687. doi: 10.1177/1745691610388767

Gernsbacher, M. A. (2017). Editorial Perspective: The use of person-first language in scholarly writing may accentuate stigma. *Journal of Child Psychology and Psychiatry*, *58*(7), 859–861. doi: 10.1111/jcpp.12706

Gernsbacher, M. A., Morson, E. M., & Grace, E. J. (2016). Language and speech in autism. *Annual Review of Linguistics*, *2*, 413–425. doi: 10.1146/annurev-linguistics-030514-124824

Gernsbacher, M. A., & Yergeau, M. (2019a). Empirical failures of the claim that autistic people lack a theory of mind. *Archives of Scientific Psychology*, *7*(1), 102–118. doi: 10.1037/ARC0000067

Gernsbacher, M. A., & Yergeau, M. (2019b). Empirical failures of the claim that autistic people lack a theory of mind. *Archives of Scientific Psychology*, *7*, 102–118. doi: 10.1037/ARC0000067

Gibbs, V., Cai, R. Y., Love, A., Edwards, C., & Al Ansari, M. (2024, December). Unheard Voices: A Systematic Literature Review of Studies Using Self-Report Methods to Gather the Perspectives of Autistic Adults with Intellectual Disability. *Autism in Adulthood*. doi: 10.1089/aut.2024.0272

Gibson, E., Futrell, R., Piandadosi, S. T., Dautriche, I., Mahowald, K., Bergen, L., & Levy, R. (2019). How efficiency shapes human language. *Trends in Cognitive Sciences*. doi: 10.1016/j.tics.2019.02.003

Gibson, E., Piantadosi, S. T., Brink, K., Bergen, L., Lim, E., & Saxe, R. (2013, July). A noisy-channel account of crosslinguistic word-order variation. *Psychological Science*, *24*(7), 1079–1088. doi: 10.1177/0956797612463705

Giles, H., Coupland, N., & Coupland, J. (1991). Accommodation theory: Communication, context, and consequence. In H. Giles, J. Coupland, & N. Coupland (Eds.), *Contexts of Accommodation: Developments in Applied Sociolinguistics* (pp. 1–68). Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511663673.001

Gillespie-Lynch, K., Kapp, S. K., Shane-Simpson, C., Smith, D. S., & Hutman, T. (2014). Intersections Between the Autism Spectrum and the Internet: Perceived Benefits and Preferred Functions of Computer-Mediated Communication. *Intellectual and Developmental Disabilities*, *52*(6), 456–69.

Goff, P. A., Eberhardt, J. L., Williams, M. J., & Jackson, M. C. (2008, February). Not yet human: Implicit knowledge, historical dehumanization, and contemporary consequences. *Journal of Personality and Social Psychology*, *94*(2), 292–306. doi: 10.1037/0022-3514.94.2.292

Goffman, E. (1959). *The presentation of self in everyday life*. Oxford, England: Doubleday.

Goldin-Meadow, S., So, W. C., Ozyurek, A., & Mylander, C. (2008). The natural order of events: How speakers of different languages represent events nonverbally. *Proceedings of the National Academy of Sciences*, *105*(27), 9163–9168. doi: 10.1073/pnas.0710060105

Gomez, R. L., Gerken, L., & Schvaneveldt, R. W. (2000). The basis of transfer in artificial grammar learning. *Memory & Cognition*, *28*(2), 253–263. doi: 10.3758/BF03213804

Gonzalez, C., Martin, J. M., Minshew, N. J., & Behrmann, M. (2013, October). Practice makes improvement: How adults with autism out-perform others in a naturalistic visual search task. *Journal of Autism and Developmental Disorders*, *43*(10), 2259–2268. doi: 10.1007/s10803-013-1772-4

Gottardello, D., Calvard, T., & Song, J.-W. (2025). When Neurodiversity and Ethnicity Combine: Intersectional Stereotyping and Workplace Experiences of Neurodivergent Ethnic Minority Employees. *Human Resource Management*, *n/a*(n/a). doi: 10.1002/hrm.22286

Gowen, E., Taylor, R., Bleazard, T., Greenstein, A., Baimbridge, P., & Poole, D. (2019). Guidelines for conducting research studies with the autism community. *Autism policy & practice*, *2*(1 A new beginning), 29–45.

Gratton, C. (2016, December). Resisting the Gender Binary: The Use of (ING) in the Construction of Non-binary Transgender Identities. *University of Pennsylvania Working Papers in Linguistics*(7).

Grech, L. B., Koller, D., & Olley, A. (2023). Furthering the person-first versus identity-first language debate. *Australian Psychologist*, *58*(4), 223–232. doi: 10.1080/00050067.2023.2192863

Green, M. F., Horan, W. P., & Lee, J. (2015, October). Social cognition in schizophrenia. *Nature Reviews Neuroscience*, *16*(10), 620–631. doi: 10.1038/nrn4005

Green, R. M., Travers, A. M., Howe, Y., & McDougle, C. J. (2019). Women and autism spectrum disorder: Diagnosis and implications for treatment of adolescents and adults. *Current Psychiatry Reports*, *21*(4), 22. doi: 10.1007/s11920-019-1006-3

Greenway, C. W., Robinson, A. H., & King, J. M. (2023). The effect of social devaluation, labeling, and familiarity on children's attitudes and behavioral intentions toward a peer with symptoms of ADHD. *Psychology in the Schools*, *60*(11), 4452–4465. doi: 10.1002/pits.23004

Grice, H. P. H. P. (1989). *Studies in the way of words*. Cambridge, Mass. ; London: Harvard University Press.

Griffiths, S., Allison, C., Kenny, R., Holt, R., Smith, P., & Baron-Cohen, S. (2019). The vulnerability experiences quotient (VEQ): A study of vulnerability, mental health and life satisfaction in autistic adults. *Autism Research*, *12*(10), 1516–1528. doi: 10.1002/aur.2162

Grissom, A., Finke, E., & Zane, E. (2024). Verbal fluency and autism: Reframing current data through the lens of monotropism. *Autism Research*, *17*(2), 324–337. doi: 10.1002/aur.3071

Gumperz, J. J. (1977, December). The Sociolinguistic Significance of Conversational Code-Switching. *RELC Journal*, *8*(2), 1–34. doi: 10.1177/003368827700800201

Guntuku, S. C., Ramsay, J. R., Merchant, R. M., & Ungar, L. H. (2019, October). Language of ADHD in Adults on Social Media. *Journal of Attention Disorders*, *23*(12), 1475–1485. doi: 10.1177/1087054717738083

Haas, K., Costley, D., Falkmer, M., Richdale, A., Sofronoff, K., & Falkmer, T. (2016). Factors Influencing the Research Participation of Adults with Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders*, *46*(5), 1793–1805. doi: 10.1007/s10803-016-2708-6

Happé, F. (1994, April). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. *Journal of Autism and Developmental Disorders*, *24*(2), 129–154. doi: 10.1007/BF02172093

Happé, F., & Frith, U. (2006, January). The Weak Coherence Account: Detail-focused Cognitive Style in Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders*, *36*(1), 5–25. doi: 10.1007/s10803-005-0039-0

Haspelmath, M. (2019, September). Differential place marking and differential object marking. *STUF - Language Typology and Universals*, *72*, 313–334. doi: 10.1515/stuf-2019-0013

Haspelmath, M. (2021, August). Explaining grammatical coding asymmetries: Form–frequency correspondences and predictability. *Journal of Linguistics*, *57*(3), 605–633. doi: 10.1017/S0022226720000535

Hassrick, E. M., Holmes, L. G., Sosnowy, C., Walton, J., & Carley, K. (2021). Benefits and Risks: A Systematic Review of Information and Communication Technology Use by Autistic People. *Autism in Adulthood*, *3*(1), 72–84. doi: 10.1089/aut.2020.0048

Hawkins, E., Gathercole, S., Astle, D., & Holmes, J. (2016). Language Problems and ADHD Symptoms: How Specific Are the Links? *Brain Sciences*, *6*(4). doi: 10.3390/brainsci6040050

Haworth, K. (2006). Upper Paleolithic art, autism, and cognitive style: Implications for the evolution of language. *SEMIOTICA*, *162*(1-4), 127–174. doi: 10.1515/SEM.2006.075

Hazen, E. P., Stornelli, J. L., O'Rourke, J. A., Koesterer, K., & McDougle, C. J. (2014). Sensory symptoms in autism spectrum disorders. *Harvard Review of Psychiatry*, *22*(2), 112–124. doi: 10.1097/01.HRP.0000445143.08773.58

Heasman, B., & Gillespie, A. (2019). Participants Over-Estimate How Helpful They Are in a Two-Player Game Scenario Toward an Artificial Confederate That Discloses a Diagnosis of Autism. *Frontiers in Psychology*, *10*.

Heini, A., & and Kredens, K. (2024, November). Remote data collection in sociolinguistics: Lessons from the COVID-19 pandemic. *International Journal of Social Research Methodology*, *27*(6), 747–759. doi: 10.1080/13645579.2023.2265257

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, *33*(2-3), 61–83. doi: 10.1017/S0140525X0999152X

Hernández-Campoy, J. M. (2015, May). Research methods in Sociolinguistics. *AILA Review*, *27*(1), 5–29. doi: 10.1075/aila.27.01her

Herrmann, E., Call, J., Hernàndez-Lloreda, M. V., Hare, B., & Tomasello, M. (2007, September). Humans Have Evolved Specialized Skills of Social Cognition: The Cultural Intelligence Hypothesis. *Science*, *317*(5843), 1360–1366. doi: 10.1126/science.1146282

Hewlin, P. F. (2009). Wearing the cloak: Antecedents and consequences of creating facades of conformity. *The Journal of Applied Psychology*, *94*(3), 727–741. doi: 10.1037/a0015228

Heyes, C. M., & Frith, C. D. (2014, June). The cultural evolution of mind reading. *Science*, *344*(6190), 1243091. doi: 10.1126/science.1243091

Hill, J. (2024). 'If I behave like the stupidly kind character maybe I will stop being accidentally rude to people': Does reading fiction inform the social understanding and masking behaviours of autistic females? *English in Education*, *0*(0), 1–16. doi: 10.1080/04250494.2024.2330905

Hobson, H. M., & Lee, A. (2023). Camouflaging in Developmental Language Disorder: The Views of Speech and Language Pathologists and Parents. *Communication Disorders Quarterly*, *44*(4), 247–256. doi: 10.1177/15257401221120937

Holtz, A. (2024). *Cognitive biases in competition: Innovation and the evolution of language structure* (Unpublished doctoral dissertation). The University of Edinburgh.

Hopkins, Z., Yuill, N., & Branigan, H. P. (2017). Inhibitory control and lexical alignment in children with an autism spectrum disorder. *Journal of Child Psychology and Psychiatry*, *58*, 1155–1165. doi: 10.1111/jcpp.12792

Hopkins, Z., Yuill, N., & Keller, B. (2016). Children with autism align syntax in natural conversation. *Applied Psycholinguistics*, *37*(2), 347–370. doi: 10.1017/S0142716414000599

Howard, P. L., & Sedgewick, F. (2021). 'Anything but the phone!': Communication mode preferences in the autism community. *AUTISM*, *25*(8), 2265–2278. doi: 10.1177/13623613211014995

Hudson Kam, C. L., & Newport, E. L. (2009). Getting it right by getting it wrong: When learners change languages. *Cognitive Psychology*, *59*(1), 30–66. doi: 10.1016/j.cogpsych.2009.01.001

Hull, L., Levy, L., Lai, M.-C., Petrides, K. V., Baron-Cohen, S., Allison, C., . . . Mandy, W. (2021). Is social camouflaging associated with anxiety and depression in autistic adults? *Molecular Autism*, *12*(1), 13. doi: 10.1186/s13229-021-00421-1

Hull, L., Mandy, W., Lai, M. C., Baron-Cohen, S., Allison, C., Smith, P., & Petrides, K. V. (2019, March). Development and Validation of the Camouflaging Autistic Traits Questionnaire (CAT-Q). *Journal of autism and developmental disorders*, *49*(3), 819–833. doi: 10.1007/S10803-018-3792-6

Hull, L., Mandy, W., Lai, M. C., Baron-Cohen, S., Allison, C., Smith, P., & Petrides, K. V. (2019). Development and validation of the camouflaging autistic traits questionnaire (CAT-Q). *Journal of autism and developmental disorders*, *49*, 819–833. doi: 10.1007/S10803-018-3792-6

Hull, L., Petrides, K. V., Allison, C., Smith, P., Baron-Cohen, S., Lai, M. C., & Mandy, W. (2017). "Putting on My Best Normal": Social Camouflaging in Adults with Autism Spectrum Conditions. *Journal of autism and developmental disorders*, *47*(8), 2519–2534. doi: 10.1007/S10803-017-3166-5

Hull, L., Petrides, K. V., Allison, C., Smith, P., Baron-Cohen, S., Meng, . . . Mandy, W. (2017). “Putting on My Best Normal": Social Camouflaging in Adults with Autism Spectrum Conditions. *Journal of Autism and Developmental Disorders*, *47*, 2519–2534. doi: 10.1007/s10803-017-3166-5

Hull, L., Petrides, K. V., & Mandy, W. (2020). The female autism phenotype and camouflaging: a narrative review. *Review Journal of Autism and Developmental Disorders*, *7*, 306–317. doi: 10.1007/S40489-020-00197-9

Hull, L., Petrides, K. V., & Mandy, W. (2021). Cognitive Predictors of Self-Reported Camouflaging in Autistic Adolescents. *Autism Research*, *14*(3), 523–532. doi: 10.1002/aur.2407

Iakoucheva, L. M., Muotri, A. R., & Sebat, J. (2019, September). Getting to the Cores of Autism. *Cell*, *178*(6), 1287–1298. doi: 10.1016/j.cell.2019.07.037

Iemmolo, G. (2010, August). Topicality and differential object marking: Evidence from Romance and beyond. *Studies in Language*, *34*(2), 239–272. doi: 10.1075/sl.34.2.01iem

Ilbury, C. (2025). *Researching Language and Digital Communication: A Student Guide*. Oxford, UNITED KINGDOM: Taylor & Francis Group.

Imm, P., White, T., & Durkin, M. S. (2019). Assessment of racial and ethnic bias in autism spectrum disorder prevalence estimates from a US surveillance system. *Autism : the international journal of research and practice*, *23*(8), 1927–1935. doi: 10.1177/1362361319827510

Jäger, G. (2007). Evolutionary game theory and typology: A case study. *Language*, *83*(1), 74–109.

Jaiswal, A., & Washington, P. (2024, January). Using #ActuallyAutistic on Twitter for Precision Diagnosis of Autism Spectrum Disorder: Machine Learning Study. *JMIR Formative Research*, *8*. doi: 10.2196/52660

Jaswal, V. K., & Akhtar, N. (2019a). Being versus appearing socially uninterested: Challenging assumptions about social motivation in autism. *Behavioral and Brain Sciences*, *42*, e82. doi: 10.1017/S0140525X18001826

Jaswal, V. K., & Akhtar, N. (2019b). Being versus appearing socially uninterested: Challenging assumptions about social motivation in autism. *Behavioral and Brain Sciences*, *42*, e82. doi: 10.1017/S0140525X18001826

Jedrzejewska, A., & Dewey, J. (2022). Camouflaging in Autistic and Non-autistic Adolescents in the Modern Context of Social Media. *Journal of Autism and Developmental Disorders*, *52*(2), 630–646. doi: 10.1007/S10803-021-04953-6/FIGURES/1

Jennes-Coussens, M., Magill-Evans, J., & Koning, C. (2006). The quality of life of young men with asperger syndrome. *Autism*, *10*, 403–414. doi: 10.1177/1362361306064432

Johansson, C., & Folgerø, P. O. (2022, June). Is Reduced Visual Processing the Price of Language? *Brain Sciences*, *12*(6), 771. doi: 10.3390/brainsci12060771

Johnson, D. G., Mattan, B. D., Flores, N., Lauharatanahirun, N., & Falk, E. B. (2021). Social-Cognitive and Affective Antecedents of Code Switching and the Consequences of Linguistic Racism for Black People and People of Color. *Affective Science*, *3*(1), 5–13. doi: 10.1007/s42761-021-00072-8

Johnson, T., Siegelman, N., & Arnon, I. (2020). Individual differences in learning abilities impact structure addition: Better learners create more structured languages. *Cognitive Science*, *44*, e12877. doi: 10.1111/COGS.12877

Johnston, K., Murray, K., Spain, D., Walker, I., & Russell, A. (2019, October). Executive Function: Cognition and Behaviour in Adults with Autism Spectrum Disorders (ASD). *Journal of Autism and Developmental Disorders*, *49*(10), 4181–4192. doi: 10.1007/s10803-019-04133-7

Jones, D. R., Botha, M., Ackerman, R. A., King, K., & Sasson, N. J. (2024). Non-autistic observers both detect and demonstrate the double empathy problem when evaluating interactions between autistic and non-autistic adults. *AUTISM*, *28*(8), 2053–2065. doi: 10.1177/13623613231219743

Jorgenson, C., Lewis, T., Rose, C., & Kanne, S. (2020). Social Camouflaging in Autistic and Neurotypical Adolescents: A Pilot Study of Differences by Sex and Diagnosis. *Journal of Autism and Developmental Disorders*, *50*(12), 4344–4355. doi: 10.1007/s10803-020-04491-7

Joseph, R. M., McGrath, L. M., & Tager-Flusberg, H. (2005). Executive Dysfunction and Its Relation to Language Ability in Verbal School-Age Children With Autism. *Developmental neuropsychology*, *27*(3), 361–378. doi: 10.1207/s15326942dn2703_4

Josserand, M. (2024). *Impact of inter-individual and inter-group variations on language evolution* (Unpublished doctoral dissertation). Université Lumière, Lyon, France.

Josserand, M., Allassonnière-Tang, M., Pellegrino, F., Dediu, D., & de Boer, B. (2024). How Network Structure Shapes Languages: Disentangling the Factors Driving Variation in Communicative Agents. *Cognitive Science*, *48*(4), e13439. doi: 10.1111/cogs.13439

Josserand, M., Allassonnière-Tang, M., Pellegrino, F., & Dediu, D. (2021). Interindividual Variation Refuses to Go Away: A Bayesian Computer Model of Language Change in Communicative Networks. *Frontiers in Psychology*, *12*. doi: 10.3389/fpsyg.2021.626118

Josserand, M., Pellegrino, F., Grosseck, O., Dediu, D., & Raviv, L. (2024). Adapting to individual differences: An experimental study of variation in language evolution. In *The Evolution of Language: Proceedings of the 15th International Conference (Evolang XV).* doi: 10.17617/2.3587960

Jury, M., Perrin, A.-L., Desombre, C., & Rohmer, O. (2021). Teachers' attitudes toward the inclusion of students with autism spectrum disorder: Impact of students' difficulties. *Research in Autism Spectrum Disorders*, *83*, 101746. doi: 10.1016/j.rasd.2021.101746

Kanwal, J., Smith, K., Culbertson, J., & Kirby, S. (2017). Zipf's law of abbreviation and the principle of least effort: Language users optimise a miniature lexicon for efficient communication. *Cognition*, *165*, 45–52. doi: 10.1016/J.COGNITION.2017.05.001

Kapnoula, E. C., & McMurray, B. (2021, December). Idiosyncratic use of bottom-up and top-down information leads to differences in speech perception flexibility: Converging evidence from ERPs and eye-tracking. *Brain and Language*, *223*, 105031. doi: 10.1016/j.bandl.2021.105031

Kapnoula, E. C., Winn, M. B., Kong, E. J., Edwards, J., & McMurray, B. (2017). Evaluating the sources and functions of gradiency in phoneme categorization: An individual differences approach. *Journal of Experimental Psychology: Human Perception and Performance*, *43*(9), 1594–1611. doi: 10.1037/xhp0000410

Kapp, S. K. (Ed.). (2020). *Autistic Community and the Neurodiversity Movement: Stories from the Frontline*. Singapore: Springer. doi: 10.1007/978-981-13-8437-0

Kapp, S. K. (2023, February). Profound Concerns about "Profound Autism": Dangers of Severity Scales and Functioning Labels for Support Needs. *Education Sciences*, *13*(2), 106. doi: 10.3390/educsci13020106

Kapp, S. K. (2025, April). Sensory–movement underpinnings of lifelong neurodivergence: Getting a grip on autism. *Frontiers in Integrative Neuroscience*, *19*, 1489322. doi: 10.3389/fnint.2025.1489322

Keates, N., Martin, F., & Waldock, K. E. (2024). Autistic People's Perspectives on Functioning Labels and Associated Reasons, and Community Connectedness. *Journal of Autism and Developmental Disorders*. doi: 10.1007/s10803-024-06316-3

Keating, C. T., Hickman, L., Geelhand, P., Takahashi, T., Leung, J., Monk, R., ... Sowden-Carvalho, S. (2024, March). Cross-cultural variation in experiences of acceptance, camouflaging and mental health difficulties in autism: A registered report. *PLOS ONE*, *19*(3), e0299824. doi: 10.1371/journal.pone.0299824

Keating, C. T., Hickman, L., Leung, J., Monk, R., Montgomery, A., Heath, H., & Sowden, S. (2023). Autism-related language preferences of English-speaking individuals across the globe: A mixed methods investigation. *Autism Research*, *16*(2), 406–428. doi: 10.1002/aur.2864

Kenny, L., Hattersley, C., Molins, B., Buckley, C., Povey, C., & Pellicano, E. (2016a). Which terms should be used to describe autism? perspectives from the uk autism community [Journal Article]. *Autism*, *20*(4), 442–62. doi: 10.1177/1362361315588200

Kenny, L., Hattersley, C., Molins, B., Buckley, C., Povey, C., & Pellicano, E. (2016b). Which terms should be used to describe autism? Perspectives from the UK autism community. *Autism*, *20*(4), 442–462. doi: 10.1177/1362361315588200

Kenny, L., Remington, A., & Pellicano, E. (2024). Everyday executive function issues from the perspectives of autistic adolescents and their parents: Theoretical and empirical implications. *Autism*, 13623613231224093. doi: 10.1177/13623613231224093

Keogh, A., Kirby, S., & Culbertson, J. (2024). Predictability and Variation in Language Are Differentially Affected by Learning and Production. *Cognitive Science*, *48*(4), e13435. doi: 10.1111/cogs.13435

Keogh, A., & Lupyan, G. (2024). Who benefits from redundancy in learning noun class systems? In *The Evolution of Language: Proceedings of the 15th International Conference (Evolang XV).* Madison, WI. doi: 10.17617/2.3587960

Kercood, S., Grskovic, J. A., Banda, D., & Begeske, J. (2014, October). Working memory and autism: A review of literature. *Research in Autism Spectrum Disorders*, *8*(10), 1316–1332. doi: 10.1016/j.rasd.2014.06.011

Kerr, S., & Durkin, K. (2004, December). Understanding of Thought Bubbles as Mental Representations in Children with Autism: Implications for Theory of Mind. *Journal of Autism and Developmental Disorders*, *34*(6), 637–648. doi: 10.1007/s10803-004-5285-z

Kerswill, P. (1996). Children, Adolescents, and Language Change. *Language Variation and Change*, *8*(2), 177–202.

Kerswill, P., Cheshire, J., Fox, S., & Torgersen, E. (2013). English as a contact language: The role of children and adolescents. In D. Schreier & M. Hundt (Eds.), *English as a Contact Language* (pp. 258–282). Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511740060.015

Kessler, P. B., & Ikuta, T. (2023). Pragmatic Deficits in Attention Deficit/Hyperactivity Disorder: Systematic Review and Meta-Analysis. *Journal of Attention Disorders*, *27*(8). doi: 10.1177/10870547231161534

Kessler, R. C., Adler, L. A., Gruber, M. J., Sarawate, C. A., Spencer, T., & Van Brunt, D. L. (2007). Validity of the World Health Organization Adult ADHD Self-Report Scale (ASRS) Screener in a representative sample of health plan members. *International Journal of Methods in Psychiatric Research*, *16*(2), 52–65. doi: 10.1002/mpr.208

Khoo, J., & Ilbury, C. (2024, July). Navigating ‘safe’ and ‘non-safe’ queer spaces: A study of style-shifting in Singapore. *Journal of Language and Sexuality*, *13*(2), 201–226. doi: 10.1075/jls.00036.kho

Khudiakova, V., Levy, X., Sowden-Carvalho, S., & Surtees, A. D. (2025). A Qualitative Exploration of Autistic People’s Experiences of Camouflaging Across Different Social Contexts. *Autism in Adulthood*. doi: 10.1089/aut.2024.0288

Kidd, E., & Donnelly, S. (2020, January). Individual Differences in First Language Acquisition. *Annual Review of Linguistics*, *6*(Volume 6, 2020), 319–340. doi: 10.1146/annurev-linguistics-011619-030326

Kirby, S., Griffiths, T., & Smith, K. (2014, October). Iterated learning and the evolution of language. *Current Opinion in Neurobiology*, *28*, 108–114. doi: 10.1016/j.conb.2014.07.014

Kirby, S., Tamariz, M., Cornish, H., & Smith, K. (2015, August). Compression and communication in the cultural evolution of linguistic structure. *Cognition*, *141*, 87–102. doi: 10.1016/j.cognition.2015.03.016

Kirton, F., Kirby, S., Smith, K., Culbertson, J., & Schouwstra, M. (2021, January). Constituent order in silent gesture reflects the perspective of the producer. *Journal of Language Evolution*, *6*(1), 54–76. doi: 10.1093/jole/lzaa010

Kissine, M., Saint-Denis, A., & Mottron, L. (2023, October). Language acquisition can be truly atypical in autism: Beyond joint attention. *Neuroscience & Biobehavioral Reviews*, *153*, 105384. doi: 10.1016/j.neubiorev.2023.105384

Klassen, S., & Fiesler, C. (2022, October). “This Isn’t Your Data, Friend”: Black Twitter as a Case Study on Research Ethics for Public Data. *Social Media + Society*, *8*(4), 20563051221144317. doi: 10.1177/20563051221144317

Koplenig, A., Meyer, P., Wolfer, S., & Müller-Spitzer, C. (2017). The statistical trade-off between word order and word structure – large-scale evidence for the principle of least effort. *PLOS ONE*, *12*, e0173614. doi: 10.1371/JOURNAL.PONE.0173614

Koplenig, A., Wolfer, S., & Meyer, P. (2023, September). A large quantitative analysis of written language challenges the idea that all languages are equally complex. *Scientific Reports*, *13*(1), 15351. doi: 10.1038/s41598-023-42327-3

Koteyko, N., Van Driel, M., Billan, S., Barros Pena, B., & Vines, J. (2024). Stigma Management Strategies of Autistic Social Media Users. *Autism in Adulthood*. doi: 10.1089/aut.2023.0095

Krendl, A. C., Hugenberg, K., & Kennedy, D. P. (2024). Comparing data quality from an online and in-person lab sample on dynamic theory of mind tasks. *Behavior Research Methods*, *56*(3), 2353–2375. doi: 10.3758/s13428-023-02152-y

Kruschke, J. K., & Liddell, T. M. (2018, February). The Bayesian New Statistics: Hypothesis testing, estimation, meta-analysis, and power analysis from a Bayesian perspective. *Psychonomic Bulletin & Review*, *25*(1), 178–206. doi: 10.3758/s13423-016-1221-4

Kruyt, J., & Beňuš, Š. (2021). Prosodic entrainment in individuals with autism spectrum disorder. *Topics in Linguistics*, *22*(2), 47–61. doi: 10.2478/topling-2021-0010

Kurumada, C., & Grimm, S. (2019). Predictability of meaning in grammatical encoding: Optional plural marking. *Cognition*, *191*, 103953. doi: 10.1016/j.cognition.2019.04.022

Kurumada, C., & Jaeger, T. F. (2015). Communicative efficiency in language production: Optional case-marking in japanese. *Journal of Memory and Language*, *83*, 152–178. doi: 10.1016/J.JML.2015.03.003

Kusters, A., S., Massimiliano, S., Ruth, & and Tapio, E. (2017, July). Beyond languages, beyond modalities: Transforming the study of semiotic repertoires. *International Journal of Multilingualism*, *14*(3), 219–232. doi: 10.1080/14790718.2017.1321651

Kysow, K., Park, J., & Johnston, C. (2017). The use of compensatory strategies in adults with ADHD symptoms. *ADHD Attention Deficit and Hyperactivity Disorders*, *9*(2), 73–88. doi: 10.1007/s12402-016-0205-6

Labov, W. (1990, July). The intersection of sex and social class in the course of linguistic change. *Language Variation and Change*, *2*(2), 205–254. doi: 10.1017/S0954394500000338

Labov, W. (2001). *Principles of Linguistic Change, Volume 2: Social Factors*. Wiley-Blackwell.

Labov, W. (2010). *Principles of Linguistic Change, Volume 3: Cognitive and Cultural Factors*. John Wiley & Sons.

Ladd, R., Roberts, S., & Dediu, D. (2015, January). Correlational Studies in Typological and Historical Linguistics. *Annual Review of Linguistics*, *1*, 221–241. doi: 10.1146/annurev-linguist-030514-124819

Lai, M. C., Lombardo, M. V., Auyeung, B., Chakrabarti, B., & Baron-Cohen, S. (2015). Sex/gender differences and autism: Setting the scene for future research. *Journal of the American Academy of Child & Adolescent Psychiatry*, *54*, 11–24. doi: 10.1016/J.JAAC.2014.10.003

Leary, M. R., & Kowalski, R. M. (1990). Impression management: A literature review and two-component model. *Psychological Bulletin*, *107*(1), 34–47. doi: 10.1037/0033-2909.107.1.34

Lehmann, C. (1985). Grammaticalization, Synchronic Variation and Diachronic Change. *LINGUA E STILE*, *20*(3), 303–318.

Lehnert-LeHouillier, H., Terrazas, S., & Sandoval, S. (2020). Prosodic Entrainment in Conversations of Verbal Children and Teens on the Autism Spectrum. *Frontiers in Psychology*, *11*. doi: 10.3389/fpsyg.2020.582221

Leonard, L. B. (2015). Language symptoms and theirpossible sources ofSpecific Language Impairment. In E. L. Bavin & L. R. Naigles (Eds.), *The Cambridge Handbook of Child Language* (2nd ed., pp. 545–563). Cambridge: Cambridge University Press. doi: 10.1017/CBO9781316095829.025

Leonard, L. B. (2022). Developmental Language Disorder and the role of language typology. *Enfance*, *1*(1), 25–39.

Leveille, A. D. (2024, July). “Tell Me You Have ADHD Without Telling Me You Have ADHD”: Neurodivergent Identity Performance on TikTok. *Social Media + Society*, *10*(3), 20563051241269260. doi: 10.1177/20563051241269260

Levinson, S. C., & Gray, R. D. (2012). Tools from evolutionary biology shed new light on the diversification of languages. *Trends in Cognitive Sciences*, *16*(3), 167–173. doi: 10.1016/j.tics.2012.01.007

Levon, E. (2011, February). Teasing Apart to Bring Together: Gender and Sexuality in Variationist Research. *American Speech*, *86*(1), 69–84. doi: 10.1215/00031283-1277519

Levon, E., Sharma, D., & Ilbury, C. (2022). *Speaking Up: Accents and Social Mobility.* The Sutton Trust. Retrieved from `https://www.suttontrust.com/wp-content/uploads/2022/11/Accents-and-social-mobility.pdf`

Levon, E., Sharma, D., Watt, D. J. L., Cardoso, A., & Ye, Y. (2021). Accent Bias and Perceptions of Professional Competence in England. *Journal of English Linguistics*, *49*(4), 355–388. doi: 10.1177/00754242211046316

Levshina, N. (2021). Communicative efficiency and differential case marking: a reverse-engineering approach. *Linguistics vanguard : multimodal online journal*, *7*. doi: 10.1515/LINGVAN-2019-0087

Levshina, N., & Moran, S. (2021). Efficiency in human languages: Corpus evidence for universal principles. *Linguistics Vanguard*, *7*(s3). doi: 10.1515/lingvan-2020-0081

Levshina, N., Namboodiripad, S., Allassonnière-Tang, M., Kramer, M., Talamo, L., Verkerk, A., ... Stoynova, N. (2023, July). Why we need a gradient approach to word order. *Linguistics*, *61*(4), 825–883. doi: 10.1515/ling-2021-0098

Lieven, E. V., Pine, J. M., & Barnes, H. D. (1992, June). Individual differences in early vocabulary development: Redefining the referential-expressive distinction. *Journal of Child Language*, *19*(2), 287–310. doi: 10.1017/s0305000900011429

Livingston, L. A., Hargitai, L. D., & Shah, P. (2025). The double empathy problem: A derivation chain analysis and cautionary note. *Psychological Review*, *132*(3), 744–757. doi: 10.1037/rev0000468

Loomes, R., Hull, L., & Mandy, W. P. L. (2017). What Is the Male-to-Female Ratio in Autism Spectrum Disorder? A Systematic Review and Meta-Analysis. *Journal of the American Academy of Child & Adolescent Psychiatry*, *56*(6), 466–474. doi: 10.1016/j.jaac.2017.03.013

Love, A. M., Cai, R. Y., Edwards, C., & Gibbs, V. (2023, December). Exploring Identity Importance for Autistic Adults and Associations with Disclosure Experiences: A Brief Report. *Autism in Adulthood*, *5*(4), 450–456. doi: 10.1089/aut.2023.0005

Lundin, A., Kosidou, K., & Dalman, C. (2019). Measuring Autism Traits in the Adult General Population with the Brief Autism-Spectrum Quotient, AQ-10: Findings from the Stockholm Public Health Cohort. *Journal of Autism and Developmental Disorders*, *49*(2), 773–780. doi: 10.1007/s10803-018-3749-9

Lupyan, G., & Dale, R. (2010). Language Structure Is Partly Determined by Social Structure. *PLOS ONE*, *5*(1), e8559. doi: 10.1371/journal.pone.0008559

Lupyan, G., & Dale, R. (2016). Why Are There Different Languages? The Role of Adaptation in Linguistic Diversity. *Trends in Cognitive Sciences*, *20*(9), 649–660. doi: 10.1016/j.tics.2016.07.005

Lupyan, G., & Raviv, L. (2024). A cautionary note on sociodemographic predictors of linguistic complexity: Different measures and different analyses lead to different conclusions. In *Proceedings of the International Conference on the Evolution of Language 2024 (Evolang XV).*

Luyster, R., Richler, J., Risi, S., Hsu, W.-L., Dawson, G., Bernier, R., … Lord, C. (2005, June). Early Regression in Social Communication in Autism Spectrum Disorders: A CPEA Study. *Developmental Neuropsychology*, *27*(3), 311–336. doi: 10.1207/s15326942dn2703_2

Luyster, R. J., Zane, E., & Wisman Weil, L. (2022). Conventions for unconventional language: Revisiting a framework for spoken language features in autism. *Autism and Developmental Language Impairments*, *7*. (Publisher: SAGE Publications Ltd) doi: 10.1177/23969415221105472/ASSET/IMAGES/LARGE/10.1177_23969415221105472-FIG1.JPEG

MacDonald, M. C. (2013, April). How language production shapes language form and comprehension. *Frontiers in Psychology*, *4*. doi: 10.3389/fpsyg.2013.00226

Main, A. Z. (2003). *Allism: An introduction to a little-known condition.* Retrieved 2024-07-31, from `https://www.fysh.org/~zefram/allism/allism_intro.txt`

Majid, A. (2023). Establishing psychological universals. *Nature Reviews Psychology*, *2*(4), 199–200. doi: 10.1038/s44159-023-00169-w

Malik-Moraleda, S., Taliaferro, M., Shannon, S., Jhingan, N., Swords, S., Peterson, D. J., … Fedorenko, E. (2025, March). Constructed languages are processed by the same brain mechanisms as natural languages. *Proceedings of the National Academy of Sciences*, *122*(12), e2313473122. doi: 10.1073/pnas.2313473122

Manalili, M. A., Pearson, A., Sulik, J., Creechan, L., Elsherif, M., Murkumbi, I., … Morstead, T. (2023a). From Puzzle to Progress: How Engaging With Neurodiversity Can Improve Cognitive Science. *Cognitive Science*, *47*(2). doi: 10.1111/cogs.13255

Manalili, M. A., Pearson, A., Sulik, J., Creechan, L., Elsherif, M., Murkumbi, I., ... Morstead, T. (2023b). From puzzle to progress: How engaging with neurodiversity can improve cognitive science. *Cognitive Science*, *47*. doi: 10.1111/cogs.13255

Manenti, M., Ferré, S., Tuller, L., Houy-Durand, E., Bonnet-Brilhault, F., & Prévost, P. (2024). Profiles of structural language and nonverbal intellectual abilities in verbal autistic adults. *Research in Autism Spectrum Disorders*, *114*, 102361. doi: 10.1016/j.rasd.2024.102361

Marchetta, N. D. J., Hurks, P. P. M., De Sonneville, L. M. J., Krabbendam, L., & Jolles, J. (2008). Sustained and Focused Attention Deficits in Adult ADHD. *Journal of Attention Disorders*, *11*(6), 664–676. doi: 10.1177/1087054707305108

Marcus, E., & O'Neill, S. (2020, December). *Tone Is Hard to Grasp Online. Can Tone Indicators Help?* The New York Times. Retrieved from `https://www.nytimes.com/2020/12/09/style/tone-indicators-online.html`

Marocchini, E., & Baldin, I. (2024). Cross-neurotype communication from an autistic point of view: Insights on autistic Theory of Mind from a focus group study. *International Journal of Language & Communication Disorders*, *n/a*(n/a). doi: 10.1111/1460-6984.13095

Maroney, M. R., & Horne, S. G. (2022). "Tuned into a different channel": Autistic transgender adults' experiences of intersectional stigma. *Journal of Counseling Psychology*, *69*(6), 761–774. doi: 10.1037/cou0000639

Martin, A., Adger, D., Abels, K., Kanampiu, P., & Culbertson, J. (2024). A Universal Cognitive Bias in Word Order: Evidence From Speakers Whose Language Goes Against It. *Psychological Science*, *35*(3), 304–311. doi: 10.1177/09567976231222836

Martin, A., & Culbertson, J. (2020). Revisiting the Suffixing Preference: Native-Language Affixation Patterns Influence Perception of Sequences. *Psychological Science*, *31*(9), 1107–1116. doi: 10.1177/0956797620931108

Martin, A., & Peperkamp, S. (2020, February). Phonetically natural rules benefit from a learning bias: A re-examination of vowel harmony and disharmony. *Phonology*, *37*(1), 65–90. doi: 10.1017/S0952675720000044

Matyjek, M., Bast, N., & Faraco, S. S. (2025). Preference for Social Motion in Autistic Adults. *Psychophysiology*, *62*(4), e70053. doi: 10.1111/psyp.70053

Mayo, J., & Eigsti, I.-M. (2012, November). Brief Report: A Comparison of Statistical Learning in School-Aged Children with High Functioning Autism and Typically Developing Peers. *Journal of Autism and Developmental Disorders*, *42*(11), 2476–2485. doi: 10.1007/s10803-012-1493-0

Mazzaggio, G., & Shield, A. (2020). The Production of Pronouns and Verb Inflections by Italian Children with ASD: A New Dataset in a Null Subject Language. *Journal of Autism and Developmental Disorders*, *50*(4), 1425–1433. doi: 10.1007/s10803-019-04349-7

McArthur, D. (2024, July). When you die, are you ‘unalived’? The strange world of social media algospeak. *The Herald*.

McCluney, C. L., Durkee, M., Smith, R. E., Robotham, K. J., & Lee, S. S.-L. (2021). To be, or not to be ... Black: The effects of racial codeswitching on perceived professionalism in the workplace ... *Journal of Experimental Social Psychology*, *97*, 104199. doi: 10.1016/j.jesp.2021.104199

McCracken, C. (2021). Autistic identity and language learning: Response to Kissine. *Language*, *97*(3), e211-e217.

McDonald, T. (2020). Autism Identity and the “Lost Generation”: Structural Validation of the Autism Spectrum Identity Scale and Comparison of Diagnosed and Self-Diagnosed Adults on the Autism Spectrum. *Autism in Adulthood: Challenges and Management*, *2*(1), 13–23. doi: 10.1089/aut.2019.0069

McElreath, R. (2020). *Statistical Rethinking: A Bayesian Course with Examples in R and STAN*. Milton, UNITED KINGDOM: CRC Press LLC.

McQuaid, G. A., Lee, N. R., & Wallace, G. L. (2022, February). Camouflaging in autism spectrum disorder: Examining the roles of sex, gender identity, and diagnostic timing. *Autism*, *26*(2), 552–559. doi: 10.1177/13623613211042131/ASSET/IMAGES/LARGE/10.1177_13623613211042131-FIG1.JPEG

Meir, I., Aronoff, M., Börstell, C., Hwang, S.-O., Ilkbasaran, D., Kastner, I., ... Sandler, W. (2017, January). The effect of being human and the basis of grammatical word order: Insights from novel communication systems and young sign languages. *Cognition*, *158*, 189–207. doi: 10.1016/j.cognition.2016.10.011

Meir, N., & Novogrodsky, R. (2020). Syntactic abilities and verbal memory in monolingual and bilingual children with High Functioning Autism (HFA). *First Language*, *40*(4), 341–366. doi: 10.1177/0142723719849981

Meyer, I. H. (2003). Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: Conceptual issues and research evidence. *Psychological Bulletin*, *129*(5), 674–697. doi: 10.1037/0033-2909.129.5.674

Miller, D., Rees, J., & Pearson, A. (2021a). “Masking Is Life”: Experiences of Masking in Autistic and Nonautistic Adults. *https://home-liebertpub-com.ezproxy.is.ed.ac.uk/aut*, *3*(4), 330–338. doi: 10.1089/AUT.2020.0083

Miller, D., Rees, J., & Pearson, A. (2021b). “masking is life”: Experiences of masking in autistic and nonautistic adults. *Autism in Adulthood*, *3*, 330–338. doi: 10.1089/AUT.2020.0083

Mills, M. T., & Washington, J. A. (2015). Managing Two Varieties: Code-Switching in the Educational Context. In J. Bloomquist, L. J. Green, & S. L. Lanehart (Eds.), *The Oxford Handbook of African American Language* (p. 0). Oxford University Press. doi: 10.1093/oxfordhb/9780199795390.013.22

Milton, D. (2012a). On the ontological status of autism: the 'double empathy problem'. *http://dx.doi.org/10.1080/09687599.2012.710008*, *27*, 883–887. doi: 10.1080/09687599.2012.710008

Milton, D. (2012b). On the ontological status of autism: the 'double empathy problem'. *Disability & Society*, *27*(6), 883–887.

Milton, D., Gurbuz, E., & Lopez, B. (2022). The 'double empathy problem': Ten years on. *https://doi-org.ezproxy.is.ed.ac.uk/10.1177/13623613221129123*, *26*(8), 1901–1903. doi: 10.1177/13623613221129123

Milton, D. E. M., Heasman, B., & Sheppard, E. (2018). Double Empathy. In F. R. Volkmar (Ed.), *Encyclopedia of Autism Spectrum Disorders* (pp. 1–8). New York, NY: Springer New York. doi: 10.1007/978-1-4614-6435-8_102273-1

Mitchell, S., Brian, J., Zwaigenbaum, L., Roberts, W., Szatmari, P., Smith, I., & Bryson, S. (2006). Early language and communication development of infants later diagnosed with autism spectrum disorder. *Journal of developmental and behavioral pediatrics : JDBP*, *27*. doi: 10.1097/00004703-200604002-00004

Mizuno, A., Liu, Y., Williams, D. L., Keller, T. A., Minshew, N. J., & Just, M. A. (2011, August). The neural basis of deictic shifting in linguistic perspective-taking in high-functioning autism. *Brain*, *134*(8), 2422–2435. doi: 10.1093/brain/awr151

Moore, I., Morgan, G., Welham, A., & Russell, G. (2022, November). The intersection of autism and gender in the negotiation of identity: A systematic review and metasynthesis. *Feminism & Psychology*, *32*(4), 421–442. doi: 10.1177/09593535221074806

Moriarty, E., & and Kusters, A. (2021, April). Deaf cosmopolitanism: Calibrating as a moral process. *International Journal of Multilingualism*, *18*(2), 285–302. doi: 10.1080/14790718.2021.1889561

Morin, K., Guy, J., Habak, C., Wilson, H. R., Pagani, L., Mottron, L., & Bertone, A. (2015). Atypical Face Perception in Autism: A Point of View? *Autism Research*, *8*(5), 497–506. doi: 10.1002/aur.1464

Morrison, K. E., DeBrabander, K. M., Jones, D. R., Faso, D. J., Ackerman, R. A., & Sasson, N. J. (2020). Outcomes of real-world social interaction for autistic adults paired with autistic compared to typically developing partners. *Autism*, *24*(5), 1067–1080. doi: 10.1177/1362361319892701

Motamedi, Y., Schouwstra, M., Smith, K., Culbertson, J., & Kirby, S. (2019, November). Evolving artificial sign languages in the lab: From improvised gesture to systematic sign. *Cognition*, *192*, 103964. doi: 10.1016/j.cognition.2019.05.001

Mühlenbernd, R., & Quinley, J. (2017). Language change and network games. *Language and Linguistics Compass*, *11*(2), e12235. doi: 10.1111/lnc3.12235

Muir, K., Joinson, A., Cotterill, R., & Dewdney, N. (2016). Characterizing the Linguistic Chameleon: Personal and Social Correlates of Linguistic Style Accommodation. *Human Communication Research*, *42*(3), 462–484. doi: 10.1111/hcre.12083

Mundy, I. R., & Hannant, P. (2020). Exploring the phonological profiles of children with reading difficulties: A multiple case study. *Dyslexia*, *26*(4), 411–426. doi: 10.1002/dys.1667

Murray, A. L., Allison, C., Smith, P. L., Baron-Cohen, S., Booth, T., & Auyeung, B. (2017). Investigating diagnostic bias in autism spectrum conditions: An item response theory analysis of sex bias in the AQ-10. *Autism Research*, *10*(5), 790–800. doi: 10.1002/aur.1724

Naigles, L. R., & Tek, S. (2017). 'Form is easy, meaning is hard' revisited: (re) characterizing the strengths and weaknesses of language in children with autism spectrum disorder. *WIREs Cognitive Science*, *8*(4), e1438. doi: 10.1002/wcs.1438

Nair, V. K., Farah, W., & Boveda, M. (2024). Is neurodiversity a Global Northern White paradigm? *Autism*, 13623613241280835. doi: 10.1177/13623613241280835

National Institute on Deafness and Other Communication Disorders. (2023, May). *Developmental Language Disorder.* https://www.nidcd.nih.gov/health/developmental-language-disorder.

Navarro, D. J., Perfors, A., Kary, A., Brown, S. D., & Donkin, C. (2018). When Extremists Win: Cultural Transmission Via Iterated Learning When Populations Are Heterogeneous. *Cognitive Science*, *42*(7), 2108–2149. doi: 10.1111/cogs.12667

Neely, L., Gerow, S., Rispoli, M., Lang, R., & Pullen, N. (2016, March). Treatment of Echolalia in Individuals with Autism Spectrum Disorder: A Systematic Review. *Review Journal of Autism and Developmental Disorders*, *3*(1), 82–91. doi: 10.1007/s40489-015-0067-4

Nettle, D. (2012, July). Social scale and structural complexity in human languages. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *367*(1597), 1829–1836. doi: 10.1098/rstb.2011.0216

Nguyen, D., Doğruöz, A. S., Rosé, C. P., & de Jong, F. (2016, September). Computational Sociolinguistics: A Survey. *Computational Linguistics*, *42*(3), 537–593. doi: 10.1162/COLI_a_00258

NICE. (2021). *Autism spectrum disorder in adults: diagnosis and management.* `https://www.nice.org.uk/guidance/CG142`.

Nicolaidis, C., Raymaker, D. M., Ashkenazy, E., McDonald, K. E., Dern, S., Baggs, A. E., . . . Boisclair, W. C. (2015). "respect the way i need to communicate with you": Healthcare experiences of adults on the autism spectrum. *Autism*, *19*(7), 824–831. doi: 10.1177/1362361315576221

Niego, A., & Benítez-Burraco, A. (2019). Williams Syndrome, Human Self-Domestication, and Language Evolution. *Frontiers in Psychology*, *10*. doi: 10.3389/fpsyg.2019.00521

Normand, S., Schneider, B. H., Lee, M. D., Maisonneuve, M.-F., Chupetlovska-Anastasova, A., Kuehn, S. M., & Robaey, P. (2013). Continuities and changes in the friendships of children with and without ADHD: A longitudinal, observational study. *Journal of Abnormal Child Psychology*, *41*(7), 1161–1175. doi: 10.1007/s10802-013-9753-9

Noterdaeme, M., Wriedt, E., & Höhne, C. (2010, June). Asperger's syndrome and high-functioning autism: Language, motor and cognitive profiles. *European Child & Adolescent Psychiatry*, *19*(6), 475–481. doi: 10.1007/s00787-009-0057-0

Oakley, B. F., Tillmann, J., Ahmad, J., Crawley, D., Cáceres, A. S. J., Holt, R., ... Loth, E. (2021). How do core autism traits and associated symptoms relate to quality of life? findings from the longitudinal european autism project. *Autism : the international journal of research and practice*, *25*, 389–404. doi: 10.1177/1362361320959959

Oates, M., Bean, A., Kickbusch, R., & Sauer, S. (2024). Extending Double Empathy: Effects of Neurotype-Matching on Communication Success in an Expository Context. *American Journal of Speech-Language Pathology*, *33*(5), 2364–2377. doi: 10.1044/2024_AJSLP-23-00393

Obeid, R., Brooks, P. J., Powers, G.-L. K., K. L., & & Lum, J. A. (2016). Statistical learning in specific language impairment and autism spectrum disorder: A meta-analysis. *Frontiers in psychology*, *7*, 1245.

O'Dell, L., B. R., Hanna, O., Francisco, B., Charlotte, & and Orsini, M. (2016). Critical autism studies: Exploring epistemic dialogues and intersections, challenging dominant understandings of autism. *Disability & Society*, *31*(2), 166–179. doi: 10.1080/09687599.2016.1164026

Ostrolenk, A., d'Arc, B. F., Jelenic, P., Samson, F., & Mottron, L. (2017). Hyperlexia: Systematic review, neurocognitive modelling, and outcome. *Neuroscience & Biobehavioral Reviews*, *79*, 134–149. doi: 10.1016/J.NEUBIOREV.2017.04.029

Ostrolenk, A., Forgeot d'Arc, B., Jelenic, P., Samson, F., & Mottron, L. (2017, August). Hyperlexia: Systematic review, neurocognitive modelling, and outcome. *Neuroscience & Biobehavioral Reviews*, *79*, 134–149. doi: 10.1016/j.neubiorev.2017.04.029

Øverland, E., Andersen, P. N., Orm, S., Øie, M. G., Skogli, E. W., & Hauge, Å. L. (2024, October). "I Have Tried to Fit In, but I Just Want to Be Me": Development Toward Identity Formation in Young Autistic Adults. *Autism in Adulthood*. doi: 10.1089/aut.2024.0156

Overweg, J., Hartman, C. A., & Hendriks, P. (2018). Children with autism spectrum disorder show pronoun reversals in interpretation. *Journal of Abnormal Psychology*, *127*(2), 228–238. doi: 10.1037/abn0000338

Palma, P., Lee, S., Hodgins, V., & Titone, D. (2023). From One Bilingual to the Next: An Iterated Learning Study on Language Evolution in Bilingual Societies. *Cognitive Science*, *47*(5), e13289. doi: 10.1111/cogs.13289

Palomares, N. A., Giles, H., Soliz, J., & Gallois, C. (2016). Intergroup Accommodation, Social Categories, and Identities. In H. Giles (Ed.), *Communication Accommodation Theory: Negotiating Personal Relationships and Social Identities across Contexts* (pp. 123–151). Cambridge: Cambridge University Press. doi: 10.1017/CBO9781316226537.007

Paolacci, G., & Chandler, J. (2014). Inside the Turk: Understanding Mechanical Turk as a Participant Pool. *Current Directions in Psychological Science*, *23*(3), 184–188. doi: 10.1177/0963721414531598

Parish-Morris, J., Liberman, M. Y., Cieri, C., Herrington, J. D., Yerys, B. E., Bateman, L., ... Schultz, R. T. (2017, September). Linguistic camouflage in girls with autism spectrum disorder. *MOLECULAR AUTISM*, *8*, 48. doi: 10.1186/s13229-017-0164-6

Parks, K. M. A., Hannah, K. E., Moreau, C. N., Brainin, L., & Joanisse, M. F. (2023, November). Language abilities in children and adolescents with DLD and ADHD: A scoping review. *Journal of Communication Disorders*, *106*, 106381. doi: 10.1016/j.jcomdis.2023.106381

Patel, S. P., Cole, J., Lau, J. C. Y., Fragnito, G., & Losh, M. (2022). Verbal entrainment in autism spectrum disorder and first-degree relatives. *Scientific Reports*, *12*(1), 11496. doi: 10.1038/s41598-022-12945-4

Pearson, A., & Rose, K. (2021). A conceptual analysis of autistic masking: Understanding the narrative of stigma and the illusion of choice. *Autism in Adulthood: Challenges and Management*, *3*, 52. doi: 10.1089/AUT.2020.0043

Peer, E., Brandimarte, L., Samat, S., & Acquisti, A. (2017). Beyond the Turk: Alternative platforms for crowdsourcing behavioral research. *Journal of Experimental Social Psychology*, *70*, 153–163. doi: 10.1016/j.jesp.2017.01.006

Peer, E., Rothschild, D., Gordon, A., Evernden, Z., & Damer, E. (2022). Data quality of platforms and panels for online behavioral research. *Behavior Research Methods*, *54*(4), 1643–1662. doi: 10.3758/s13428-021-01694-3

Pellicano, E., Adams, D., Crane, L., Hollingue, C., Allen, C., Almendinger, K., ... Wheeley, E. (2024). Letter to the Editor: A possible threat to data integrity for online qualitative autism research. *Autism*, *28*(3), 786–792. doi: 10.1177/13623613231174543

Pérez-Litago, U., Rojas-Guerra, J. M., Martínez-García, C., & Suárez-Coalla, P. (2025, March). Language skills of adults with dyslexia in English as a foreign language: Proposal of a language spontaneity deficit hypothesis. *Annals of Dyslexia*. doi: 10.1007/s11881-025-00326-1

Perfetti, C., Pugh, K., & Verhoeven, L. (2019). Developmental Dyslexia across Languages and Writing Systems: The Big Picture. In C. Perfetti, K. Pugh, & L. Verhoeven (Eds.), *Developmental Dyslexia across Languages and Writing Systems* (pp. 441–461). Cambridge: Cambridge University Press. doi: 10.1017/9781108553377.020

Perry, E., Mandy, W., Hull, L., & Cage, E. (2022). Understanding Camouflaging as a Response to Autism-Related Stigma: A Social Identity Theory Approach. *Journal of Autism and Developmental Disorders*, *52*(2), 800–810. doi: 10.1007/S10803-021-04987-W/TABLES/5

Petrolini, V., Rodríguez-Armendariz, E., & Vicente, A. (2023, January). Autistic camouflaging across the spectrum. *New Ideas in Psychology*, *68*, 100992. doi: 10.1016/j.newideapsych.2022.100992

Piantadosi, S. T., Tily, H., & Gibson, E. (2011). Word lengths are optimized for efficient communication. *Proceedings of the National Academy of Sciences*, *108*(9), 3526–3529. doi: 10.1073/pnas.1012551108

Pickering, M. J., & Garrod, S. (2004). Toward a mechanistic psychology of dialogue. *Behavioral and Brain Sciences*, *27*(2), 169–190. doi: 10.1017/S0140525X04000056

Pickering, M. J., & Garrod, S. (2006). Alignment as the Basis for Successful Communication. *Research on Language and Computation*, *4*(2), 203–228. doi: 10.1007/s11168-006-9004-0

Pinker, S. (2002). *The blank slate: The modern denial of human nature*. New York: Viking.

Plag, I. (2018). *Word-Formation in English*. Cambridge: Cambridge University press. doi: 10.1017/9781316771402

Pothos, E. M. (2007). Theories of artificial grammar learning. *Psychological Bulletin*, *133*(2), 227–244. doi: 10.1037/0033-2909.133.2.227

Prescott, K. E., & Ellis Weismer, S. (2022, May). Children with ASD and Communication Regression: Examining Pre-Loss Skills and Later Language Outcomes Through the Preschool Years. *Journal of Autism and Developmental Disorders*, *52*(5), 1956–1970. doi: 10.1007/s10803-021-05098-2

Prizant, B. M., & Duchan, J. F. (1981, August). The Functions of Immediate Echolalia in Autistic Children. *Journal of Speech and Hearing Disorders*, *46*(3), 241–249. doi: 10.1044/jshd.4603.241

Prizant, B. M., & Rydell, P. J. (1984, June). Analysis of Functions of Delayed Echolalia in Autistic Children. *Journal of Speech, Language, and Hearing Research*, *27*(2), 183–192. doi: 10.1044/jshr.2702.183

R Core Team. (2022). R: A language and environment for statistical computing [Computer software manual]. Vienna, Austria.

Rachanska, P. E. (2025). The Double Empathy Problem: An Exploration of Trans-Neurotype Attitudes on Autistic–Non-Autistic Social Interactions and Communication. *Advances in Neurodevelopmental Disorders*. doi: 10.1007/s41252-024-00435-9

Radulski, E. M. (2022a). Conceptualising Autistic Masking, Camouflaging, and Neurotypical Privilege: Towards a Minority Group Model of Neurodiversity. *Human Development*, *66*(2), 113–127. doi: 10.1159/000524122

Radulski, E. M. (2022b). Conceptualising autistic masking, camouflaging, and neurotypical privilege: Towards a minority group model of neurodiversity. *Human Development*, *66*, 113–127. doi: 10.1159/000524122

Ratto, A. B., Bascom, J., daVanport, S., Strang, J. F., Anthony, L. G., Verbalis, A., ... Kenworthy, L. (2023). Centering the Inner Experience of Autism: Development of the Self-Assessment of Autistic Traits. *Autism in Adulthood*, *5*(1), 93–105. doi: 10.1089/aut.2021.0099

Raviv, L., Meyer, A., & Lev-Ari, S. (2020). The Role of Social Network Structure in the Emergence of Linguistic Structure. *Cognitive Science*, *44*(8), e12876. doi: 10.1111/cogs.12876

Reber, A. S. (1967, December). Implicit learning of artificial grammars. *Journal of Verbal Learning and Verbal Behavior*, *6*(6), 855–863. doi: 10.1016/S0022-5371(67)80149-X

Reitter, D., & Moore, J. D. (2014, October). Alignment and task success in spoken dialogue. *Journal of Memory and Language*, *76*, 29–46. doi: 10.1016/j.jml.2014.05.008

Rickford, J., & Price, M. (2013). Girlz II women: Age-grading, language change and stylistic variation. *Journal of Sociolinguistics*, *17*(2), 143–179. doi: 10.1111/josl.12017

Rickford, J. R., & King, S. (2016). Language and linguistics on trial: Hearing Rachel Jeantel (and other vernacular speakers) in the courtroom and beyond. *Language*, *92*(4), 948–988.

Ridgway, K., Cooke, K., Demmer, D. H., Hooley, M., Westrupp, E., & Stokes, M. A. (2024). Camouflaging Autism in Pursuit of Friendship and Intimate Relationships: A Systematic Review. *Autism in Adulthood*. doi: 10.1089/aut.2023.0160

Rita, M., Strub, F., Grill, J.-B., Pietquin, O., & Dupoux, E. (2022). *On the role of population heterogeneity in emergent communication.* doi: 10.48550/arXiv.2204.12982

Ritzman, M. J., & Subramanian, R. (2024). Voices from a pandemic: Understanding how young adults on the autism spectrum use computer-mediated communication. *Autism*, *28*(2), 381–389. doi: 10.1177/13623613231170963

Rivera, R. A., & Bennetto, L. (2023, September). Applications of identity-based theories to understand the impact of stigma and camouflaging on mental health outcomes for autistic people. *Frontiers in Psychiatry*, *14*. doi: 10.3389/fpsyt.2023.1243657

Roberts, G., & Fedzechkina, M. (2018). Social biases modulate the loss of redundant forms in the cultural evolution of language. *Cognition*, *171C*, 194–201.

Roberts, G., & Sneller, B. (2020, September). Empirical foundations for an integrated study of language evolution. *Language Dynamics and Change*. doi: 10.1163/22105832-bja10001

Roberts, J. (2024, January). Ableism, Code-Switching, and Camouflaging: A Letter to the Editor on Gerlach-Houck and DeThorne (2023). *Language, Speech, and Hearing Services in Schools*, *55*(1), 217–223. doi: 10.1044/2023_LSHSS-23-00037

Roberts, J. M. A. (2014, October). Chapter 3. Echolalia and language development in children with autism. In J. Arciuli & J. Brock (Eds.), *Communication in Autism* (pp. 53–74). John Benjamins Publishing Company. doi: 10.1075/tilar.11.04rob

Roberts, M. E., Barthel, F. M. S., Lopez, C., Tchanturia, K., & Treasure, J. L. (2011). Development and validation of the Detail and Flexibility Questionnaire (DFlex) in eating disorders. *Eating Behaviors*, *12*(3), 168–174. doi: 10.1016/j.eatbeh.2011.04.001

Robertson, C. E., & Baron-Cohen, S. (2017). Sensory perception in autism. *Nature Reviews Neuroscience*, *18*(11), 671–684. doi: 10.1038/nrn.2017.112

Robinson, E., Hull, L., & Petrides, K. V. (2020, January). Big Five model and trait emotional intelligence in camouflaging behaviours in autism. *Personality and Individual Differences*, *152*, 109565. doi: 10.1016/j.paid.2019.109565

Roche, L., Adams, D., & Clark, M. (2021, February). Research priorities of the autism community: A systematic review of key stakeholder perspectives. *Autism*, *25*(2), 336–348. doi: 10.1177/1362361320967790

Rodd, J. M. (2024). Moving experimental psychology online: How to obtain high quality data when we can't see our participants. *Journal of Memory and Language*, *134*, 104472. doi: 10.1016/j.jml.2023.104472

Roestorf, A., Bowler, D. M., Gaigg, S. B., & Howlin, P. (2025, April). Prospective memory and quality of life in older and younger autistic adults. *Cortex*, *185*, 31–49. doi: 10.1016/j.cortex.2025.01.006

Roman-Urrestarazu, A., van Kessel, R., Allison, C., Matthews, F. E., Brayne, C., & Baron-Cohen, S. (2021). Association of race/ethnicity and social disadvantage with autism prevalence in 7 million school children in england [Journal Article]. *JAMA Pediatrics*, *175*(6), e210054. doi: 10.1001/jamapediatrics.2021.0054

Romualdez, A. M., Heasman, B., Walker, Z., Davies, J., & Remington, A. (2021). "People Might Understand Me Better": Diagnostic disclosure experiences of autistic individuals in the workplace. *Autism in Adulthood*, *3*(2), 157–167. doi: 10.1089/aut.2020.0063

Rosenboom, H., & Joseph, R. L. (2024, May). "What makes you think I'm African American?": Identity performance, code switching and the Strong Black Woman on Love Is Blind. *Critical Studies in Media Communication*.

Rothou, K. M., & Padeliadu, S. (2019, October). Morphological processing influences on dyslexia in Greek-speaking children. *Annals of Dyslexia*, *69*(3), 261–278. doi: 10.1007/s11881-019-00184-8

Rudkin, G., Warrington, K. L., Wilson, E., Iley, B., & Zisk, A. H. (2025, April). Curricula May Not Apply: "Abnormal" Exceptions Speak Back to the Curriculum. *Teaching of Psychology*, 00986283251328986. doi: 10.1177/00986283251328986

Ruzich, E., Allison, C., Smith, P., Watson, P., Auyeung, B., Ring, H., & Baron-Cohen, S. (2015). Measuring autistic traits in the general population: A systematic review of the Autism-Spectrum Quotient (AQ) in a nonclinical population sample of 6,900 typical adult males and females. *Molecular Autism*, *6*, 2. doi: 10.1186/2040-2392-6-2

Ryan, S., Roberts, J., & Beamish, W. (2024). Echolalia in Autism: A Scoping Review. *International Journal of Disability, Development and Education*, *71*(5), 831–846. doi: 10.1080/1034912X.2022.2154324

Saldana, C., Oseki, Y., & Culbertson, J. (2021, June). Cross-linguistic patterns of morpheme order reflect cognitive biases: An experimental study of case and number morphology. *Journal of Memory and Language*, *118*, 104204. doi: 10.1016/j.jml.2020.104204

Salomone, S., Fleming, G. R., Bramham, J., O'Connell, R. G., & Robertson, I. H. (2020). Neuropsychological Deficits in Adult ADHD: Evidence for Differential Attentional Impairments, Deficient Executive Functions, and High Self-Reported Functional Impairments. *Journal of Attention Disorders*, *24*(10), 1413–1424. doi: 10.1177/1087054715623045

Sanderson, K. (2021, September). High-profile autism genetics project paused amid backlash. *Nature*, *598*(7879), 17–18. doi: 10.1038/d41586-021-02602-7

Sandler, W., Meir, I., Padden, C., & Aronoff, M. (2005, February). The emergence of grammar: Systematic structure in a new language. *Proceedings of the National Academy of Sciences of the United States of America*, *102*(7), 2661–2665. doi: 10.1073/pnas.0405448102

Sankalaite, S., Van Eylen, L., Ceulemans, E., Noens, I., & Baeyens, D. (2025, January). Heterogeneity of Strengths and Challenges in Executive Functions of Autistic Children and Adolescents. *Advances in Neurodevelopmental Disorders*. doi: 10.1007/s41252-024-00434-w

Sanz-Sánchez, I., & Moyna, M. I. (2023). Children as agents of language change: Diachronic evidence from Latin American Spanish phonology. *Journal of Historical Linguistics*, *13*(3), 327–374. doi: 10.1075/jhl.21033.san

Sasson, N. J., Faso, D. J., Nugent, J., Lovell, S., Kennedy, D. P., & Grossman, R. B. (2017a). Neurotypical Peers are Less Willing to Interact with Those with Autism based on Thin Slice Judgments. *Scientific Reports*, *7*(1), 40700. doi: 10.1038/srep40700

Sasson, N. J., Faso, D. J., Nugent, J., Lovell, S., Kennedy, D. P., & Grossman, R. B. (2017b). Neurotypical Peers are Less Willing to Interact with Those with Autism based on Thin Slice Judgments. *Scientific Reports*, *7*(1), 40700. doi: 10.1038/srep40700

Sasson, N. J., & Morrison, K. E. (2019). First impressions of adults with autism improve with diagnostic disclosure and increased autism knowledge of peers. *Autism*, *23*(1), 50–59. doi: 10.1177/1362361317729526

Schaeffer, J., Abd El-Raziq, M., Castroviejo, E., Durrleman, S., Ferré, S., Grama, I., . . . Tuller, L. (2023). Language in autism: Domains, profiles and co-occurring conditions. *Journal of Neural Transmission*, *130*(3), 433–457. doi: 10.1007/s00702-023-02592-y

Schneid, I., & Raz, A. E. (2020, March). The mask of autism: Social camouflaging and impression management as coping/normalization from the perspectives of autistic adults. *Social Science & Medicine (1982)*, *248*, 112826. doi: 10.1016/j.socscimed.2020.112826

Schouwstra, M., & de Swart, H. (2014, June). The semantic origins of word order. *Cognition*, *131*(3), 431–436. doi: 10.1016/j.cognition.2014.03.004

Senghas, A. (2005, June). Language Emergence: Clues from a New Bedouin Sign Language. *Current biology : CB*, *15*(12), R463-R465. doi: 10.1016/j.cub.2005.xx.xxx

Shakespeare, T. (2016). The Social Model of Disability. In L. J. Davis (Ed.), *The Disability Studies Reader* (5th ed.). Routledge.

Sharma, D. (2025). Testing sociolinguistic theory and methods in world Englishes. *World Englishes*, *44*(1-2), 26–42. doi: 10.1111/weng.12693

Sharma, D., Levon, E., & Ye, Y. (2022). 50 years of British accent bias: Stability and lifespan change in attitudes to accents. *English World-Wide*, *43*(2), 135–166. doi: 10.1075/eww.20010.sha

Sharpe, V., Schoot, L., Lewandowski, K. E., Öngür, D., Türközer, H. B., Hasoğlu, T., & Kuperberg, G. R. (2022). We both say tomato: Intact lexical alignment in schizophrenia and bipolar disorder. *Schizophrenia Research*, *243*, 138–146. doi: 10.1016/j.schres.2022.02.032

Shcherbakova, O., Michaelis, S. M., Haynie, H. J., Passmore, S., Gast, V., Gray, R. D., . . . Skirgård, H. (2023, August). Societies of strangers do not speak less complex languages. *Science Advances*, *9*(33), eadf7704. doi: 10.1126/sciadv.adf7704

Sheehy, K., & Duffy, H. (2009). Attitudes to Makaton in the ages on integration and inclusion. *International Journal of Special Education*, *24*.

Sheppard, E., Pillai, D., Wong, G. T.-L., Ropar, D., & Mitchell, P. (2016). How Easy is it to Read the Minds of People with Autism Spectrum Disorder? *Journal of Autism and Developmental Disorders*, *46*(4), 1247–1254. doi: 10.1007/s10803-015-2662-8

Sheppard, E., Webb, S., & Wilkinson, H. (2023). Mindreading beliefs in same- and cross-neurotype interactions. *Autism*. doi: 10.1177/13623613231211457/ASSET/IMAGES/LARGE/10.1177_13623613231211457-FIG2.JPEG

Sher, D. A. (2020). *The aftermath of the Hans Asperger exposé.* https://www.bps.org.uk/psychologist/aftermath-hans-asperger-expose.

Shield, A. (2014, October). Preliminary Findings of Similarities and Differences in the Signed and Spoken Language of Children with Autism. *Seminars in Speech and Language*, *35*, 309–320. doi: 10.1055/s-0034-1389103

Shield, A., Meier, R. P., & Tager-Flusberg, H. (2015, July). The Use of Sign Language Pronouns by Native-Signing Children with Autism. *Journal of Autism and Developmental Disorders*, *45*(7), 2128–2145. doi: 10.1007/s10803-015-2377-x

Shkedy, G., Shkedy, D., & Sandoval-Norton, A. H. (2021). Long-term ABA therapy is abusive: A response to gorycki, ruppel, and zane. *Advances in Neurodevelopmental Disorders*, *5*(2), 126–134. doi: 10.1007/s41252-021-00201-1

Shmulsky, S., Gobbo, K., Donahue, A., & Klucken, F. (2021). Do Neurodivergent College Students Forge a Disability Identity? A Snapshot and Implications. *Journal of Postsecondary Education & Disability*, *34*(1), 53–63.

Silberman, S. (2015). *NeuroTribes: The Legacy of Autism and the Future of Neurodiversity*. Penguin.

Singer, J. (1999). Why can't you be normal for once in your life? from a problem with no name to the emergence of a new category of difference. *Disability discourse*, 59–67.

Sinnemäki, K. (2008, February). Complexity trade-offs in core argument marking. In M. Miestamo, K. Sinnemäki, & F. Karlsson (Eds.), *Language Complexity: Typology, contact, change* (pp. 67–88). John Benjamins Publishing Company. doi: 10.1075/slcs.94.06sin

Slocombe, K. E., Alvarez, I., Branigan, H. P., Jellema, T., Burnett, H. G., Fischer, A., ... Levita, L. (2013). Linguistic Alignment in Adults with and Without Asperger's Syndrome. *Journal of Autism and Developmental Disorders*, *43*(6), 1423–36. doi: 10.1007/s10803-012-1698-2

Smith, K. (2011, April). Learning Bias, Cultural Evolution of Language, and the Biological Evolution of the Language Faculty. *Human Biology*, *83*(2), 261–278. doi: 10.3378/027.083.0207

Smith-Spark, J. H., Henry, L. A., Messer, D. J., & Zięcik, A. P. (2017). Verbal and Non-verbal Fluency in Adults with Developmental Dyslexia: Phonological Processing or Executive Control Problems? *Dyslexia*, *23*(3), 234–250. doi: 10.1002/dys.1558

Sneller, B., & Roberts, G. (2018, January). Why some behaviors spread while others don't: A laboratory simulation of dialect contact. *Cognition*, *170*, 298–311. doi: 10.1016/j.cognition.2017.10.014

Somerville, M., MacPherson, S. E., & Fletcher-Watson, S. (2024, February). The Associations Between Camouflaging, Autistic Traits, and Mental Health in Nonautistic Adults. *https://home-liebertpub-com.ezproxy.is.ed.ac.uk/aut*. doi: 10.1089/AUT.2023.0018

Stabile, M., & Eigsti, I.-M. (2022). Lexical Alignment and Communicative Success in Autism Spectrum Disorder. *Journal of Speech, Language, and Hearing Research*, *65*(11), 4300–4305. doi: 10.1044/2022_JSLHR-22-00314

Stacey, R., & Cage, E. (2023, September). "Simultaneously Vague and Oddly Specific": Understanding Autistic People's Experiences of Decision Making and Research Questionnaires. *Autism in Adulthood: Challenges and Management*, *5*(3), 263–274. doi: 10.1089/aut.2022.0039

Stagg, S. D., & Belcher, H. (2019). Living with autism without knowing: receiving a diagnosis in later life. *Health Psychology and Behavioral Medicine*, *7*(1), 348–361. doi: 10.1080/21642850.2019.1684920

Steen, E., Yurechko, K., & Klug, D. (2023, July). You Can (Not) Say What You Want: Using Algospeak to Contest and Evade Algorithmic Content Moderation on TikTok. *Social Media + Society*, *9*(3), 20563051231194586. doi: 10.1177/20563051231194586

Steinbrenner, J. R., McIntyre, N., Rentschler, L. F., Pearson, J. N., Luelmo, P., Jaramillo, M. E., ... Hume, K. A. (2022). Patterns in reporting and participant inclusion related to race and ethnicity in autism intervention literature: Data from a large-scale systematic review of evidence-based practices. *Autism*, 1–15. doi: 10.1177/13623613211072593

Stephane, M., Kuskowski, M., & Gundel, J. (2014, May). Abnormal dynamics of language in schizophrenia. *Psychiatry Research*, *216*(3), 320–324. doi: 10.1016/j.psychres.2014.02.027

Sterponi, L., & Shankey, J. (2014, March). Rethinking echolalia: Repetition as interactional resource in the communication of a child with autism. *Journal of Child Language*, *41*(2), 275–304. doi: 10.1017/S0305000912000682

Stevens, J. S., & Roberts, G. (2019). Noise, Economy, and the Emergence of Information Structure in a Laboratory Language. *Cognitive Science*, *43*(2), e12717. doi: 10.1111/cogs.12717

Stewart, N., Chandler, J., & Paolacci, G. (2017). Crowdsourcing Samples in Cognitive Science. *Trends in Cognitive Sciences*, *21*(10), 736–748. doi: 10.1016/j.tics.2017.06.007

Strauss, U., Grzybek, P., & Altmann, G. (2007). *Word length and word frequency*. Springer.

Sturm, A., Huang, S., Bal, V., & Schwartzman, B. (2024). Psychometric exploration of the RAADS-R with autistic adults: Implications for research and clinical practice. *Autism*, 13623613241228329. doi: 10.1177/13623613241228329

Su, Y. E., & Naigles, L. R. (2019). Online Processing of Subject–Verb–Object Order in a Diverse Sample of Mandarin-Exposed Preschool Children with Autism Spectrum Disorder. *Autism Research*, *12*(12), 1829–1844. doi: 10.1002/aur.2190

Suffill, E., Kutasi, T., Pickering, M. J., & Branigan, H. P. (2021). Lexical alignment is affected by addressee but not speaker nativeness. *Bilingualism: Language and Cognition*, *24*(4), 746–757. doi: 10.1017/S1366728921000092

Sukenik, N., & Friedmann, N. (2018). ASD Is Not DLI: Individuals With Autism and Individuals With Syntactic DLI Show Similar Performance Level in Syntactic Tasks, but Different Error Patterns. *Frontiers in Psychology*, *9*, 279. doi: 10.3389/fpsyg.2018.00279

Sukenik, N., & Tuller, L. (2023, March). Lexical Semantic Knowledge of Children with ASD—a Review Study. *Review Journal of Autism and Developmental Disorders*, *10*(1), 130–143. doi: 10.1007/s40489-021-00272-9

Svendsen, B. A. (2018). The dynamics of citizen sociolinguistics. *Journal of Sociolinguistics*, *22*(2), 137–160. doi: 10.1111/josl.12276

Szatmari, P., Archer, L., Fisman, S., Streiner, D. L., & Wilson, F. (1995, December). Asperger's Syndrome and Autism: Differences in Behavior, Cognition, and Adaptive Functioning. *Journal of the American Academy of Child & Adolescent Psychiatry*, *34*(12), 1662–1671. doi: 10.1097/00004583-199512000-00017

Szechy, K. A., Turk, P. D., & O'Donnell, L. A. (2024). Autism and Employment Challenges: The Double Empathy Problem and Perceptions of an Autistic Employee in the Workplace. *Autism in Adulthood*, *6*(2), 205–217. doi: 10.1089/aut.2023.0046

Tabullo, á., Arismendi, M., Wainselboim, A., Primero, G., Vernis, S., Segura, E., ... Yorio, A. (2012, September). On the Learnability of Frequent and Infrequent Word Orders: An Artificial Language Learning Study. *Quarterly Journal of Experimental Psychology*, *65*(9), 1848–1863. doi: 10.1080/17470218.2012.677848

Tager-Flusberg, H., & Kasari, C. (2013). Minimally Verbal School-Aged Children with Autism Spectrum Disorder: The Neglected End of the Spectrum. *Autism Research*, *6*(6), 468–478. doi: 10.1002/aur.1329

Tagliamonte, S. A., & D'Arcy, A. (2009). Peaks Beyond Phonology: Adolescence, Incrementation, and Language Change. *Language*, *85*(1), 58–108.

Takarae, Y., Luna, B., Minshew, N. J., & Sweeney, J. A. (2008, November). Patterns of visual sensory and sensorimotor abnormalities in autism vary in relation to history of early language delay. *Journal of the International Neuropsychological Society*, *14*(6), 980–989. doi: 10.1017/S1355617708081277

Tal, S., & Arnon, I. (2022). Redundancy can benefit learning: Evidence from word order and case marking. *Cognition*, *224*, 105055. doi: 10.1016/j.cognition.2022.105055

Tal, S., Grossman, E., Rohde, H., & Arnon, I. (2023). Speakers use more redundant references with language learners: Evidence for communicatively-efficient referential choice. *Journal of Memory and Language*, *128*, 104378. doi: 10.1016/j.jml.2022.104378

Tal, S., Smith, K., Culbertson, J., Grossman, E., & Arnon, I. (2022). The Impact of Information Structure on the Emergence of Differential Object Marking: An Experimental Study. *Cognitive Science*, *46*(3), e13119. doi: 10.1111/cogs.13119

Tamminga, M., MacKenzie, L., & Embick, D. (2016, January). The dynamics of variation in individuals. *Linguistic variation*, *16*(2), 300–336. doi: 10.1075/lv.16.2.06tam

Tamura, M., Cage, E., Perry, E., Hongo, M., Takahashi, T., Seto, M., ... Oshima, F. (2024, February). Understanding Camouflaging, Stigma, and Mental Health for Autistic People in Japan. *Autism in Adulthood*. doi: 10.1089/aut.2023.0035

Tchanturia, K., Larsson, E., & Adamson, J. (2016). How anorexia nervosa patients with high and low autistic traits respond to group Cognitive Remediation Therapy. *BMC Psychiatry*, *16*(1), 334. doi: 10.1186/s12888-016-1044-x

Tei, S., Fujino, J., Hashimoto, R.-i., Itahashi, T., Ohta, H., Kanai, C., ... Takahashi, H. (2018). Inflexible daily behaviour is associated with the ability to control an automatic reaction in autism spectrum disorder. *Scientific Reports*, *8*, 8082. doi: 10.1038/s41598-018-26465-7

Theisen, C. A., Oberlander, J., & Kirby, S. (2010). Systematicity and arbitrariness in novel communication systems. *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *11*(1), 14–32. doi: 10.1075/is.11.1.08the

Thomas, J., & Kirby, S. (2018, March). Self domestication and the evolution of language. *Biology & Philosophy*, *33*(1), 9. doi: 10.1007/s10539-018-9612-8

Thompson, B., Kirby, S., & Smith, K. (2016, April). Culture shapes the evolution of cognition. *Proceedings of the National Academy of Sciences*, *113*(16), 4530–4535. doi: 10.1073/pnas.1523631113

Thompson, S. (2021, September). So Much Modern Slang Is AAVE. Here's How Language Appropriation Erases The Influence Of Black Culture. *BuzzFeed News*.

Thye, M. D., Bednarz, H. M., Herringshaw, A. J., Sartin, E. B., & Kana, R. K. (2018, January). The impact of atypical sensory processing on social impairments in autism spectrum disorder. *Developmental Cognitive Neuroscience*, *29*, 151–167. doi: 10.1016/j.dcn.2017.04.010

Tily, H., Frank, M., & Jaeger, F. (2011). The learnability of constructed languages reflects typological patterns. *Proceedings of the Annual Meeting of the Cognitive Science Society*, *33*(33).

Tobar-Henríquez, A., Rabagliati, H., & Branigan, H. P. (2021). Speakers extrapolate community-level knowledge from individual linguistic encounters. *Cognition*, *210*, 104602. doi: 10.1016/j.cognition.2021.104602

Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *The Behavioral and Brain Sciences*, *28*(5), 675–691; discussion 691–735. doi: 10.1017/S0140525X05000129

Tóth, O., Pesthy, O., Farkas, K., Guttengéber, A., Komoróczy, E., Réthelyi, J. M., ... Németh, D. (2022). Intact fluency in autism? A comprehensive approach of verbal fluency task including word imageability and concreteness. *Autism Research*, *15*(4), 677–686. doi: 10.1002/aur.2672

Trudgill, P. (2011). *Sociolinguistic Typology: Social Determinants of Linguistic Complexity*. OUP Oxford.

Trudgill, P. (2017). Sociolinguistic Typology: Social Structure and Linguistic Complexity. In A. Y. Aikhenvald & R. M. W. Dixon (Eds.), *The Cambridge Handbook of Linguistic Typology* (pp. 124–150). Cambridge: Cambridge University Press. doi: 10.1017/9781316135716.005

Tucha, L., Fuermaier, A. B. M., Koerts, J., Buggenthin, R., Aschenbrenner, S., Weisbrod, M., ... Tucha, O. (2017). Sustained attention in adult ADHD: Time-on-task effects of various measures of attention. *Journal of Neural Transmission*, *124*(1), 39–53. doi: 10.1007/s00702-015-1426-0

Tulver, K., Aru, J., Rutiku, R., & Bachmann, T. (2019, June). Individual differences in the effects of priors on perception: A multi-paradigm approach. *Cognition*, *187*, 167–177. doi: 10.1016/j.cognition.2019.03.008

Udonsi, P. (2022, August). Young, gifted and black: The intersectionality of race, intellectual disability and neurodivergence.
doi: 10.1332/204986021X16530492120870

Ustun, B., Adler, L. A., Rudin, C., Faraone, S. V., Spencer, T. J., Berglund, P., ... Kessler, R. C. (2017). The World Health Organization Adult Attention-Deficit/Hyperactivity Disorder Self-Report Screening Scale for DSM-5. *JAMA Psychiatry*, *74*(5), 520–526. doi: 10.1001/jamapsychiatry.2017.0298

Valentino, A. L., Shillingsburg, M. A., Conine, D. E., & Powell, N. M. (2012). Decreasing echolalia of the instruction “say” during echoic training through use of the cues-pause-point procedure. *Journal of Behavioral Education*, *21*(4), 315–328. doi: 10.1007/s10864-012-9155-z

van Baaren, R. B., Holland, R. W., Steenaert, B., & van Knippenberg, A. (2003). Mimicry for money: Behavioral consequences of imitation. *Journal of Experimental Social Psychology*, *39*(4), 393–398. doi: 10.1016/S0022-1031(03)00014-3

Van de Cruys, S., Evers, K., Van der Hallen, R., Van Eylen, L., Boets, B., de-Wit, L., & Wagemans, J. (2014, October). Precise minds in uncertain worlds: Predictive coding in autism. *Psychological Review*, *121*(4), 649–675. doi: 10.1037/a0037665

Van der Hallen, R., Evers, K., Brewaeys, K., Van den Noortgate, W., & Wagemans, J. (2015, May). Global processing takes time: A meta-analysis on local-global visual processing in ASD. *Psychological Bulletin*, *141*(3), 549–573. doi: 10.1037/bul0000004

van Santen, J. P. H., Sproat, R. W., & Hill, A. P. (2013, October). Quantifying repetitive speech in autism spectrum disorders and language impairment. *Autism Research: Official Journal of the International Society for Autism Research*, *6*(5), 372–383. doi: 10.1002/aur.1301

van der Putten, W. J., Mol, A. J. J., Groenman, A. P., Radhoe, T. A., Torenvliet, C., van Rentergem, J. A. A., & Geurts, H. M. (2024). Is camouflaging unique for autism? A comparison of camouflaging between adults with autism and ADHD. *Autism Research*, *17*(4), 812–823. doi: 10.1002/aur.3099

Van Eylen, L., Boets, B., Steyaert, J., Wagemans, J., & Noens, I. (2018). Local and Global Visual Processing in Autism Spectrum Disorders: Influence of Task and Sample Characteristics and Relation to Symptom Severity. *Journal of Autism and Developmental Disorders*, *48*(4), 1359–1381. doi: 10.1007/s10803-015-2526-2

van Ostade, I. T.-B. (2024). 7 Breaking the Who/Whom Rule: The Final Taboo? In *New Horizons in Prescriptivism Research* (pp. 120–136). Multilingual Matters.

Vasishth, S., & Gelman, A. (2021, September). How to embrace variation and accept uncertainty in linguistic and psycholinguistic data analysis. *Linguistics*, *59*(5), 1311–1342. doi: 10.1515/ling-2019-0051

Vasishth, S., Nicenboim, B., Beckman, M. E., Li, F., & Kong, E. J. (2018, November). Bayesian data analysis in the phonetic sciences: A tutorial introduction. *Journal of phonetics*, *71*, 147–161. doi: 10.1016/j.wocn.2018.07.008

Venagli, I., & Kupisch, T. (2024, May). Chapter 3. How does dyslexia impact second language acquisition?: Insights from a questionnaire study with Italian and German learners of L2 English. In *Multilingual Acquisition and Learning* (pp. 90–115). John Benjamins Publishing Company.

Verhoef, T., Marghetis, T., Walker, E., & Coulson, S. (2024, May). Brain responses to a lab-evolved artificial language with space-time metaphors. *Cognition*, *246*, 105763. doi: 10.1016/j.cognition.2024.105763

Vivanti, G., McCormick, C., Young, G. S., Abucayan, F., Hatt, N., Nadig, A., ... Rogers, S. J. (2011). Intact and impaired mechanisms of action understanding in autism. *Developmental Psychology*, *47*(3), 841–856. doi: 10.1037/a0023105

Volden, J., & Lord, C. (1991, June). Neologisms and idiosyncratic language in autistic speakers. *Journal of Autism and Developmental Disorders*, *21*(2), 109–130. doi: 10.1007/BF02284755

Walker, N. (2021). *Neuroqueer Heresies: Notes on the neurodiversity paradigm, autistic empowerment, and postnormal possibilities*. Texas, US: Autonomous Press.

Walker, N., & Raymaker, D. M. (2021). Toward a Neuroqueer Future: An Interview with Nick Walker. *Autism in Adulthood*, *3*(1), 5–10. doi: 10.1089/aut.2020.29014.njw

Watts, G., Crompton, C., Grainger, C., Long, J., Botha, M., Somerville, M., & Cage, E. (2024). 'A certain magic' – autistic adults' experiences of interacting with other autistic people and its relation to Quality of Life: A systematic review and thematic meta-synthesis. *Autism*, 13623613241255811. doi: 10.1177/13623613241255811

Werth, A., Perkins, M., & Boucher, J. (2001, June). 'Here's the Weavery Looming Up': Verbal Humour in a Woman with High-Functioning Autism. *Autism*, *5*(2), 111–125. doi: 10.1177/1362361301005002002

White, J. (2014). Evidence for a learning bias against saltatory phonological alternations. *Cognition*, *130*(1), 96–115. doi: 10.1016/j.cognition.2013.09.008

Williams, G. L., Wharton, T., & Jagoe, C. (2021). Mutual (mis)understanding: Reframing autistic pragmatic “impairments” using relevance theory. *Frontiers in Psychology*, *12*. doi: 10.3389/fpsyg.2021.616664

Williams, M. L., Burnap, P., & Sloan, L. (2017, December). Towards an Ethical Framework for Publishing Twitter Data in Social Research: Taking into Account Users’ Views, Online Context and Algorithmic Estimation. *Sociology*, *51*(6), 1149–1168. doi: 10.1177/0038038517708140

Wilson, A. C. (2024). Cognitive Profile in Autism and ADHD: A Meta-Analysis of Performance on the WAIS-IV and WISC-V. *Archives of Clinical Neuropsychology*, *39*(4), 498–515. doi: 10.1093/arclin/acad073

Wiseheart, R., & Altmann, L. J. P. (2018). Spoken sentence production in college students with dyslexia: Working memory and vocabulary effects. *International Journal of Language & Communication Disorders*, *53*(2), 355–369. doi: 10.1111/1460-6984.12353

Wonnacott, E., Newport, E. L., & Tanenhaus, M. K. (2008, May). Acquiring and Processing Verb Argument Structure: Distributional Learning in a Miniature Language. *Cognitive psychology*, *56*(3), 165–209. doi: 10.1016/j.cogpsych.2007.04.002

Wray, A., & Grace, G. W. (2007, March). The consequences of talking to strangers: Evolutionary corollaries of socio-cultural influences on linguistic form. *Lingua*, *117*(3), 543–578. doi: 10.1016/j.lingua.2005.05.005

Xu, Y. A., Naigles, L. R., & Su, Y. E. (2022, January). Early Word Order Usage in Preschool Mandarin-Speaking Typical Children and Children With Autism Spectrum Disorder: Influences of Caregiver Input? *Frontiers in Psychology*, *12*. doi: 10.3389/fpsyg.2021.766133

Yergeau, M. (2013). Clinically significant disturbance: On theorists who theorize theory of mind $|disabilitystudiesquarterly.$ *Disability Studies Quarterly*, *33*.

Yergeau, M. R. (2018). *Authoring Autism: On Rhetoric and Neurological Queerness*. Durham, UNITED STATES: Duke University Press.

Yu, A. C. L., & Zellou, G. (2019, January). Individual Differences in Language Processing: Phonology. *Annual Review of Linguistics*, *5*(Volume 5, 2019), 131–150. doi: 10.1146/annurev-linguistics-011516-033815

Zachi, E. C., Costa, T. L., Barboni, M. T. S., Costa, M. F., Bonci, D. M. O., & Ventura, D. F. (2017, June). Color Vision Losses in Autism Spectrum Disorders. *Frontiers in Psychology*, *8*. doi: 10.3389/fpsyg.2017.01127

Zhang, D., & Nicol, J. (2022). Lexical alignment in second language communication: Evidence from a picture-naming task. *Language, Cognition and Neuroscience*, *37*(6), 732–749. doi: 10.1080/23273798.2021.2019285

Zhou, P., Crain, S., Gao, L., & Jia, M. (2017, January). The Use of Linguistic Cues in Sentence Comprehension by Mandarin-Speaking Children with High-Functioning Autism. *Journal of Autism and Developmental Disorders*, *47*(1), 17–32. doi: 10.1007/s10803-016-2912-4

Zimmerman, J. (2022). *Jordyn Zimmerman's Remarks to the Interagency Autism Coordinating Committee.* https://communicationfirst.org/jordyn-zimmermans-remarks-to-the-interagency-autism-coordinating-committee/.

Ziori, E., & Pothos, E. (2015, September). An introduction to key issues and debates: Artificial grammar learning. In P. Rebuschat (Ed.), *Implicit and Explicit Learning of Languages* (pp. 247–274). John Benjamins Publishing Company. doi: 10.1075/sibil.48.11zio

Zipf, G. (1935). *The psycho-biology of language* (Vol. ix). Houghton Mifflin.

Zisk, A. H., & Dalton, E. (2019, June). Augmentative and Alternative Communication for Speaking Autistic Adults: Overview and Recommendations. *Autism in Adulthood: Challenges and Management*, *1*(2), 93–100. doi: 10.1089/aut.2018.0007

Zisk, A. H., & Konyn, L. (2025, April). *How to talk about AAC and AAC users (according to them).* https://www.assistiveware.com/blog/how-to-talk-about-aac.

Ziva, A., & Ziori, E. (2024, September). Implicit learning in children and adolescents with and without autism spectrum disorders: Exploring the effects of individual differences. *Quarterly Journal of Experimental Psychology*, 17470218241281639. doi: 10.1177/17470218241281639

Zuberbühler, K. (2019, May). Evolutionary roads to syntax. *Animal Behaviour*, *151*, 259–265. doi: 10.1016/j.anbehav.2019.03.006