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# Understanding and supporting neurodevelopmental needs: a systematic review of prospective memory in children and adults with ADHD; and an investigation of the underlying cognitive mechanisms of stress appraisal of classroom assistants and teachers of autistic students

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**Thesis abstract**

The needs of neurodiverse populations are inherently atypical and often complex. To better understand and support such populations, it is necessary to better understand neurodiverse individuals' abilities and difficulties in tasks critical to navigating daily life. Furthermore, it is important to consider the key figures in the systems around neurodiverse individuals, and factors that may influence their confidence and well-being when supporting them.

Chapter One of the current thesis systematically reviews evidence of prospective memory (PM) ability, in children, adolescents and adults with a diagnosis of attention deficit/hyperactivity disorder (ADHD). PM involves remembering to execute plans at the appropriate moment, such as taking medication at the correct time, and so is critical to successful daily life. Fourteen studies were identified from systematic searches of the literature; nine involving children and adolescents, and five involving adults. Overall, results demonstrated a general PM deficit for all age groups with ADHD, compared to neurotypical controls. Performance was mostly in line with the Multiprocess Framework; specifically, that PM is disproportionality more difficult for those with limited executive capacity on tasks assumed to place more demand on executive functioning (e.g., time-based tasks, or tasks with low cue salience). Consideration is then given to these results in how they may inform the design and implementation of strategies to support PM in the ADHD population, including cognitive "offloading" (e.g., setting reminders), PM and executive functioning training and environmental adaptations.

Chapter 2 reports the results of a cross-sectional study, the primary aim of which was to investigate the role of teacher and classroom assistant self-efficacy, specific to autism (SE-ASC), in explaining the relationship between autism knowledge and stress appraisal of classroom incidents involving autistic pupils. Two hundred and seven responses were

acquired via an online questionnaire. Autism knowledge was not associated with any other construct, requiring unplanned, exploratory analysis. Results revealed SE-ASC to be a significant (negative) predictor of negative, but not positive, stress appraisal. The same (non)significant relationships were found in the other direction; negative, but not positive, stress appraisal (negatively) predicted SE-ASC. Pupil age, school-type (e.g., mainstream vs specialist school) and autism training also predicted SE-ASC. Finally, between-group analysis revealed teachers indicated significantly higher levels of positive stress appraisal than classroom assistants. However, both groups were parallel on scores of SE-ASC and autism knowledge. These results indicate the importance of SE-ASC in the perceived stress of teachers and classroom assistants when supporting autistic pupils, and of the potential importance of factors such as school-type and training in contributing to higher levels of SE-ASC.

Together, these chapters highlight the daily functioning difficulties of neurodiverse populations, particularly those with executive functioning impairments, and the factors that potentially contribute to the confidence and perceived stress when supporting them.

## Lay summary

Life for neurodiverse individuals (i.e., with neurodevelopmental differences, such as autism and attention deficit/hyperactive disorder (ADHD)) can be difficult and confusing. To support such individuals better, therefore, it is important to try and understand the aspects of daily life that might be particularly difficult for them.

The current thesis is split over two chapters. The first chapter reviews all of the available evidence regarding a prospective memory (PM) in individuals with ADHD. PM involves remembering to do something in the future, or remembering to remember, such as taking medication at the correct time, and so is critical to everyday life. Fourteen papers are described, evaluated and summarised. The findings of the review suggest that PM tasks are difficult for this population, especially tasks that require higher levels of attention and focus. The review then puts forward different strategies that could be used to support PM for those with ADHD to help them manage the demands of everyday life.

The second chapter describes a study that investigated the confidence of teachers and classroom assistants (self-efficacy) in supporting autistic pupils in their class, and how it might be related to their perceptions of stress in the classroom. Two hundred and seven teachers and classroom assistants completed an online survey. The findings of the survey showed that self-efficacy was important for perceptions of stress; low self-efficacy was related to perceiving difficulties in class negatively, and vice-versa. The study also found that pupil age, the type of school (e.g., mainstream vs specialist school) and autism training were important for self-efficacy in supporting autistic pupils.

Altogether, the two chapters highlight the difficulties neurodiverse individuals experience on a daily basis, and the issues that might be important to the confidence and stress of the people that support them.

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# Chapter 1: Systematic review

## Prospective memory in children and adults with Attention Deficit/Hyperactivity Disorder: a systematic literature review*

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## Abstract

**Objectives:** the current paper aimed to review all extant research examining prospective memory (PM), in children, adolescents and adults with a diagnosis of attention deficit/hyperactivity disorder (ADHD). PM involves remembering to execute plans at the appropriate moment, such as taking medication at the correct time, and so is critical to successful daily life,

**Method:** Fourteen studies were identified from systematic searches of the literature; nine involving children and adolescents, and five involving adults. Studies are first summarised and critiqued in detail, followed by ways in which the findings can be applied to support those diagnosed with ADHD in daily life.

**Results:** Overall, results demonstrated a general PM deficit for all age groups with ADHD, compared to neurotypical controls. Performance was mostly in line with the Multiprocess Framework; specifically, that PM is disproportionality more difficult for those with limited executive capacity on tasks assumed to place more demand on executive functioning (e.g., time-based tasks, or tasks with low cue salience).

**Conclusions:** Given the ubiquitous nature of PM tasks in everyday life and their importance to independence and well-being, the likely difficulties with PM are likely to be an important underlying factor in the established poor academic, social and daily functional outcomes of individuals with ADHD. Strategies to support PM and EF are discussed.



**Key words**: ADHD, prospective memory, executive function, Multiprocess Framework

## Introduction

Attention deficit hyperactivity disorder (ADHD) is a developmental condition characterised by difficulties with inattention, hyperactivity and impulsivity (APA, 2013). The predominant existence of these characteristics results in further classification into three subtypes: inattentive (ADHD-I), hyperactive/impulsive (ADHD-H) and combined type (ADHD-C) (APA, 2013). ADHD is relatively common, with prevalence rates estimated as around 8.4% of children in the United States (Danielson et al., 2018) and approximately 4.4% of adults (Kessler et al., 2006). ADHD is strongly associated with poor social, behavioural and academic outcomes in children, including academic underachievement (Agnew-Blais et al., 2018; Arnold et al., 2020; Galéra et al., 2009; Scholtens et al., 2013), poor organisational skills (DuPaul et al., 2022; DuPaul et al., 2014), oppositional behaviour (Biederman et al., 2008), poor daily living skills e.g., brushing teeth, getting dressed (Irwin et al., 2021) and difficulties developing and maintain peer relationships (DuPaul et al., 2014; McQuade & Hoza, 2008). Poor functional, social and economic outcomes are also reported for adults (Merrill et al., 2019), including difficulty with regulating emotions and managing relationships (Bodalski et al., 2019), poor employment (Biederman et al., 2006; Klein et al., 2012), substance use and dependency (Jacob et al., 2007), anti-social behaviour (Loeber et al., 1995; Mannuzza et al., 2004) police cautions and convictions (Agnew-Blais et al., 2018), poor daily functioning (Butzbach et al., 2021b) and low levels of self-reported quality of life (Scholtens et al., 2013). Across the lifespan, ADHD is associated with high rates of comorbidity with mental health difficulties, with studies showing, for example, 25% of the ADHD population suffer from anxiety (Koyuncu et al., 2022) and depression (Jacob et al., 2007).

Given the high prevalence rates of ADHD, and the weight of evidence demonstrating the impact on health and functioning, especially on a day-to-day basis, it is critical to identify

and better understand processes and abilities that may underpin successful daily functioning, and, therefore, overall health and quality of life. Many of the daily tasks and activities reported to be difficult for those with ADHD, such as remembering homework, bringing in the correct equipment to school, remembering shopping and paying bills on time, have been described as prospective memory (PM) tasks (Altgassen et al., 2012); that is, the process of remembering to execute a planned intention at the appropriate moment in the future (Einstein & McDaniel, 1996, 2005). PM tasks can be event-based (event-based prospective memory; EBPM), which need to be executed at the appropriate event, such as posting a letter upon seeing a post box; or time-based (time-based prospective memory; TBPM), which need to be executed at a certain time, such as calling to make an appointment at the doctor at 8am. Such tasks are ubiquitous in daily life across the lifespan and thus critical to the development and maintenance of independence and quality of life (Ballhausen et al., 2019; Zuber & Kliegel, 2020). Therefore, better understanding PM in children and adults with ADHD, and the cognitive mechanisms that may underlie the process, would arguably help to better understand the difficulties experienced by those with ADHD in daily life and elucidate the impact of cognitive difficulties on daily life and inform effective strategies at home and school.

PM is a complex, dynamic process and involves planning ahead and the formation of an intention, which then must be executed at the correct moment in the future (Ellis & Kvavilashvili, 2000; Scullin et al., 2013). PM does not therefore describe a discreet cognitive function, but rather a multi-phased process that relies on the coordination and execution of different actions and cognitive functions at different stages across time. For instance, one may feel unwell and decide to make a GP appointment at the first opportunity at 8am the next morning (target time). The intention to call is thus formed and stored in (retrospective) memory. There will then be a necessary delay, filled with typical jobs and tasks up until the

moment of making the appointment, such as making dinner, brushing teeth, supporting one's children in getting ready for school in the morning (ongoing tasks; OT). When 8am the next morning approaches, it will be necessary to monitor the time throughout various OTs and, at the appropriate moment, inhibit and switch from OTs and execute the plan to call the GP. Thus, the prospective memory process comprises a retrospective memory component, involved with the encoding and subsequent retrieval of intentions, and a prospective component involved with the control and allocation of executive, attentional resources needed manage and hold in mind ongoing tasks whilst monitoring the environment for cues to the intention, and to inhibit behaviours and switch between OTs and the PM task (Einstein & McDaniel, 1996; Kvavilashvili et al., 2001) once the appropriate moment arises. These cognitive processes are often described in the literature under the umbrella term Executive Function (EF). The typical phases of such a computer-based EBPM dual-task paradigm, and the EFs proposed to underlie each one, are outlined in Figure 1, taken from Mahy's Executive Framework (Mahy, 2022a, 2022b; Mahy et al., 2014) which posits EF as central to the development of prospective memory in children, which has been supported empirically (Zuber et al., 2019).

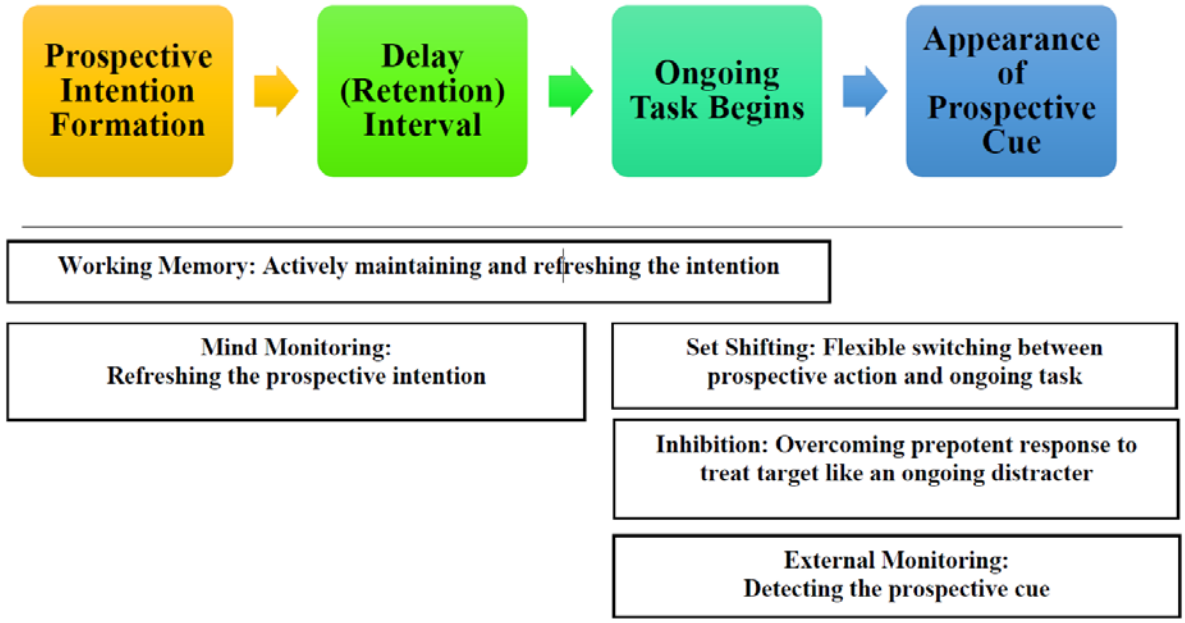


**Figure 1. EBPM process and proposed e**xecutive functions necessary at each phase. Reprinted from Mahy (2022b) with permission.

Despite the four phases (illustrated in Figure 1) being common to all PM tasks, the demand on executive resources is thought to vary depending on the type of PM task (Einstein & McDaniel, 2005). TBPM tasks are described as the most demanding as there is no external cue; instead, it falls to the agent to regularly inhibit and switch from OTs to monitor the time and, when the target time arrives, to again inhibit and switch tasks to self-initiate execution of the intention (Einstein & McDaniel, 1996). For EBPM, on the other hand, much of the cognitive demand can be "offloaded" (Gilbert, 2015) to external cues (e.g., alarms) thus relieving demand on executive resources. According to the influential Multiprocess Framework (McDaniel & Einstein, 2000), the EBPM intention is retrieved either via spontaneous processes or more effortful cognitive processes, depending on characteristics of the EBPM task and cues. Specifically, McDaniel and Einstein (2000) argue that cue salience (relevance and/or distinctiveness), cue focality, (the extent to which the cue is processed as part of the OT, e.g., ), task importance/motivation (e.g., remembering cat food vs taking critical medication), length of time/delay between PM formation and execution and OT

difficulty are important task/cue characteristics that determine the level to which the intention rather automatically “pops into mind” or rather necessitates the monitoring of the environment and thus regular inhibition, switching and working memory, placing far greater demands on executive resources.

In addition to EF, other cognitive mechanisms have been implicated in PM. For instance, Theory of Mind (ToM) has been found to be related to PM performance in adolescents (Altgassen, Vetter, et al., 2014). Recently, metacognition, specifically the pre- and postdiction of one’s performance on PM tasks, has been found to predict PM performance, and improve with age in young children (Cottini et al., 2021; Lavis & Mahy, 2021).

There is, therefore, an established evidence base for the important way in which cognitive mechanisms such as attention, EF, retrospective memory, and, more recently, ToM, underlie successful PM. It is of real concern therefore, that difficulties in these domains are well-established in those with ADHD. Difficulties with inattention and inhibition are, of course, core symptoms of the condition (APA, 2013), but such difficulties have been established empirically, with findings demonstrating difficulties with attention, inhibition, set shifting, switching attention, working memory, monitoring, sustaining attention (Frick et al., 2022; Molitor et al., 2019; Roshannia et al., 2021). Indeed, EFs have been put forward as central to the etiology of the condition (Barkley, 1997; Brown, 2013; Willcutt et al., 2005), as illustrated in Figure 2.

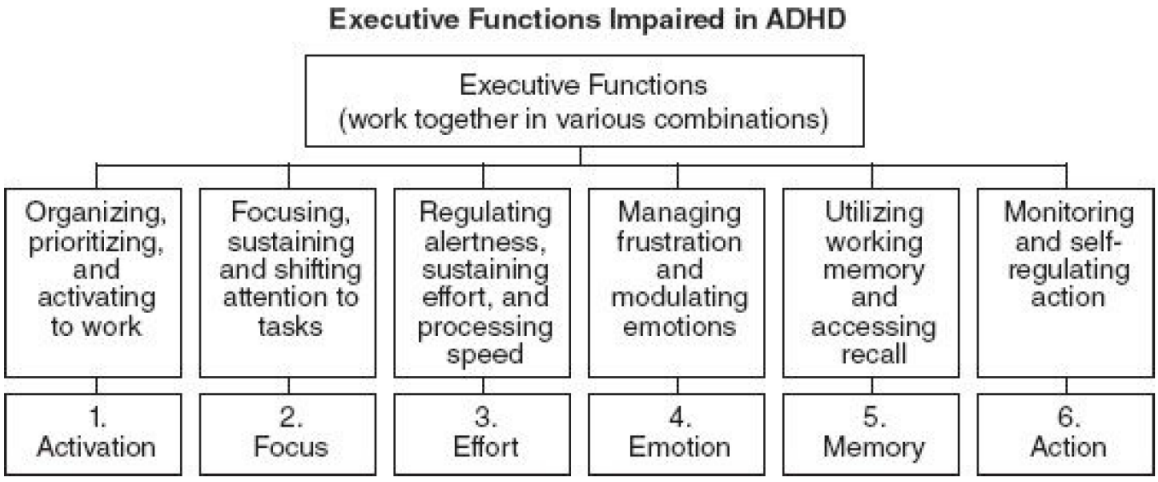


**Figure 2.** Executive functions impaired in ADHD. Reprinted from Brown (2013) with permission.

It is clear, therefore, that the established EF impairments in ADHD (Figure 2) map closely on to the EFs deemed critical for successful PM development and performance (Figure 1). These EF difficulties, in addition to problems with other key mechanisms of PM, including retrospective memory (Alderson et al., 2022; Skodzik et al., 2017), ToM (Pineda-Alhucema et al., 2018) and metacognition (Butzbach et al., 2021a; Butzbach et al., 2021b) make it likely that PM will be very difficult for this population. Indeed, there is evidence that other clinical populations with established EF and other cognitive impairments have difficulties with PM, with recent systematic reviews demonstrating this can be seen for those on the autism spectrum (Sheppard et al., 2018) schizophrenia (Wang et al., 2018), Parkinson's disease (Costa et al., 2018), multiple sclerosis (Rouleau et al., 2018) and acquired brain injury (Raskin et al., 2018).

In summary, PM is important for everyday life and independence. EF and memory are posited as crucial to the process, whilst also posited as core to theories of ADHD (Barkley, 1997; Brown, 2013). These theories are supported by a weight of evidence of impairment in ADHD, for children and adults, in cognitive mechanisms crucial to successful PM, and the pattern of PM difficulties within other neurodevelopmental conditions with overlapping cognitive difficulties. Indeed, previous work by Talbot and colleagues (2018) reviewed six

studies investigating PM in children with ADHD, was in line with this. The current review will update this work by including, in addition to the six studies (seven experiments) included in the first review, a further three studies (four experiments). The addition of these studies was important as they facilitated further, valuable examination of the potential underlying mechanisms of PM in ADHD children, including EF, WM, time perception and ADHD symptoms of inhibition and hyperactivity. Furthermore, understanding how PM develops across the lifespan in ADHD is critical, especially given the ADHD symptoms and functional difficulties that persist into adulthood (Franke et al., 2018), yet a review of the literature has yet to be conducted. Therefore, a further critical aim of the current review was to include studies of PM in adults with ADHD, to facilitate comparison of PM ability in different age groups, thus providing insight into PM development across the lifespan. Consequently, total of five studies (six experiments) of PM in adults with ADHD were included in the current review. The research questions of the current review were, therefore:

1. Is PM impaired in children and adults diagnosed with ADHD;
2. Are patterns of performance in accordance with the MPF, namely, that when executive function demand of the PM task is higher (i.e., involving cues of low salience and/or focality, long delays to PM execution from intention formation or difficult OT) performance is worse, and has a greater impact on those with ADHD due to their limited EF resources?
3. Is there evidence showing a differential effect across the lifespan?

## Methods

### Search strategy

A literature search was conducted in-line with the Preferred Reporting Items for Systematic Reviews and Meta-analyses standards (PRISMA; Moher et al., 2009), with the aim of identifying all studies investigating prospective memory in children and adults,

published up until November 2021 (see Figure 3). As the current review was updating the previous work of Talbot and colleagues (2018), all six reviewed papers investigation PM in children with ADHD were included.

**Eligibility criteria**

Studies were included in the systematic review if: a) PM was the primary variable of interest/outcome measure (i.e., not when PM was included as a battery of cognitive measures); b) they included participants with an ADHD diagnosis and a matched, neurotypical control group; c) they reported sufficient information with regards to results and study design; d) the full text was in English; and e) if the paper had been published after peer review and/or as part of a doctoral thesis (given doctoral papers are also subject to a rigorous quality control process).

Participants included in the review were children and adults aged between 6-57, and included those with a diagnosis of ADHD-I, ADHD-H or ADHD-C.

**Search protocol**

Given the paucity of research in the field, a broad search protocol, searching titles and abstracts, was employed. Specifically:

"prospective memory" AND “ADHD” OR "attention deficit” OR “attention deficit/hyperactivity disorder"

Furthermore, a range of different databases were searched to ensure the maximum number of appropriate papers were retrieved, including Scopus, Google Scholar, DiscoverEd and PubMed.

**Risk of bias/critical appraisal/methodological quality**

Six of the included papers were selected randomly for methodological quality appraisal. The tool used to appraise the quality of the papers was the Joanna Briggs Institute checklist for quasi-experimental studies (Institute, 2017). This checklist is a nine-item

checklist designed to appraise papers and evaluate the risk of bias, across the certain criteria, including: within-group homogeneity, the inclusion of a well-matched control group, consistency and reliability of outcome measurement and analysis. The studies were first appraised independently by two critical appraisers, including the current first author. Cohen's k was run to determine if there was agreement between the two appraisers' rating of the six studies. There was strong agreement between the two appraisers' judgements, k = .769, $p <$ .001. Any disagreement between the appraisals were then discussed and resolved. No studies were excluded following the critical appraisal.

**Data extraction**

The following data was extracted from the 14 papers eligible for the review: bibliographical information, ADHD subtype, medication status of participants, sample size, age, gender, PM type (EBPM, TBPM), OT task, PM and OT performance/group differences, additional cognitive measures (e.g., EF, ToM).

**Characteristics of studies**

Table 1 presents the extracted data of the 14 studies included in the review. The child studies are presented first, followed by the adult studies. With respect to results, the studies in the table are presented in the following order (for the child and subsequent adult section): studies showing intact PM; impaired PM; and within-study mixed results (e.g., intact EBPM but impaired TBPM). This sequence is repeated in the subsequent results section, where each study is described and critiqued in detailed.

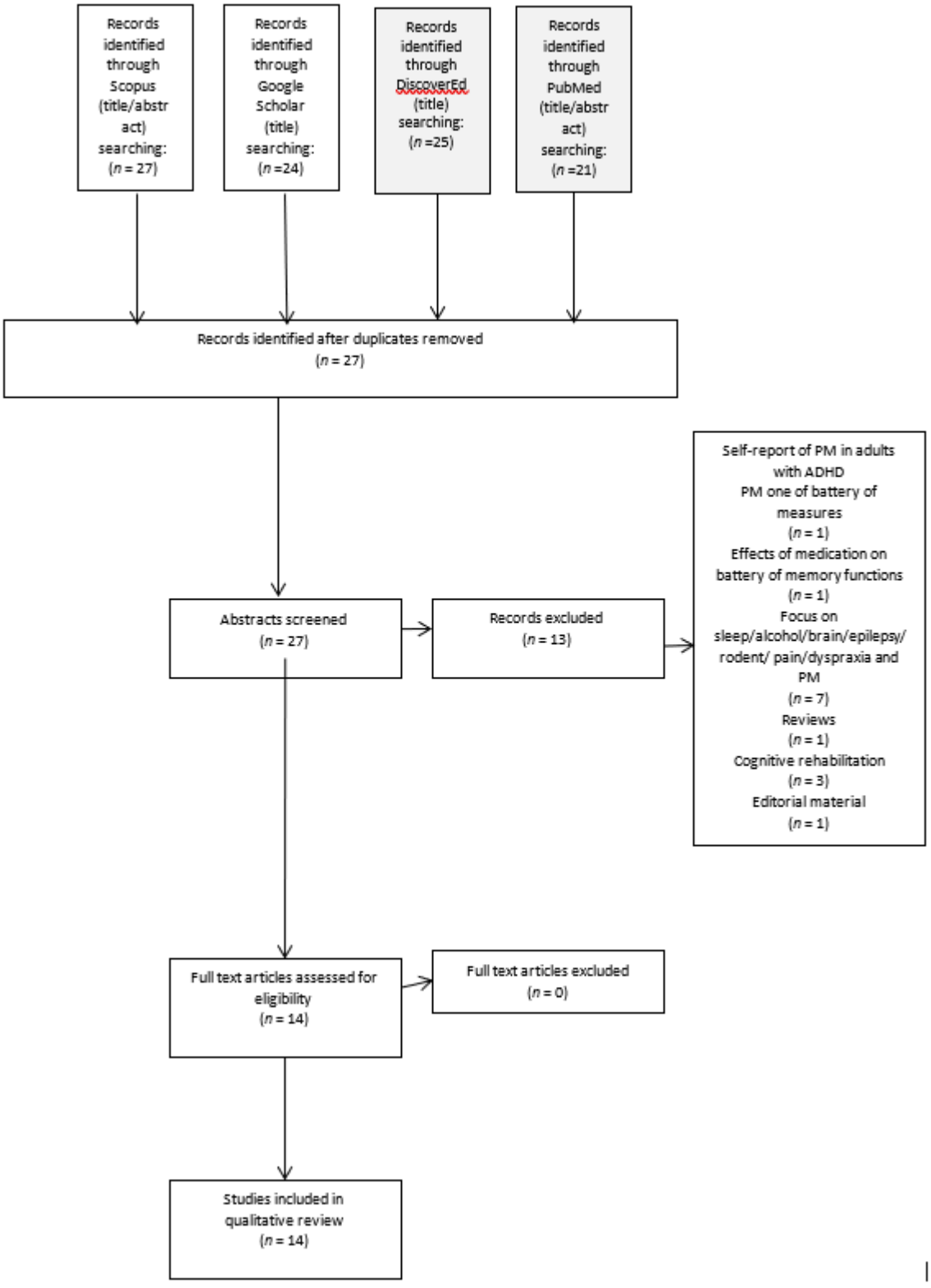


**Figure 1.** PRIMSA flow-chart (Moher et al., 2009) illustrating literature search process

Table 1. Characteristics and results of all studies investigating prospective memory in ADHD.

| | | | Sample size | | PM | | OT | | Additional cognitive test | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ADHD type (*N*) | Psychostimulant medication taken within 24 hours of testing? *(N)* | ADHD *N* (N male) $M_{age}$ (SD) | Control *N* (N male) $M_{age}$ (SD) | Sub-type | Results | Task | Results | | Further comm |
| **CHILD STUDIES – Intact PM** | | | | | | | | | | |
| Brandimonte et al. (2011) | Mixed, not specified | No | *N*=30 (28)<br>8.34 (1.62) | *N*=30 (28)<br>10.86 (1.52) | EBPM | No EBPM deficit | Computerised categorisation task | No OT deficit | Inhibition (Go/NoGo condition) | Very recent ADHD diagnosis<br>ADHD group performed less when on Go/NoGo inhibition task |
| Yang et al. (2019) | ADHD-I (13)<br>ADHD-HI (2)<br>ADHD-C (12)<br>Not specified (1) | Yes (21) | *N*=28 (22)<br>8.67 (1.56) | *N*=28 (22)<br>8.86 (1.48) | EBPM<br>TBPM | No EBPM or TBPM deficit | Computerised fishing game | Overall: OT > all OT+PMs OT+EBPM > OT+TBPM<br>OT + PM deficit | Inhibition<br>Switching | No PM differences, but ADHD did show higher cost than TDs to OT in EBPM task (but not TBPM task)<br>ADHD lower scores on sustained/control/switch attention measures<br>But, no correlation between PM and attention measures |
| Kliegel et al. (2006) | ADHD-C (20) | Yes:discontinued at least 6 hours prior to testing (14) | *N*= 20 (20)<br>8.9 (0.6) | *N*= 20 (20)<br>8.8 (0.48) | EBPM | No EBPM deficit | HEXE | OT deficit | | No PM differences, but ADHD did show higher cost to OT<br>ADHD group poorer recollection of planned intentions |
| Levén and Hillertz (2014) | Mixed not specified Inc. DAMP | Not reported | *N*= 9<br>Age range: 10-13<br>($M_{age}$ not specified) | *N*= 11<br>Age range: 10-12<br>($M_{age}$ not specified) | TBPM | No TBPM deficit | Memory game | No OT deficit | WM (digit span)<br>Time-perception | ADHD poorer time reproduction<br>No group differences on Inhibition or Working Memory<br>ADHD checked time more often |
| Kerns and Price (2001) Experiment 2 | ADHD-C (21)<br>Y (19) – | No | *N*= 21<br>9.4 (1.8) | *N*= 21<br>9.3 (1.8) | TBPM | No TBPM deficit | *The CyberCruiser* (TB) | Not measured | Sustained attention - CPRS (Continuous | CPRS (Hyperactivity) –predicted PM performance.<br>2 scores on Conner's CPT (Sustained attention) predicted PM performance |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Performance task) | No group time monitoring differences |
| **CHILD STUDIES – Impaired PM** | | | | | | | | | | |
| (Zinke et al., 2010) | ADHD-I (10)<br>ADHD-C (12) | No | *N*= 22 (18)<br>9.8 (0.89) | *N*=39 (25)<br>9.73 (0.74) | TBPM | TBPM deficit | 1-back WM task | Overall: OT > OT+TBPM<br>No OT deficit | CPRS | Correlation between correct PM and CPRS<br>No group time monitoring differences |
| Talbot and Kerns (2014) | ADHD-C (36) | No | *N*= 36<br>10.86 (1.52)<br>Age range: 8-13 | *N*= 33<br>10.89 (1.76) | EBPM<br>TBPM<br>PRMQC | TBPM and EBPM deficit<br>PRMQC deficit | *CyberCruiser-II* (TB)<br>*Super Little Fisherman* (EB) | No OT deficit | Time perception | Age predicted EBPM OT (fishing game)<br>Larger cost of PM to OT for TD group, not ADHD grp<br>ADHD group showed poorer time estimation |
| (Mioni et al., 2017) | Mixed, not specified | Not reported | *N*=23 (18)<br>10.89 (1.04) | *N*=24n (17)<br>10.89 (0.91) | TBPM | TBPM deficit | Cartoon watching | OT deficit | Working memory<br>Time perception | TBPM deficit despite no group differences in time perception and working memory<br>Age range: not reported<br>TBPM related to time perception for TD only<br>No group time monitoring differences<br>NC checked more frequently as target time approached<br>ADHD also further from target time |
| Costanzo et al. (2021) | ADHD-I (7)<br>ADHD-C (17) | | *N*= 24 (15)<br>10.42 (1.34) | *N*= 23 (16)<br>10.15 (1.51) | EBPM | EBPM deficit | Computerised categorisation task | General cost to OT of PM tasks<br>ADHD less accurate than TD but no slower | CPRS | ADHD less accurate on 2 of 4 PM conditions: the 4-target task and the unfocal task (not 1-target or reward)<br>ADHD slower RTs on PM tasks<br>Evidence that CPRS Inattention and Hyperactivity measure negatively related to PM performance<br>66% of ADHD "*at least one comorbid learning disorder*" |
| **CHILD STUDIES – Mixed results** | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Kerns and Price (2001) Experiment 1 | Mixed, not specified | Yes (5) | *N*= 10 (7)<br>10.5 (2.0) | *N*= 10 (7)<br>10.5 (1.8) | EBPM<br>TBPM | No EBPM deficit<br>TBPM deficit | *The CyberCruiser* (TB) | Not measured | | CPRS Hyperactivity – positively predicted PM performance.<br>No group time monitoring differences |
| **ADULT STUDIES – Intact PM** | | | | | | | | | | |
| Fuermaier et al. (2013) | ADHD-I (14)<br>ADHD—H (1)<br>ADHD-C (30) | No | *N*= 45 (22)<br>34.9 (10.9) | *N*= 45 (22)<br>31.1 (9.8) | "Complex PM"<br>EBPM | No EBPM deficit | Series of sub-tests, including arithmetic, cancellation task | Not scored | WM (WAIS)<br>Focused attention<br>Flexibility<br>Inhibition (Stroop) | ADHD PM deficit defined as poorer task planning and switching<br>ADHD lower scores on short-term memory, attention, inhibition and flexibility<br>ADHD Inhibition predicted task planning |
| **ADULT STUDIES – Impaired PM** | | | | | | | | | | |
| Karidi (2013) Experiment 1 | Not specified | Yes (3) | *N*= 19 (11)<br>25.58 (6.04) | *N*= 24<br>26.00 (6.35) | EBPM<br>TBPM<br>PRMQ | TBPM and EBPM deficit<br>PRMQ deficit | *Virtual Week* | No score | | Number of ADHD symptoms, and scores of Hyperactive/Impulsivity scores and Inattention negatively correlated with overall PM performance<br>PRMQ: within ADHD, PM scores significantly higher than RM scores<br>No group time monitoring differences |
| Karidi (2013) Experiment 2 | Not specified | Yes (3) | *N*= 18 (10)<br>25.6 (5.75) | *N*= 22 (16)<br>26.05 (6.41) | EBPM<br>TBPM<br>PRMQ | TBPM and EBPM deficit<br>PRMQ deficit | *Virtual Week* | No score | WM (WMS-III)<br>Set-shifting, Inhibition (D-KEFS) | PRMQ: ADHD higher scores for both PM and RM; within ADHD, PM scores significantly higher than RM scores<br>For ADHD (not TD), PRMQ negatively correlated with PM performance<br>PM performance significantly predicted by Working Memory (for both groups)<br>Main group effects no longer significant when Working Memory included as covariate |
| Altgassen, Koch, et al. (2019) | ADHD-C (14)<br>ADD (4) | No | *N*= 18 (18)<br>25.11 (5.6) | *N*= 18 (17)<br>25.78 (5.9) | EBPM | EBPM deficit | Categorisation task | OT deficit<br>OT cost of PM: both groups | Inhibition load task | ADHD also poorer on auditory inhibition tasks<br>PM of both groups worse with high inhibition load<br>PM of ADHD worse than controls with higher tasks/inhibition demand |
| **ADULT STUDIES – Mixed results** | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Altgassen, Scheres, et al. (2019) | ADHD-I (8)<br>ADHD—H (2)<br>ADHD-C (19) | No | *N*= 29 (16)<br><br>36.52 (11.1) | *N*= 24 (7)<br><br>37.58 (14.1) | EBPM<br>TBPM<br>Naturalistic | No EBPM or TBPM deficit<br><br>Naturalistic deficit | | | Immediate and delayed episodic memory (WMS)<br><br>Future orientation | Several ADHD diagnosed with serious mental health disorders, e.g., PTSD, Bipolar, Social Phobia<br>ADHD symptoms predicted procrastination and naturalistic PM – relationship partially mediated by self-assigned PM<br>NOTE – change in meds – stop taking for 3 days? |
| Altgassen, Kretschmer, et al. (2014) | Not specified | No | *N*=25 (12)<br><br>40.00 (11.20) | *N*= 25 (11)<br><br>41.16 (10.74) | EBPM<br>TBPM | No EBPM deficit<br>TBPM deficit | *Dresden Breakfast task*<br>Setting table | No OT deficit<br><br>Deficit in plan quality and adherence | | No group time monitoring differences |

ADHD-I = ADHD Inattentive; ADHD-H = ADHD Hyperactive; ADHD-C = ADHD Combined; DAMP = Deficits in Attention, Motor Control and Perception; EBPM = Event Based Prospective Memory; TBPM = Time Based Prospective Memory; OT = Ongoing Task; RM = Retrospective Memory; WM = Working Memory; EF = Executive Function; D-KEFS = Delis-Kaplan Executive Function System; WMS-III = Wechsler Memory Scale-III; CPRS = Conners' Parent Rating Scale; Conner's CPT = Conners' Continuous Performance Task; PRMQ(C) = Prospective and Retrospective Memory Questionnaire (for Children)

## Results

### Children: Intact PM

Kliegel et al. (2006) conducted the first of four experiments to investigate PM in ADHD children, 14 of whom were medicated but were asked to cease at least 6 hours prior to participating. Complex prospective memory was assessed using tasks based on the Six Elements Task (Shalice and Burgess 1991). Children were required to plan out the sequence of four ongoing tasks (two tasks from each of the arithmetic and picture-task categories), remembering the task switching rule that they were only permitted to switch to a task from a different category upon completion of the current task. Children were asked to remember to initiate the four HEXE tasks upon completion of a prior task (EBPM) and to ensure they initiated the three remaining tasks within a 2-minute time limit represented by a time bar at the top of the screen (TBPM). In summary, participants were required to plan their activities, recall the plan after a 10-minute delay, initiate and execute the plan a further 10-minute delay and upon completion of a task, all within the time limit, which the authors argued represented the way in which PM tasks were embedded amongst multiple tasks and demands in everyday life.

Results demonstrated ADHD children performed as well as NCs on both PM measures, evidence in support of intact TBPM and EBPM. Furthermore, ADHD children were as good as NCs at self-initiated switching. However, it is important to note that this preserved PM and switching ability came at a cost to the OTs of the HEXE battery. Specifically, whilst attempting and switching to a similar number of OT questions to NCs, ADHD children gave a significantly higher number of incorrect answers than NCs. With regards to the intact PM performance, the authors did point out that the OTs were relatively simple, potentially resulting in low cognitive demand.

Another study to find intact EBPM in ADHD children was that of Brandimonte and

colleagues (2011). This study also employed a computerised paradigm, but one more similar to the classic dual-task paradigm of McDaniel and Einstein (2005). That is, children were asked to perform an ongoing categorisation task, within which the EBPM task was embedded. Specifically, children pressed designated, coloured keys to indicate whether the line drawing on screen was an item of clothing or a piece of furniture (80 trials), but had to press the yellow spacebar when a certain picture (the EBPM target; 4 trials) was presented. An additional "response inhibition" condition was included in this study whereby children were asked not press anything on presentation of the target picture (again, 4 trials within 80 OT trials). Performance was measured by way of accuracy and response times. With regard to EBPM performance, ADHD children were as accurate and as quick when identifying and responding to EBPM targets. However, ADHD children did perform less well than NCs in the Response Inhibition condition, pressing a key, rather than inhibiting a response, more often than NCs. Such results suggest that EBPM is intact for ADHD children, although when an event-based intention involves further executive control, namely, response inhibition, performance is impaired.

In contrast to Kliegel et al. (2006), the addition of a PM did not cause any greater OT cost for the ADHD group. However, the addition of the response inhibition task did see a significantly higher cost to the OT for the ADHD children, compared to the NC children. That is, ADHD children were significantly less accurate (but no slower) on the OT than NC children when they were also asked to inhibit responses upon presentation of a target picture. These results again seem to suggest that when the execution of intentions involves a higher level of executive (inhibition) demand, they are more difficult for children with an ADHD diagnosis, and have a greater impact on their ability to perform OTs.

Leven and Hillertz (2014) also investigated TBPM in children with ADHD, although children were also included in the ADHD group if diagnosed with a deficit in attention, motor

control and perception (DAMP; Gillberg et al., 1982), a condition seen as a combination of both ADHD and Developmental Coordination Disorder (DCD; see Visser, 2003 for a review) routinely diagnosed in Scandinavia (Gillberg, 2003). In their study, participants played a computerised game set on a farm, whereby children played an ongoing memory game (unspecified) for 8-minutes, whilst also remembering to check on the cow and feed it when it was hungry. TBPM was measured by the number of times the cow was not fed. Specifics around the number of target times (e.g., potentially every full minute, so a possible 8 target times), and acceptable time-windows (e.g., +/- 10 seconds) were not reported. No group differences in TBPM were found, indicative of preserved PM in the ADHD children, although they were found to monitor the time (check the cow) more often than NCs. Furthermore, there were no differences in additional inhibition (Go/NoGo) and working memory (digit span) tasks. ADHD children did, however, perform significantly less well on a task measuring time estimation, significantly underestimating how long a lamp had been displayed on screen. The results from this study are helpful in better understanding TBPM in ADHD, however, details are missing in terms of participant information (e.g., no mean ages, only age range) and the procedure, as detailed above. The sample size was also very small (9 and 11 children in the ADHD and NC group, respectively) and included children with a diagnosis of DAMP. Thus, the results must be interpreted cautiously.

The most recent study to investigate EB and TBPM in ADHD children was conducted by Yang and colleagues (2019). Participants played a computerised fishing game and were asked to catch as many as possible in the session (OT), the duration of which was 3 minutes 40 seconds. For the embedded EBPM task condition, participants were asked to stop fishing and click the cat to feed it every time a certain fish appeared (which appeared three times, once every minute). For the embedded TBPM condition, the children were asked to stop and feed the cat every minute. For an additional EBPM measure, the children were asked to

remember to click on the boat when a bone appeared on the screen to signal the session was complete. Whilst overall PM performance was best in the final EBPM task, and worst in the TBPM task, no significant group differences emerged, suggestive of intact EB and TBPM performance in ADHD. It is important to note that, of the 28 children in the ADHD group, 21 (75%) were medicated with either atomoxetine (noradrenaline reuptake inhibitor) or methylphenidate (psychostimulant) at the time of testing, which may have improved the attentional ability of the children, thereby confounding the PM results. However, on two separate tasks of attention selected from the Chinese version of the Test of Everyday Attention for Children battery (Chan et al., 2006) the ADHD group did score significantly lower than the NCs, suggesting that attentional abilities were still worse in the ADHD group despite medication. Nevertheless, the apparent parallel PM performance of the ADHD group in this study should be considered in light of potentially ameliorated attentional impairment due to medication.

**Children: Impaired PM**

Talbot and Kerns (2014) used an adapted version of CyberCruiser, originally developed by Kerns and Price (2001) to examine TBPM in children. To play the game, children were asked to control a rocket, using a joystick, as it moved along in space whilst trying to avoid as many obstacles as possible (OT). The OT difficulty changed dynamically, according to performance (i.e., more or less obstacles) in an effort to maintain a similar level of OT challenge/demand for all participants. The children are also asked to make sure the rocket did not run out of fuel (which it would do every full minute), for which they would lose all of their points (TBPM). Children could press a button to monitor the fuel level by pressing the spacebar, and could only refuel when it the tank was three quarters full or less, which ensured children had to keep monitoring until the right moment, rather than simply continuously refuelling. The authors attempted to increase the motivation and importance of

the refuelling TBPM task by promising a reward for a high score. Despite this increase in motivation, the findings were in line with those of Kerns and Price (2001) as TBPM was also poorer in the ADHD group. The children's EBPM was also investigated by way of the computerised fishing game designed by Yang et al. (2019). The authors gained additional, parent-report measures of daily prospective and retrospective memory using the Prospective Retrospective Memory Questionnaire for Children (PRMQC) which was adapted from the original instrument developed for adults by Smith et al. (2000). In contrast to Yang et al. (2019), the ADHD group performed less well than the NCs, suggestive of an EBPM and TBPM deficit. All children in the Talbot study however had ceased medication at least 24 hours prior to testing, whereas 75% of children in the Yang study maintained their medication.

Interestingly, whilst there were no group differences in the OT performance for the EBPM task, and no overall group differences in the OT performance for the TBPM task, the NC group did show a greater cost to the OT with the addition of the PM task (i.e., OT performance was worse in the dual-task than the single, practice round of the OT). As in Levén and Hillertz (2014) the ADHD group also performed less well in a time-reproduction task, evidencing poorer time estimation, which may have contributed towards the poorer TBPM performance, although time reproduction and TBPM scores were not significantly correlated. Interestingly, scores on the PRMQC were positively related to attentional difficulties as measured by the CPRS (Conners, 1990).

Zinke et al. (2010) embedded a PM task within a 1-back memory OT, in a more classic computerised dual-task paradigm, to explore TBPM in children. Children indicated, by key press, whether the line drawing on screen was a repeat of the line drawing presented just before it (OT), but also had to remember to press a different key every two minutes (TBPM; correct if button pressed within a time window of 2 seconds, +/- 1 second of every

full minute). Children were able to press another key to display a timer on screen for 3 seconds. Results showed that children in the ADHD group managed significantly less correct TBPM responses. However, whilst there was an overall cost to the accuracy and response times of the OT of adding the TBPM task, this did not differ by group. Interestingly, clock check patterns were analysed, finding that all participants increased their number of clock checks as the target time approached, with no difference between groups. Such a result suggests that children with ADHD are as able to strategically monitor time, and switch attention from a current task, in pursuit of a goal, as well as NC children. However, TBPM performance was negatively correlated with the CPRS (Conners, 1990), suggesting that the ability to control attention did in some way contribute to the poorer TBPM performance of the ADHD group.

Mioni and colleagues (2017) also found a TBPM deficit in ADHD children. In their study, children watched a cartoon and were told to pay attention as they would be asked questions afterwards (OT), but also had to monitor the time to ensure they pressed a key every two minutes (accurate if pressed within a 10s of target time, i.e., +/- 5s). ADHD children were found to manage less correct TBPM responses than matched NCs. In contrast to Zinke et al. (2010), ADHD children performed less well than NCs answering questions on the cartoon for the OT, suggesting a higher cost for ADHD children to OT performance of the PM than for NCs. Furthermore, NC children were found to employ a better time-checking strategy; that is, they increased their clock checks significantly more over the two minutes leading up to the target time, and checked significantly more in the final 30 seconds before the target time. This suggests that the difference in TBPM performance was at least partially a result of poorer strategic allocation of attentional resources, rather than attention resource capacity per se, of the ADHD children. Overall, ANCOVAs showed that time perception, but not WM, influenced PM accuracy. However, when conducted on groups

separately, this was true only for NCs.

The most recent study investigating PM in ADHD children and matched controls was that conducted by Costanzo et al. (2021). A classic computerised dual-task paradigm was again employed, this time requiring the children to perform an EBPM task embedded within a categorisation OT whereby children had to indicate whether the animal presented on screen was a flying or a non-flying animal. Four EBPM conditions were employed in this study, to examine the impact of different cognitive factors, namely, WM, cue focality and motivation. The examination of WM was achieved through the manipulation of the possible number of EBPM target pictures; specifically, one condition included only one target picture, whilst another condition included four target pictures. Cue focality was investigated by including a non-focal condition; specifically, EBPM targets were certain plants that were surrounding the animal pictures, thereby not processed as part of the OT. Motivation was examined by increasing the number of points for each correct EBPM response. The researchers hypothesised that the increase in WM load (4-target condition) and reduction in cue focality (non-focal condition) would increase cognitive load and the need for strategic allocation of attentional resources, thereby differentially impacting the performance of the ADHD group. Results were in-line with these predictions, with the ADHD group responding less accurately and more slowly in the 4-target and non-focal conditions, but not the 1-target and Reward condition. All children demonstrated an OT cost, in terms of speed and accuracy, and more so in the two more cognitively demanding conditions, however, ADHD group were less accurate than NCs in these two conditions. An important limitation of the study, however, was the fact that 66% of the ADHD group had an additional learning disorder (although these were not specified) which may have confounded results.

**Children: Mixed results**

The earliest study to investigate TBPM in children with ADHD was that by Kerns and

Price (2001), which employed the computerised car game CyberCruiser, (Kerns, 2000) across two experiments. The task was identical to that of the Talbot and Kerns (2014) study, except the game involved car on a road, rather than a rocket in space. Results of both experiments revealed a TBPM deficit in the ADHD group, despite the number of fuel checks (time monitoring) being no different. The first experiment also employed an EBPM measure, whereby participants were asked to perform an action on cue from the researcher (e.g., stand up to turn the door knob when the research clicks their fingers) four times throughout the session, for which no group differences were found. Interestingly, for both experiments, measures of hyperactivity, obtained from the Conners' Parent Rating Scale (CPRS; Conners, 1990) were significant predictors of the number of times the children ran out of fuel, as were two measures of sustained attention in the second experiment, suggesting that difficulties with attention contributed to the poorer TBPM performance of the ADHD group.

**Adults: Intact PM**

Fuermaier and colleagues (2013), designed a planning task, based on the HEXE paradigm employed by Kliegal and colleagues' child PM study (2006), to measure "complex prospective memory" in adults. Participants were required to plan and complete 10 subtasks that involved a range of cognitive and motor challenges, including arithmetic, item cancellation (crossing out target stimuli with a pencil), word finding, nut screwing (using hands to remove a nut from a screw) and squeezing foam balls. Indices of PM included task planning quality (assessed using a scoring system), plan recall (verbally recall plan after approximately 40 minutes), self-initiation (initiate task execution once participants reached the age section on a demographics form, i.e., EBPM) and plan fidelity (adherence to plan). Results revealed comparable performance to NCs in plan recall and fidelity, and task self-initiation (EBPM), but worse performance in making plans and task switching. Thus, the ADHD group managed to recall, initiate and execute plans on cue (EBPM) as well as NC

group, despite scoring significantly lower on other measures of memory, attention and cognitive flexibility.

**Adults: Impaired PM**

For their doctoral thesis, Karidi (2013) investigated TBPM and EBPM, and the potential impact of EF and task-type over two experiments, in young adults (average age approximately 25-years). Karidi employed the computerised version of the "Virtual Week" task to measure PM, a computer-based board game designed to replicate daily PM tasks. The task was originally developed by Rendell and Craik (2000) and has been used extensively to measure PM since (for a review, see Rendell & Henry, 2009). To play, players roll two digital dice to move around an on-screen board, with each full circuit equivalent to one "day". Players must pick up a card and choose an activity every time they pass an "event" square. Once they roll a number that corresponds to their chosen activity, they can move again. PM tasks within the game include EBPM tasks, such as "take medication with breakfast", and TBPM tasks such as "call the plumber at 5pm". Retrospective memory demand is varied by the employing "regular" PM tasks, that are repeated in exactly the same way every "day", placing less demand on retrospective memory; and "irregular" PM tasks that are unique. To perform these tasks at the appropriate moment, participants must press the "perform" button and choose the correct option from a list of actions. Participants are able to monitor the time via a keypress. Self-reported, daily prospective and retrospective memory was measured using the PRMQ (Smith et al., 2000). In the second study, WM, switching and inhibition were additionally measured by the administration of subtasks from the Delis-Kaplan executive function system (DKEFS; Delis et al., 2001). Whilst performance on EBPM and regular tasks were better for all participants, ADHD adults performed less well on EBPM and TBPM tasks, and EF subtasks, compared to NCs, in both experiments. PRMQ scores also reflected poorer self-reported daily memory for the ADHD group.

In the final adult ADHD and PM study, Altgassen and Koch (2019) employed a classic computer-based paradigm, embedding an EBPM task within a word categorisation OT (indicate as quickly as possible, via keypress, which of the two possible words matched the category presented above). The authors also included an inhibition load task, whereby participants were presented with a number via headphones and told to add 3 and say the result aloud, but not when the number equalled 8 or 15 (high inhibition), or add 5 to every number and always say the number aloud (low inhibition). Participants first completed a single inhibition task block (high or low inhibition), then a dual inhibition-OT task block, and finally a triple inhibition-OT-PM task. This procedure was then repeated for the other inhibition task. Results demonstrated an EBPM deficit in the ADHD group across all conditions, but group performance was for both groups was not affected by inhibitory load.

**Adults: Mixed results**

For their study of PM in adults with ADHD, Altgassen and colleagues (2014) developed the computerised Dresden Breakfast task, that attempted to emulate the way in which PM tasks are often embedded with a complex series of plans and actions in everyday life. Participants in this study were on average the oldest included in any study of PM and ADHD thus far, with a mean age of just over 40-years-old. Participants were told they had to set the breakfast table on screen before the guests arrived in 7 minutes' time. They had to set the table in a certain way by dragging and dropping items into the correct place. TBPM was measured by informing participants they had to take the tea bag out after 4 minutes, and put the butter on the table 5 minutes prior to the guests arriving, and were permitted to check the elapsed time at any moment by clicking on a timer icon (scored as correct if performed within a 2-minute window around the target times, so, +/- 1 minute). EBPM was examined by observing asking participants to make the tea when the kettle was ready, indicated by the kettle turning blue, and switching off the egg cooker when it was ready, indicated by an

auditory beep sound. Given the complexity of the task, and the need to consider the sequence in which items were set on the table, participants were given time the opportunity prior to starting to plan out their actions, a plan which they described to the researcher and which was recorded to provide a measure of plan quality and adherence. There were no group differences in the frequency of time checks, although the strategic pattern with respect to a potential increase in frequency as the target time approached was not analysed in this study.

Whilst results revealed intact EBPM for the ADHD group, there were clear, large effect TBPM deficits, with ADHD participants scoring less than 20% of TBPM tasks correctly, whilst NCs scored around 40% correctly. NCs were also found to generate higher quality plans (better task priority) and adhered to their plans better during the task, than the ADHD participants.

A recent study examined the role of procrastination in TBPM and EBPM in adults with ADHD (Altgassen, Scheres, et al., 2019). The study included participants with an average age of around 35-years, and matched NCs, who were required to complete four PM tasks. Two tasks were laboratory-based, whereby participants had to retrieve a token from a box and hand it to the experimenter every time the experimenter said “the next task involves memory”, which happened on three occasions (EBPM), and to tell the experimenter what the time was on a clock situated behind them (which they could turn to check anytime) after 10, 20 and 30 minutes had passed (TBPM). The two other tasks were naturalistic: one task involved participants telephoning the experimenter 3 days after the laboratory session, and again 3 days after that (TBPM); and another for which participants listed five to seven non-routine tasks they were planning to complete over the 3 days subsequent to testing (mixed, self-assigned PM tasks). The researchers also employed measures of episodic memory, procrastination and future orientation (e.g., consideration of potential action consequences, planning ahead). Interestingly, ADHD adults performed comparably to NCs, but significantly

worse on all measures of everyday PM performance. The ADHD participants, on average, made less on-time phone calls, and planned and successfully executed less activities. Analysis also revealed that ADHD symptoms were associated with levels of procrastination, and negatively correlated with the naturalistic (but not lab-based) PM performance and future orientation. It is of note here, however, that 18 participants were also diagnosed with serious mental health conditions, including depression, personality disorder, post-traumatic stress disorder and bipolar disorder. It is likely therefore that such mental health difficulties impacted on their daily functioning, potentially confounding the naturalistic PM results.

## Discussion

The current review set out to better understand PM in both child and adult ADHD populations, and shed light on the well documented difficulties with daily functioning in the population, especially given the poor academic and social outcomes in the population (e.g., Franke et al., 2018). The review aimed to understand whether any PM difficulties in the ADHD population were in line with predictions based on the MPF (McDaniel & Einstein, 2000) and EF framework of PM development (Mahy, 2022b; Mahy et al., 2014); specifically, whether PM tasks thought to place more demand on executive function were disproportionately more difficult for the ADHD population, compared to NCs, given their known EF difficulties (Brown, 2013). The reviewed studies investigating PM in ADHD children and adolescents will be summarised first, followed by the adult studies. Subsequently, the potential application of the results will be suggested.

Overall, nine studies to date investigated PM in children and adolescents diagnosed with ADHD. Within those studies, ten experiments were conducted, which produced fourteen sets of results for either EBPM (n=6) or TBPM(n=8). Caution must be taken when comparing the results for each subtype, given results are obtained from both within and between studies, across a range of varying designs and methods and quality (see Table 1). However, the

distinction between PM subtypes is informative: on face value, 50% of the data revealed intact PM in ADHD children. However, when separated into PM subtypes, only approximately one third of the EBPM results (2 of 6 sets of results) indicated a PM deficit, whereas approximately two thirds of TBPM results (5 of 7) showed a deficit. On closer inspection, of the two results that found a EBPM deficit, Costanzo et al. (2021) did find intact PM on tasks that involved either just one PM target or were high in reward; deficits were found when either the cues were low in focality or when there were four different PM targets, increasing the demands on attentional executive resources, as posited by the MPF (McDaniel & Einstein, 2000). Further in line with the MPF, of the four sets of results demonstrating intact EBPM in ADHD children, two revealed a greater OT cost compared to NCs (Kliegel et al., 2006; Yang et al., 2019) and one revealed a PM deficit when the task was embedded within a demanding inhibition (Go/NoGo) task (Altgassen, Koch, et al., 2019), further evidence of executively demanding tasks disproportionately impacting on the PM performance, or, when PM is spared, OT performance, of those with limited EF resources. Of further note, 75% of the 28 participants in the study by (Yang et al., 2019) were medicated throughout testing, perhaps due to the known benefits of ADHD medication to EF (Miklós et al., 2019; Molitor et al., 2019).

The high proportion of results demonstrating a TBPM deficit is also in line with the MPF, given that TBPM tasks represent the most attentionally, executively demanding tasks as they rely on the effortful, internal, top-down processes needed to monitor the time and self-initiate the execution of plans at the appropriate moment (Einstein & McDaniel, 1996). Thus, TBPM difficulties are expected for those with known difficulties in these areas, including those within the ADHD population. Interestingly, time-perception results were inconsistent, and only once related to PM performance, and even then for NCs, not for ADHD children (Mioni et al., 2017). Whilst two studies (Levén & Hillertz, 2014; Yang et

al., 2019) did indicate intact TBPM performance, which may contradict conclusions based on the MPF, interpretations are difficult given significant limitations of each study. Specifically, the study by Levén and Hillertz (2014) included very small sample sizes, and did not disclose important information, such as mean ages, the number of children who were medicated and clear and specific details about the procedure (the authors were approached for further information but none was forthcoming). With regards to the study by Yang et al. (2019), 21 of 28 children were medicated throughout testing. Whilst this represents a significant confound, it is also suggestive of the benefits of medication to PM and, therefore, EF ability, a finding which is established in the literature (Hai et al., 2022; Weyandt et al., 2020).

With regards to the studies investigating PM in adults with ADHD, the five studies published to date included six experiments, producing eleven sets of results measuring either EBPM (n=6) or TBPM (n=4). A set of results derived from naturalistic, self-assigned everyday PM tasks were also described in Altgassen, Scheres, et al. (2019) but subtypes here were not disclosed. Again, overall comparison and interpretation of these data is limited, given the range of methods and design. However, overall, 70% of the results demonstrated a PM deficit. When examined by PM subtype, of the six result sets investigating EBPM, four revealed impaired PM compared to NCs. Of the results regarding TBPM, 4 revealed a deficit, leaving only one result suggesting TBPM ability was parallel to NCs. With regard to intact EBPM, one study involved remembering to place retrieve a token and place it in in the experimenter's hand when cued Altgassen, Scheres, et al. (2019). Thus, participants were not required to switch attention from an ongoing task, nor were they required to inhibit any given responses, and the task was conducted within a calm and controlled environment. The language cue from the experimenter was arguably low in salience as it was language that was not especially distinct from the other instructions, potentially demanding a higher level of attentional resources to identify the cue and recall the required action. However, this EBPM

task was still arguably low in overall EF demand, potentially explaining the comparable performance with NCs. The other set of results showing spared EBPM was produced from the EBPM tasks within the computerised Dresden Breakfast Task (Altgassen, Kretschmer, et al., 2014). These tasks were arguably highly salient and focal; that is, they were distinctive (kettle turning blue; egg timer beeping) and processed as part of the OT. Such salience and focality, as outlined by the MPF, reduces the level of EF demand thus supporting the PM of those with limited EF resources. Interestingly, a real-life version of the Dresden Breakfast Task was employed in a study by Altgassen and colleagues (2012) to examine PM in autistic participants, another population known for difficulties with EF and PM (for a review, see Sheppard et al., 2018). In this case, autistic participants performed poorly compared to NCs. It is possible, therefore, that the computerised version of the task is lower in overall cognitive demand as it does not involve the additional demands of physical coordination and motor control, and the cues are less focal and salient, potentially as they are out of sight rather than presented clearly on a relatively small computer screen. Of the four results demonstrating an EBPM deficit, all were arguably high in EF demand due to, for example, high inhibition load (Altgassen, Koch, et al., 2019), high demands on planning and switching (Fuermaier et al., 2013) and involving a mix of non-focal, irregular tasks (Karidi, 2013). With regard to the TBPM results, all four sets suggested a TBPM deficit in adults with ADHD. Overall, therefore, the TBPM and EBPM results reflect those found in children and are again in line with predictions based on the MPF. That is, that tasks vary in their demand for EF based on their characteristics, and those that involve higher levels of EF demand would disproportionately impact on populations with limited EF resources.

The current review of the literature therefore provides strong evidence that, for those diagnosed with ADHD, children through to adults, PM tasks are difficult. Furthermore, the majority of studies are in line with the predictions based on the MPF; that is, when the

executive demand of the PM tasks is high, thus depending on more effortful retrieval and execution, rather than less effortful, spontaneous retrieval and execution (e.g., for TBPM tasks, and EBPM tasks that involve cues of low focality, salience and/or an ongoing task of high cognitive demand) the gap between ADHD and neurotypical performance widens (see Figure 2).

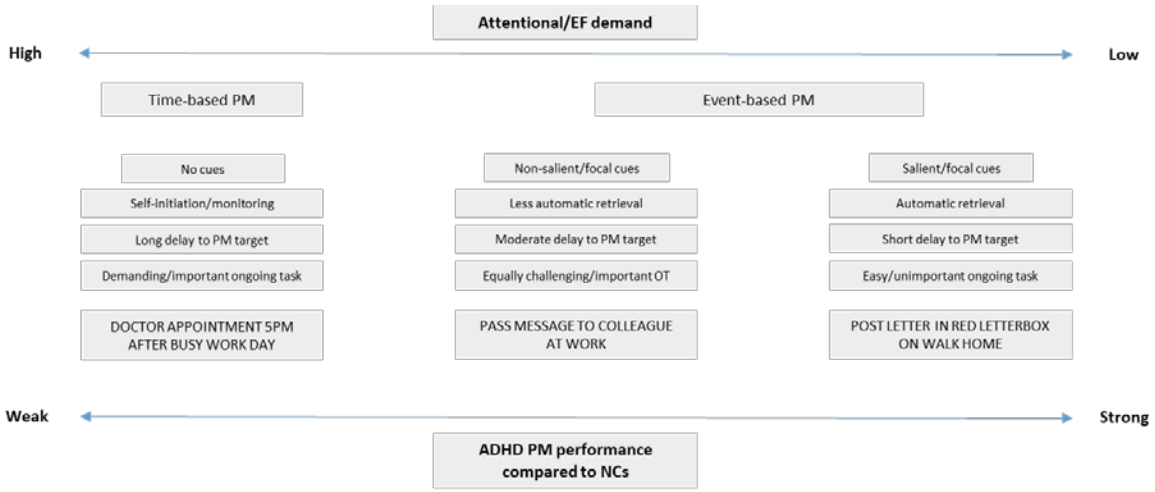


**Figure 2** – Pattern of PM performance of ADHD children, adolescents and adults within the context of the Einstein and McDaniel's (2005) Multiprocess Framework. Adapted from Sheppard (2018). Reprinted with permission.

## Clinical application

Given the ubiquity of PM tasks in everyday life, PM difficulties would pose serious barriers to navigating the demands of everyday life, ranging from the increasingly complex demands throughout childhood and school, to fundamental social and economic demands of throughout adulthood, thus posing a serious threat to independence and quality of life. It can be argued, therefore, that PM problems are likely to contribute significantly to the poor academic and social outcomes seen in children and adults with ADHD. As such, strategies to support PM may lead to improved outcomes, daily functioning and, ultimately, a better quality of life.

Given the pivotal role that EF plays in PM performance, targeting EF, both in terms of the EF characteristics of the PM task and the EF abilities of the individual, is likely to result in improved PM performance. With regard to the PM task characteristics, it seems clear that reducing the overall executive demand of PM tasks for children and adults to facilitate spontaneous retrieval, as per the MPF, would likely result in better PM performance. For instance, transforming TBPM tasks to EBPM tasks by setting reminders, thus "offloading" the high EF demand to external memory aids (Gilbert, 2015; Scarampi & Gilbert, 2020). Such aids have recently been classified as "analogue memory aids" and "electronic memory aids" and found to be beneficial to those with reduced cognitive function (for a review, see Jones et al., 2021), Reducing the executive demand of the tasks by, for example, increasing the PM cue salience should also particularly support PM in ADHD populations. Indeed, the benefits of increased cue salience for those with known EF difficulties has also been demonstrated (e.g., in autism, Sheppard & Altgassen, 2021).

Interventions focusing on episodic future thinking (EFT) may also be beneficial to PM in ADHD populations. Recent work was conducted to evaluate an EFT intervention to improve medication adherence of adults with Type 2 Diabetes (Epstein et al., 2022), whereby participants imagined and wrote down future scenarios of them taking their medication. They were required to remember to engage with these scenarios on a daily basis, a process further offloaded by storing them on their smartphones which reminded them of the task at regular intervals throughout the day. EFT interventions have also been effective in supporting children's PM (Kretschmer-Trendowicz et al., 2019), and other populations known for their reduced EF capacity, such older adults (Altgassen et al., 2015). EFT has also been effective in reducing impulsivity, a core difficulty of ADHD (APA, 2013) around eating and obesity (Daniel et al., 2013a, 2013b).

Given the role EF plays in PM, particularly for ADHD, interventions to target general

EF and attention would arguably support PM performance. Therefore, the evidence showing indicating the effectiveness of strategies to improve EF in children and adults with ADHD should be considered when supporting PM in the population, such as the robust findings for the benefit of physical exercise on EF in ADHD (for a review and meta-analysis, see Barudin-Carreiro et al., 2022; and Sun et al., 2022, respectively). Cognitive training has also been found to improve EF; for example, a recent study (Wiest et al., 2022) showed that cognitive training improved performance on lab-based tests of inhibition, attention and working memory in children and adolescents with ADHD (84% of whom had a co-occurring learning difficulty). Such results are promising, and may in turn lead to an improvement in PM. However, further research is needed to confirm whether these benefits to lab-based EF can be generalised to everyday EF. Indeed, whilst a recent meta-analysis of 15 randomised control trials studying the effects of cognitive training for individuals with ADHD found some positive effect of training on lab-based working memory performance, there was little or no effect on ADHD symptoms and academic performance, when assessed by blinded raters (Cortese et al., 2015).

The difficulties with PM for those with ADHD making sense of the known effectiveness of established behavioural strategies to support ADHD pupils in school, such as regularly reminding pupils of rules, supported by reminder cards, and positively reinforcing them throughout the day with public praise, visual class rules, tokens, daily report cards, checklists (DuPaul et al., 2014; DuPaul et al., 2011; Evans et al., 2018; Harrison et al., 2022). Indeed, many such strategies have recently been summarised within a training programme for children with ADHD called Organisational Skills Training (OST; DuPaul et al., 2022)

One potentially effective PM intervention, for children and adults, is one recently put forward to support autistic pupils in a recent review of PM in autism, illustrated by Figure 3 (Sheppard et al., 2018). Such a process incorporates several of the above strategies, and

would to support an ongoing reflection on PM performance and cycle of fine tuning strategies tailored to the individual.

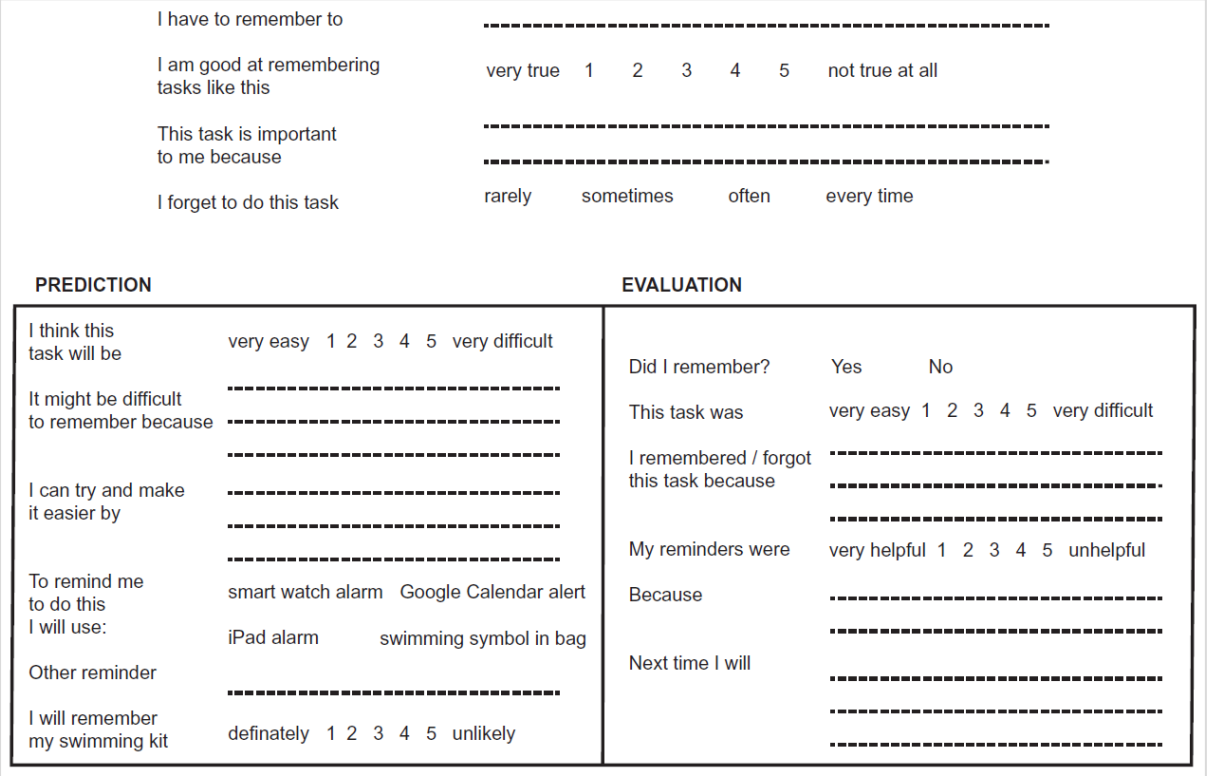


**Figure 3.** Example of worksheet to support PM tasks. Reprinted from Sheppard et al. (2018), with permission.

## Limitations and future directions

A number of limitations of the current review must be acknowledged. Firstly, whilst there has been further work conducted in recent years, the number of papers specifically investigating PM in ADHD remains relatively low. Furthermore, a variety of methodologies, predominantly lab-based, have been employed, and all studies have included relatively small sample sizes (although this is common within the PM literature, e.g., Mahy, 2022a), meaning caution must be taken when relating the results of the review to the general ADHD population. The field of PM in ADHD would benefit, therefore, from replication studies which included, where possible, larger sample sizes and naturalistic methods.

Additionally, whilst the current review is useful in comparing PM performance across

a range of ages, there are no studies investigating PM and ADHD in older adults, and none of a longitudinal nature. Therefore, the understanding of the way in which PM develops in ADHD from childhood through to adolescence and into adulthood would be improved by way of longitudinal work tracking the development of PM within groups over the lifespan.

A further issue with the current literature is the varying medication status, when disclosed, of the participants. Some studies did not disclose medication status at all (Levén & Hillertz, 2014; Mioni et al., 2017), whilst others varied in the amount of time they required participants, if medicated, to cease taking their medication before testing; others were medicated throughout testing (Yang et al., 2019). Given the beneficial effect that commonly prescribed ADHD medication, such as methylphenidate atomoxetine has on EF, compared to say, medication naive ADHD children and neurotypical children (Miklós et al., 2019; Molitor et al., 2019), the varying medication status of the participants across the studies must be considered a potential confound. However, for some of those medicated during testing, PM performance was not impaired (e.g., Yang et al., 2019). As this relationship between medication and PM is but one of many, a causal relationship cannot be concluded, but is in-line with the beneficial effects of the medication on EF and, therefore, PM. Explicit investigations of the impact of medication on PM performance could be a fruitful avenue for future research.

A further limitation of the current PM in ADHD literature, and, therefore, the current review and suggested clinical application, is the general heterogeneity within the ADHD population (Kofler et al., 2019; Luo et al., 2019; Nigg et al., 2020), which is in part reflected in the range of participants of the current review diagnosed with either ADHD-H, ADHD-I or ADHD-C, as well as the variable findings of, when measured using discrete tests, either impaired EF (e.g., inhibition, Fuermaier et al., 2013; switching, Yang et al., 2019) or intact EF (e.g., Mioni et al., 2017) of the ADHD participants compared to NCs. As has recently

been pointed out (Nigg et al., 2002; Nigg et al., 2020), there is broad variability in not only the comorbid mental health conditions and cognitive profiles of those diagnosed with ADHD, but also in the etiology of the condition, with the authors citing a wealth of evidence supporting both genetic and environmental factors. This is echoed by concerns in the field of the strong links between complex, childhood trauma and ADHD symptoms, with many concerned of the high risk of ADHD misdiagnosis (McDonald & Ejesi, 2020; Peleikis et al., 2021; Szymanski et al., 2011). These issues are perhaps reflected by the fact that, in one of the currently reviewed papers (Altgassen, Scheres, et al., 2019), 42% of ADHD participants reported a co-occurring mental health condition, including post-traumatic stress disorder, bipolar disorder recurring depression. Such heterogeneity demands carefully constructed and researched inclusion criteria of future ADHD and PM studies, and carefully designed intervention strategies based on the well-formulated needs of the individual.

## Conclusions

The current systematic review of PM in ADHD updated that of Talbot and colleagues (2018) and was the first to include studies of PM in adults with ADHD. Despite differing methodologies and relatively small sample sizes, and the limitations this places on the generalisability of the findings, the current review provides strong evidence that PM is difficult for children and adults diagnosed with ADHD. This seems particularly true when the PM tasks include cues are low in focality and/or salience, and/or when the OT is difficult, which, according to the MPF (McDaniel & Einstein, 2000), place a particularly high demand EF. These difficulties were in line with predictions based on the EF difficulties known to the population (Frick et al., 2022), and the EF theories of ADHD (Barkley, 1997; Barkley & Murphy, 2010). Given the ubiquitous nature of PM tasks in everyday life and their posited criticalness to independence and well-being, the likely difficulties with PM are likely to be an important underlying factor in the established poor academic, social and daily functional

outcomes of individuals with ADHD (Butzbach et al., 2021b; Franke et al., 2018; Merrill et al., 2019) and possibly also contribute, therefore, to the mental health difficulties found in large proportions of the population (Koyuncu et al., 2022). Thus, future work to replicate and improve the extant literature that better understands PM ability and its underlying cognitive mechanisms, taking into account the heterogeneity in the ADHD population/and how it varies according to individual differences, would facilitate targeted and effective intervention strategies in the pursuit of improving independence and overall quality of life for children and adults with ADHD.

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## Chapter 2: Empirical paper

# Teacher and Classroom Assistant autism knowledge, autism-specific self-efficacy and relations to classroom stress appraisal*

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## Abstract

**Objective**: The current study aimed to better understand the stress appraisal of teachers and classroom assistants, which has been related to teacher burnout. Specifically, the current study examined the role of teacher and classroom assistant (CA) self-efficacy, specific to autism (SE-ASC), in explaining the relationship between autism knowledge and stress appraisal of classroom incidents involving autistic pupils.

**Method**: An online questionnaire was distributed throughout the NHS Tayside region, which included items assessing respondents' classroom stress appraisal, autism knowledge, SE-ASC and perceived pupil autism severity. Two hundred and seven online questionnaires were completed, comprising of 131 teachers, and 71 CAs.

**Results**: Autism knowledge was not associated with any other construct, requiring unplanned, exploratory analysis. Results revealed SE-ASC to be a significant predictor of negative, but not positive, stress appraisal. These relationships were the same in the other direction; negative, but not positive, stress appraisal predicted SE-ASC. Pupil age, school-type (e.g., mainstream vs specialist school) and autism training also predicted SE-ASC. Finally, between-group analysis revealed teachers indicated significantly higher levels of positive stress appraisal than classroom assistants. However, both groups were parallel on scores of SE-ASC and autism knowledge.

**Conclusions:** These results indicate the importance of SE-ASC in the perceived stress of teachers and classroom assistants when supporting autistic pupils, and of the potential importance of factors such as school-type and training in contributing to higher levels of SE-ASC.



**Key words**: stress appraisal, teacher, classroom assistant, autism, teacher self-efficacy

## Introduction

Teachers are critical to student outcomes and are potentially more important than other factors related to student learning and well-being, such as teaching methods, whole-school programmes and student family environments (Hattie, 2008; Hattie, 2012). Teacher mental health appears to be an important factor, with teacher stress and burnout associated with lower quality instructional practices (Butler & Shibaz, 2015) and poorer student behaviour and academic achievement (Herman et al., 2018; Madigan & Kim, 2021; Wentzel, 2010). Teacher mental health is also significantly associated with student mental health (Harding et al., 2019), which is of great concern given the high levels of chronic stress, poor mental health and burnout well-established in the profession (Burke et al., 1996; Eaton et al., 1990; Scheuch et al., 2015). Also concerning is the fact that there exists a dearth of research investigating Classroom Assistant (CA) mental health and impact on student psychological and academic outcomes, despite the fact that they also have a significant impact on student academic outcomes (Clotfelter et al., 2016), as well as student mental health (Conboy, 2021). Of the few studies there are, there is some evidence to suggest significant levels of anxiety amongst CAs, related to, amongst other issues, job demand and control (Ravalier et al., 2021; Roach, 2003). It is important, therefore, to better understand the cognitive processes that may be related to teacher and CA stress and mental health, such as *stress appraisal* (Lazarus & Folkman, 1984, 1987; Lazarus & Smith, 1988), which is the focus of the current study.

Stress appraisal is a critical component of Lazarus and Folkman's transactional model of stress (Lazarus & Folkman, 1984, 1987) whereby individuals, in the face of stressors, evaluate the personal significance and relevance of the stressor in relation the individual's well-being (primary appraisal) and to the available resources the individual may have with which to cope with the situation (secondary appraisal). Encounters appraised as significant and within one's ability to cope, will likely be appraised as a benefit and result in positive

emotion (positive stress appraisal; PSA); conversely, encounters appraised to have personal significance but beyond one's ability to cope will likely be appraised as a threat (negative stress appraisal; NSA) resulting in negative emotions (e.g., Hulbert-Williams et al., 2013; Lazarus & Smith, 1988) and, consequently, longer term mental health conditions, such as depression (Obbarius et al., 2021). Teacher and CA appraisals of stressful classroom events, and resulting emotional responses, would therefore contribute to their sense of well-being and risk of burnout. Indeed, stress appraisal has recently been related to teacher burnout (Boujut et al., 2017; Cappe, Bolduc, et al., 2017), identifying stress appraisal as a target for better understanding and improving school staff mental health.

Critically, according to the transactional model of stress, the appraisal of stressors depends on prior knowledge (Lazarus & Smith, 1988), both general knowledge (EGs_ and context-specific knowledge. Thus, upon encountering an event, individuals draw on such knowledge to evaluate the demands of the situation and the possession, or not, of the necessary skills and abilities with which to cope. Thus, for teachers and CAs, their PSA/NSA of problematic classroom events (and therefore, their emotions and longer-term mental health) will depend on their general knowledge and understanding, and of the context within which the problem is situated. Thus, it may be that the level of teachers' and CAs' knowledge within classroom (e.g., of a pupil's complex needs and distress) would underpin their appraisal of the event and, therefore, their emotional response to it. Indirect support for such a notion can be found in several studies that have linked teacher knowledge to longer-term mental health outcomes: for example, better classroom management knowledge was related to less emotional exhaustion (Klusmann et al., 2012); whilst general teaching knowledge negatively predicted burnout (Lauermann & König, 2016). However, to the author's knowledge, research has yet to investigate direct associations between teacher and/or CA knowledge and stress appraisal.

Additionally, the importance of general and context-specific knowledge may be particularly relevant for situations known to be difficult and less common, such as those involved with supporting pupils with learning and developmental disabilities (Busby et al., 2012; Wisniewski & Gargiulo, 1997), especially given the increased awareness of and commitment to the inclusion of such pupils within mainstream classrooms (Gray et al., 2017; Roberts & Simpson, 2016). Indeed, recent work revealed high levels of anxiety in teachers and CAs in a UK school for young people with profound and multiple learning difficulties (Black & Halstead, 2021). One particular group known to present with atypical and complex needs are those on the autism spectrum (APA, 2013).

Autism spectrum conditions (ASC) are characterised by social communication difficulties and repetitive behaviours, restricted interests and/or sensory sensitivities (APA, 2013). Prevalence of ASC is estimated to be approximately 1% of the population worldwide (Zeidan et al., 2022), and approximately 1.57% of children in the UK schools (Baron-Cohen et al., 2009). Given the known heterogeneity and complexity of the condition (APA, 2013), the frequency and complexity of incidents within the classroom would likely parallel the relatively high prevalence of the condition, resulting in increasingly frequent and complex classroom situations that need to be managed by teachers and CAs. Indeed, pupils on the autism spectrum have been reported to present particular difficulties within class (Ruble et al., 2013; Saggers et al., 2016). Thus, in light of the higher risk of difficult and complex events to be appraised by teachers and CAs, the level of knowledge from which to draw on to enable positive appraisal and emotions must be high. A recent review concluded that, in general, teacher knowledge of autism (henceforth, ASC-Know) was poor (Gómez-Marí et al., 2021), but that certain factors were related to better ASC-Know, such as greater teacher experience, more training and school-type (e.g., better specialist teacher knowledge compared to mainstream secondary school teachers). The authors were keen to point out, however, that

the reviewed papers were conducted in several different countries and cultural differences were evident (e.g., higher levels of ASC-Know reported in the US; lower levels reported in Saudi Arabia).

However, whilst demonstrating links between teacher and CA ASC-Know and their PSA and/or NSA would elucidate the mechanisms contributing to school staff mental health, shedding light on the interaction between ASC-Know and stress appraisal would facilitate more targeted intervention and school staff support. Crucially, according to the transactional model of stress (Lazarus & Smith, 1988), it is not simply the possession of the knowledge and understanding of the situation, but also the *evaluation* of the adequacy of an individual's own understanding, experience and ability to apply that knowledge and cope with the situation that is important, a concept strongly related to that of self-efficacy (SE; Bandura, 1997).

Bandura (1997) defined SE as the beliefs and understanding regarding one's capacity to effectively navigate a given situation, resembling closely the secondary appraisal process of the transactional model of stress (Lazarus & Folkman, 1984). When applied to the teaching profession, SE has been described as "teachers' belief or conviction that they can influence how well students learn, even those who may be difficult or unmotivated" (Guskey & Passaro, 1994, p. 628). Within this model, the most influential source of self-efficacy is posited to be enactive mastery experience (Bandura, 1997), especially for teachers (Usher & Pajares, 2008), which refers to the experience and knowledge gained through past achievements. Other sources of SE include vicarious experience (observation of others), physiological and affective states (including stress and fatigue) and social persuasion (e.g., feedback from peers. A recent review of teacher SE (Morris et al., 2017) concluded that teacher knowledge, and their own appraisal of that knowledge, is a primary source of efficacy beliefs, partially supported by the benefit of training to teacher and CA SE (Makopoulou et

al., 2021).

Teacher SE has been the focus of a wealth of research in recent years, and has been found to be important for a range of factors important to the profession, such as: instructional quality (e.g., classroom management, supportive environment) and the selection and use of positive behavioural strategies and classroom management techniques (Reinke et al., 2013; Zee & Koomen, 2016); the development of teacher-student relationships (Hajovsky et al., 2020) and student motivation (Burić & Kim, 2020); and aspects of well-being, such as job satisfaction for both teachers (Kasalak & Dagyar, 2020) and CAs (Chan et al., 2020). Importantly, and pertinent to the current paper, SE has also been linked to teacher burnout and stress (Boujut et al., 2017; Cappe, Bolduc, et al., 2017; Daniilidou et al., 2020; Kim & Burić, 2020), and to teachers' attitudes towards the inclusion of young people with additional needs (Yada et al., 2022).

With regard to encounters of stressful classroom situations involving the complex needs of their autistic students, SE will draw on their ASC-Know; their level of SE, their belief in their ASC-Know and their capability to use it to meet the needs of the pupil and cope with the situation, will then inform their appraisal of the situation. Given these assumptions, Teacher and CA SE, in relation to supporting their autistic pupils (henceforth, SE-ASC) will, likely play a pivotal role/at least partially, mediate/explain the hypothesised relationship between teacher and CA ASC-Know and their appraisal of stressful classroom events involving autistic pupils.

Very little research has been published to date investigating teacher SE in relation to supporting autistic pupils, and none investigating CA SE-ASC. However, in support of the link between ASC-Know and teacher SE-ASC, recent work by Lu and colleagues (2020) has demonstrated a strong positive association between ASC-Know and general SE (although, a notable limitation of this study involved the use of an SE instrument adapted from one used

to measure teacher attitudes; Lian et al., 2008). Furthermore, in-line with the notion that teacher SE-ASC influences PSA/NSA, recent work has found a positive relationship between teacher SE-ASC and NSA (Boujut et al., 2017) and emotional exhaustion, with some differences between educational settings, i.e., mainstream schools vs specialist schools (Cappe, Bolduc, et al., 2017). Moreover, a recent study has found evidence for general teaching pedagogical knowledge and burnout, mediated by SE (Lauermann & König, 2016). Taken together, these studies provide evidence for the hypothesis that SE-ASC mediates the relationship between ASC-Know and stress appraisal. To date, no such work has been published regarding CAs and their SE-ASC, stress appraisal and ASC-Know.

The current study will, for the first time, include CAs with teachers to investigate the relationship between ASC-Know and appraisals of stressful classroom events involving autistic pupils. Given the evidence suggesting associations between SE and both knowledge and stress appraisal, measures of teacher and CA SE will also be included and investigated for its potential mediating role between ASC-Know and stress appraisal. In light of evidence citing significant limitations in the teacher SE literature regarding the use of general and heterogenous SE measures, a further novel aspect of the study is the use of a recently developed, autism-specific SE-ASC measure (Love et al., 2019), which will be employed for both teachers and CAs. Given the potential impact of training, autism severity, experience and school-type, these factors will be investigated for potential moderating effects. The hypotheses for the current are as follows:

1. Autism knowledge will predict the way in which stressful events are perceived by teachers/CAs. That is, greater knowledge will predict stress perceived as positive (e.g., a challenge); lesser knowledge will predict stress perceived as negative (e.g., threatening).
2. This relationship is hypothesised to be mediated by SE-ASC
3. Greater knowledge of autism has been related to greater SE-ASC (Lu et al., 2020);

therefore, given that teachers and staff who work in specialist schools are likely to have received a greater level of training than CAs and staff in mainstream schools, it is further hypothesised that the predicted relationships will be moderated by job role (Teacher x CA) and by school setting (e.g., mainstream school x specialist school), autism training, autism severity and years of experience.

## Method

### Sampling and Data Collection

Data were collected using a Qualtrics XM online survey (Qualtrics Survey Software) that enabled quick and efficient distribution of the online questionnaire (see Appendix A for a copy of the questionnaire). A non-probability, voluntary sampling method was employed for the current study, whereby all teachers and classroom assistants within the Tayside area were invited, by email, to take part in the online survey. To be included, participants were required to be 18-years-old or older, and must have supported an autistic pupil, aged 4- to 19-years-old, in class since the beginning of the current academic year.

The questionnaire was distributed to teachers and classroom assistants by way of an email containing an anonymous link. This email was initially distributed by the Additional Support Needs (ASN) managers of the three Tayside local authorities (Perth and Kinross, Dundee City and Angus) to Headteachers and/or Principal Teachers of all primary, secondary and specialist schools within their areas, who, in turn, forwarded it to teachers and classroom assistants. A total of 454 people participated in the online survey. However, 247 questionnaires (54.4%) contained no description of a stressful event and/or response to the subsequent measure regarding appraisal of that event, and were therefore excluded, leaving a final total of 207 (45.6%) completed questionnaires. All 207 cases of the final sample included 100% of data.

Ethical approval for the study was granted by the Ethics Review Committee at the

School of Health in Social Science at the University of Edinburgh, which was sufficient for Dundee City local authority approval. Further ethical approval was also granted by the ethics review boards of both Perth and Kinross and Angus local authorities.

**Questionnaire structure**

The questionnaire was structured into three blocks. The first block contained the information sheet and consent form. Once participants had navigated through the study information page and had provided informed consent, they progressed onto the second block, whereby they completed demographic information (see Table 1).

Participants then progressed onto the second block where they were asked to describe the most stressful event involving an autistic pupil whom they had been supporting in class within the current academic year. They also were required to indicate the age of the pupil, and the approximate number of other pupils in the class at the time.

Participants then progressed onto the third block where they completed four different instruments to measure participants' perceptions and understanding in the following ways: their appraisal of stress experienced during the described stressful event; their perceived self-efficacy in supporting the autistic pupil described in the event; the autism trait severity for of the autistic pupil described in the event; and their level of autism knowledge and understanding. To retain the integrity of the validated instruments, individual items within the questionnaires were presented in the order in which they had been originally validated. The instruments of primary concern (those measuring stress appraisal and self-efficacy) were presented first for all participants, to reduce the risk of fatigue effects confounding results. However, the presentation order of these two instruments was randomised. Participants then indicated their perception of the autism severity their chosen pupil, and finally indicated their level of autism knowledge and understanding.

**Table 1.** Participant characteristics

| | Assist (N=71) | Teacher (N=136) | Total (N=207) |
|---|---|---|---|
| | N (%) | N (%) | N (%) |
| **Age** | | | |
| 18-24 | 2 (2.8) | 2 (1.5) | 4 (1.9) |
| 25-29 | 3 (4.2) | 12 (8.8) | 15 (7.2) |
| 30-34 | 4 (5.6) | 10 (7.4) | 14 (6.8) |
| 35-39 | 7 (9.9) | 18 (13.2) | 25 (12.1) |
| 40-44 | 8 (11.3) | 27 (19.9) | 35 (16.9) |
| 45-49 | 15 (21.1) | 28 (20.6) | 43 (20.8) |
| 50-54 | 15 (21.1) | 18 (13.2) | 33 (15.9) |
| 55+ | 17 (23.9) | 21 (15.4) | 38 (18.40) |
| **Gender** | | | |
| Female | 69 (97.2) | 123 (90.4) | 192 (92.8) |
| Male | 2 (2.8) | 12 (8.8) | 14 (6.8) |
| Other (please specify) | 0 (0) | 1 (0.7) | 1 (0.5) |
| **Job Role experience** | | | |
| Less than 1 year | 4 (5.6) | 3 (2.2) | 7 (3.4) |
| 1-2 years | 6 (8.5) | 3 (2.2) | 9 (4.3) |
| 2-3 years | 9 (12.7) | 11 (8.1) | 20 (9.7) |
| 3-4 years | 9 (12.7) | 5 (3.7) | 14 (6.8) |
| 5-6 years | 4 (5.6) | 7 (5.1) | 11 (5.3) |
| 6-7 years | 2 (2.8) | 2 (1.5) | 4 (1.9) |
| 7-8 years | 3 (4.2) | 1 (0.7) | 4 (1.9) |
| 9-10 years | 1 (1.4) | 6 (4.4) | 7 (3.4) |
| More than 10 years | 33 (46.5) | 98 (72.1) | 131 (63.3) |
| **School Type** | | | |
| Mainstream Primary | 24 (33.8) | 71 (52.2) | 95 (45.9) |
| Mainstream Secondary | 23 (32.4) | 23 (16.9) | 46 (22.2) |
| Enhanced provision Primary | 15 (21.1) | 30 (22.1) | 45 (21.7) |
| Enhanced provision Secondary | 5 (7.0) | 9 (6.6) | 14 (6.8) |
| Specialist school | 4 (5.6) | 3 (2.2) | 7 (3.4) |
| **Autism Training** | | | |
| Yes | 45 (63.4) | 66 (48.5) | 111 (53.6) |
| No | 26 (36.6) | 70 (51.5) | 96 (46.4) |

## Measures

### *Stress appraisal*

Stress appraisal was measured using the Appraisal of Life Events Scale (ALES; Ferguson et al., 1999), an instrument theoretically derived from Lazarus and Smith's cognitive-phenomenological model of stress (1988) and designed to discern whether stressful situations are perceived as a challenge, a loss and a threat. The ALES has been employed in several recent studies investigating the way in which the appraisal of stressful situations with students was related to teachers' general SE (e.g., Boujut et al., 2017; Cappe, Bolduc, et al., 2017; Cappe, Poirier, et al., 2017). Participants were first asked to describe a stressful classroom situation involving an autistic student that had occurred since the beginning of the 2021/2022 school year. They were then asked to score 16 adjectives on the extent to which they described the situation, on a 6-point Likert-type scale (0 = not at all; to 5 = very much so). Following the procedure of Boujut and colleagues (2017), two sub-scale scores were then calculated: negative stress appraisal (NSA; 10-items, as a threat or a loss, e.g., "threatening", "intolerable"); and positive stress appraisal (PSA; 6-items, as a challenge: "stimulating", "challenging"). Cronbach's alpha reliability was high for both NSA and PSA sub-scales in the original study ($\alpha$ = 0.89 and 0.88, respectively). In the current study, NSA reliability was high ($\alpha$ = 0.90) and low for PSA ($\alpha$ = 0.53). The low Cronbach's alpha score for PSA prompted further analyses, which revealed the item "challenging" as poorly correlated with the other 5-items (0.055) and that, when removed, Cronbach's alpha increased to $\alpha$ = 0.60. However, removal of the item did not affect significance of subsequent analyses and so was not removed.

### *Self-efficacy*

SE-ASC was measured using the recently developed Teacher Self-Efficacy for Students with Autism Scale (TSEAS; Love et al., 2019). The TSEAS is a 12-item scale

designed specifically to measure self-efficacy in relation to supporting autistic students, and has been shown to discriminate from instruments measuring general teaching self-efficacy (Love et al., 2019). Participants were asked to consider the same autistic student they described for the ALES. This was to ensure consistency between the two measures, whilst also helping to control for a potentially biased selection of autistic students; for example, a social desirability bias that may have influenced participants to select an autistic student they feel most confident about, a limitation recognised by the authors of the measure (Love et al., 2019). Items were scored using a 4-point Likert-type response (1 = *not certain at all* to 4 = *very certain).* Thus, the maximum score was 48, which would indicate the highest possible level of SE-ASC. The original internal reliability of the TSEAS was reported by the developers using the coefficient omega (ω; McDonald, 1999), as strong, ω = .91 (Love et al., 2019). Internal reliability for TSEAS in the current study, measured using Cronbach's alpha, was also strong, $\alpha = 0.89$.

The TSEAS was developed and validated for use with class teachers. Therefore, in consultation with the lead developer of the TSEAS (Love et al., 2019), a form of cognitive interviewing (Willis & Boeije, 2013) was conducted with two CAs, known to the first author, at the study design stage. This was to ensure each item of the TSEAS was relevant to the experience of CAs, and that the language was comprehensible and unambiguous. Interviews were held during COVID 19 lockdown, and so were conducted via telephone. CAs were asked what they understood by each item statement, and whether the language made sense. Both CAs confirmed clear understanding and relevance of each item. Therefore, items were not changed prior to survey launch.

*Autism knowledge and understanding*

Autism knowledge was measured using the Autism Stigma and Knowledge Questionnaire (ASK-Q; Harrison et al., 2017) which has been employed many times since

it's development, including to measure trainee teachers' knowledge of autism (Vincent & Ralston, 2020) and, pertinent to the current study, to relate autism knowledge to teacher self-efficacy when supporting autistic pupils (Lu et al., 2020). Participants indicate their agreement (Yes or No) to 49 statements about autism, each of which pertain to one of four subscales, namely: knowledge of diagnosis/symptoms; etiology; treatment; and stigma. The internal reliability of the ASK-Q was reported by the developers, using Cronbach's Alpha, as high, $\alpha = .88$ (Harrison et al., 2017). Cronbach's alpha for the current study was moderate, $\alpha = 0.60$.

*Autism severity*

The severity of autism traits of the autistic pupils described in the stressful event was measured using the short (10-item) child version of the Autism Spectrum Quotient (AQ-C: for children aged 4-11-years-old; Auyeung et al., 2008) or adolescent version (AQ-A: for children aged 12-15-years-old; Baron-Cohen et al., 2006). The AQ-10 was designed as a short, parent-report screening instrument, to indicate whether further assessment was warranted. However, it has previously been shown to correlate strongly with more extensive "gold standard" measures of autism severity, such as the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) and the Social Responsiveness Scale (Constantino & Gruber, 2005) and is regularly used in research as a measure of autism severity (e.g., Ohtani et al., 2021; Yon-Hernández et al., 2022).

For the purposes of screening, only one point is awarded per question, for either Definitely Agree/Slightly Agree, or Slightly Disagree/Definitely Disagree, with a score of six (out of ten) or over as indicative of requiring further specialist diagnostic assessment. However, for the current study, employing a binary scoring method may have resulted in low score variability and so, after consultation with the instrument's developers, the scoring method for the long child's version (Auyeung et al., 2008) was employed instead.

Specifically, the same likert-scale of Agree, Slightly Agree, Slightly Disagree and Definitely Disagree was employed, but, rather than a binary 1 or 0 score, each part of the scale was scored as 1 through to 4 (and reversed where necessary).

**Planned data analysis**

*Mediation and moderation - preliminary analysis*

Mediation and moderation analyses (Baron & Kenny, 1986; Preacher & Hayes, 2004, 2008) were planned to test the hypothesis of a mediating effect of SE-ASC, and the moderating effects of Job Role, Job Experience, School Type and Autism Severity, on the predicted relationship between ASC-Know (independent variable) and PSA and NSA (dependent variables).

Visual inspection of histograms of dependent variables indicated normal distribution of NSA and PSA. This was confirmed by skewness and kurtosis indices, with skewness and kurtosis of NSA and PSA between -2 and +2, and -7 and +7 respectively. All data analyses were conducted using SPSS (version 25: IBM Corp., 2017).

To determine sufficient sample power (d = 0.80) analysis described by Fritz and MacKinnon (2007) was referred to detect a medium effect size in a simple mediation model. Their power analysis suggested a minimum sample size of 75 would be required, well within the current study sample size.

*Correlation*

Correlation analysis (Pearson's *r*) was employed to examine the relationships between the predictor variable ASC-Know and dependent variables PSA and NSA, and mediator variable of SE-ASC, thus providing a basis for regression and mediation analysis, and to check for multicollinearity (Table 2).

**Table 2.** Correlation matrix of continuous dependent, predictor variables

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 SE-ASC total score | 1 | | | | |
| 2 PSA | -.168* | 1 | | | |
| 3 NSA | -.203** | .311** | 1 | | |
| 4 ASC-Know | -.011 | -.057 | .043 | 1 | |

*Correlation is significant at the .05 level (2-tailed), **Correlation is significant at the .01 level (2-tailed)

ASC-Know scores were not related to PSA, NSA or SE-ASC. However, the predicted negative relationship between SE-ASC and PSA and NSA was confirmed. A positive relationship was also found between PSA and NSA; specifically, that high levels of positive stress appraisal was related to high levels of negative stress appraisal.

*Regression*

Regression analyses were conducted to confirm the (lack of) relationship between the predictor and dependent variables, and the existence of a relationship between the mediator and dependent variables. The analyses revealed ASC-Know did not predict PSA/NSA, nor did ASC-Know predict SE-ASC (all *p*s > 0.4). A critical assumption of mediation was therefore violated, thus rendering mediation analysis no longer appropriate/viable.

To confirm the relationship between SE-ASC and stress appraisal, separate simple linear regressions were conducted for PSA and NSA, with SE-ASC as the predictor (see Table 3). SE-ASC was found to negatively predict both variables of stress appraisal: higher scores of SE-ASC were related to lower scores of both positive and negative stress appraisal.

**Table 3**. SE-ASC regressed onto stress appraisal

| | PSA | | | | | | | NSA | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B | SE | Beta | t | p | 95% CI Coefficient | | B | SE | Beta | t | p | 95% CI Coefficient | |
| SE-ASC | -.10 | .04 | -.17 | -2.45 | .02 | -.18 | -.02 | -.39 | .13 | -.20 | -2.97 | .003 | -.65 | -.13 |

Adjusted $R^2$: PSA = .028; NSA = .037

**Unplanned, exploratory data analysis**

Given the initial mediation analysis plan was no longer viable, it was necessary to refer to the research questions of the study, and consider how they could be tested with alternative analyses. Three further exploratory analyses were therefore planned and conducted.

*1) Predictors of PSA and of NSA*

A primary goal of the current study was to investigate the predictors and moderators of PSA and NSA. The potential predictors of PSA and NSA was the continuous variable SE-ASC and ASK-Q. The potential moderators, included the continuous variables Pupil Age and Autism Severity, Job Role (Teacher, Classroom Assistant), Job Experience (Year ranges), School Type (Mainstream Primary; Mainstream Secondary; Enhanced Provision Primary; Enhanced Provision Secondary; Specialist), and Autism Training (Yes, No). As the potential predictors and moderators of PSA and NSA of the current study included both continuous and categorical variables, an analysis of covariance (ANCOVA) was conducted. However, as previous regression analyses had shown ASK-Q was not related to the predictors nor to SE-ASC, it was not included in the ANCOVA.

Post-hoc power calculations were conducted using G* Power 3.1 (Faul et al., 2007) calculate the power achieved to detect a medium effect size for ANCOVA (f = 0.25) given a sample size of 207 and seven predictors. Power with no interactions. When run to include

interactions between predictors, achieved power was 1-β = 0.37; when interactions were excluded, achieved power was 1-β = 0.57. Therefore, sample size precluded examination of interactions as this would result in very low levels of power, thereby increasing the risk of a Type II error.

*2) Predictors of SE-ASC*

The current exploratory analysis presented the opportunity to better understand potential underlying factors of SE-ASC, which may be useful for schools and could inform staff support improvements and strategies. The potential predictors of SE-ASC were the continuous variables PSA, NSA and ASK-Q. The potential moderators, given their previously found relationship with SE-ASC, included the continuous variables Pupil Age and Autism Severity, Job Role (Teacher, Classroom Assistant), Job Experience (Year ranges), School Type (Mainstream Primary; Mainstream Secondary; Enhanced Provision Primary; Enhanced Provision Secondary; Specialist), and Autism Training (Yes, No). Again, as the analysis included both continuous and categorical variables, an analysis of covariance (ANCOVA) was conducted. As previous regression analyses had shown neither ASK-Q nor AQ was related to the predictors nor to SE, these variables were not included in the ANCOVA.

As noted above, post-hoc ANCOVA power calculations using G* Power 3.1 (Faul et al., 2007) to calculate the power achieved to detect a medium effect size for ANCOVA (f = 0.25) given a sample size of 207 revealed, without interactions, achieved power of 1-β = 0.57. Again, power including interactions was 1-β = 0.37, thereby precluding examination of interactions.

*3) Teacher/classroom assistant comparisons*

A key and novel goal of the current study was to include classroom assistants in order to measure their SE and investigate potential differences to that of teachers. Given this aim, a

comparison of the teacher and classroom assistants' responses to the key measures (SE-ASC, NSA, PSA and ASK-Q) was warranted. Thus, independent t-tests were conducted to compare responses of teachers and classroom assistants.

Post-hoc power calculations were conducted using G* Power 3.1 (Faul et al., 2007) to calculate the power achieved to detect a medium effect size (d = 0.50). Given the achieved sample size for the two groups, Teachers (n=136) and Classroom Assistants (n=71) sample size, this analysis suggested there was sufficient power (1-β = 0.93).

## Results

*1) Predictors of PSA and of NSA*

Two 5 (School type) x 2 (Job role) x 9 (Job role experience) x 2 (Autism training) 4-way ANCOVAs, with the continuous variables SE-ASC, Pupil Age and Autism Severity included as predictors, were conducted (Table 4). As Table 4 shows, after including additional variables, no variables significantly predicted PSA. However, even after including controlling for additional variables, SE-ASC remained a significant negative predictor of NSA with medium effect. No other relationships were significant (all *p*s > 0.4).

**Table 4.** Predictors of PSA/NSA

| | | *PSA* | | | *NSA* | | |
|---|---|---|---|---|---|---|---|
| | df | *F* | *p* | $\eta^2_p$ | *F* | *p* | $\eta^2_p$ |
| SE-ASC | 1 | 3.365 | .068 | .017 | 7.907 | .005 | .040 |
| Pupil Age | 1 | .355 | .552 | .002 | .666 | .415 | .004 |
| Autism severity | 1 | 1.344 | .248 | .007 | .025 | .874 | .000 |
| School type | 4 | 1.328 | .261 | .027 | 1.011 | .403 | .021 |
| Job role | 1 | 3.782 | .053 | .020 | .114 | .736 | .001 |
| Job experience | 8 | 1.483 | .166 | .059 | .944 | .481 | .038 |
| Autism training | 1 | .649 | .422 | .003 | .036 | .850 | .000 |
| Error | 189 | | | | | | |

*2) Predictors of SE-ASC*

Further analyses were conducted to explore the extent to which measured variables predicted SE-ASC. A 5 (School type) x 2 (Job role) x 9 (job role experience) x 2 (Autism training) 4-way ANCOVA, with the continuous variables PSA, NSA, Pupil Age and Autism Severity included as predictors, was conducted to explore the level to which variables predicted SE-ASC (Table 5).

**Table 5**. Predictors of SE-ASC

| | df | *F* | *p* | $\eta^2_p$ |
|---|---|---|---|---|
| PSA | 1 | 1.162 | .282 | .006 |
| NSA | 1 | 5.628 | .019 | .029 |
| Pupil Age | 1 | 4.422 | .037 | .023 |
| Autism Severity | 1 | 1.111 | .293 | .006 |
| School type | 4 | 5.917 | .000 | .112 |
| Job role | 1 | .227 | .634 | .001 |
| Job experience | 8 | .470 | .877 | .020 |
| Autism training | 1 | 5.808 | .017 | .030 |
| Error | 188 | | | |

$R^2$= 0.220 (Adjusted $R^2$ = 0.145)

As shown in Table 5, all variables accounted for 14.5% of the variance in SE-ASC scores. Furthermore, NSA was a significant negative predictor of staff self-efficacy in supporting autistic pupils, albeit with small effect; PSA was not ($p$ >.05). Pupil age was also a significant predictor of SE-ASC. Separate regression analysis revealed the relationship was in a positive direction; that is, greater pupil age was related to greater SE-ASC scores.

Table 5 also shows that, after adjusting for continuous predictors, School Type and Autism Training, but not Job Role or Job Experience, significantly predicted SE-ASC. Post

hoc pairwise comparisons of School type revealed that Enhanced Provision Primary schools had significantly higher SE-ASC (*M* = 39.37, SE = 1.80) than Mainstream Primary (*M* = 35.28, *SE* = 0.84,*p* < .001) and Mainstream Secondary (*M* = 35.40, *SE* = 1.07,*p* = .002) schools, but did not differ to Enhanced Provision Secondary *(M = 38.01,SE = 1.80)* or Specialist *(M = 40.12, SE* = 2.43) schools (*p*s >.4). The estimated mean SE-ASC score of Specialist schools was also significantly higher than that of Mainstream Primary (*p* = .047), but not different to any other school (all *p*s > .05). No other significant difference between schools were found (all *p*s >.05).

Post hoc pairwise comparisons of Autism Training revealed that the mean difference of 2.17 in SE-ASC scores between those who had received autism training within the previous two years (M = 38.79, SE = 1.00) and those who had not (M = 36.63, SE = 1.01) was significant (p= 0.017; partial ETA = .030); that is, those who had received autism training within the last 2 years scored significantly higher SE-ASC scores than those who had not.

*3) Teacher/classroom assistant comparisons*

Independent t-tests were conducted to compare responses of teachers and classroom assistants. As shown in Table 6, Teachers and Classroom Assistants differed significantly on only PSA scores. A significant mean difference of 1.10 (small effect size) indicated that Teachers appraised the stress of the stressful situation in the classroom more positively than Classroom Assistants.

**Table 6**. Comparison of Teacher and CA responses

| | Classroom Assistants n = 71 Mean (SD) | Teachers n = 136 Mean (SD) | *t* | *P* | *d* |
|---|---|---|---|---|---|
| Positive stress | 12.17 (3.50) | 13.26 (3.81) | -2.02* | 0.045 | 0.30 |
| Negative stress | 28.59 (12.79) | 29.31 (12.17) | -0.40 | 0.693 | 0.06 |
| SE-ASC | 37.62 (6.20) | 37.27 (6.53) | 0.37 | 0.712 | 0.05 |
| ASC-Know | 43.00 (2.10) | 42.35 (2.87) | 1.87 | 0.063[a] | 0.26 |

*$p < .05$; [a] Levene's Test significant; equal variances therefore not assumed

## Discussion

The current study set out to investigate the potential cognitive mechanisms underlying teacher and CA stress appraisals of classroom events involving a self-selected autistic pupil. ASC-Know was expected to positively predict PSA, and negatively predict NSA. This relationship was also hypothesised to be mediated by teacher and CA SE-ASC in relation to the same chosen autistic pupil, using a recently developed autism-specific teacher measure of SE, the TSEAS (Love et al., 2019); specifically, that high SE-ASC of the pupil would be positively predicted by ASC-Know, and high SE-ASC of the pupil would positively predict PSA, and negatively predict NSA, regarding the event involving the pupil. Additionally, in light of previous evidence, these hypothesised relationships were expected to be moderated by the variables Job Role and Job Role Experience, School-Type and Autism Severity (of selected pupil). However, initial analysis showed that autism knowledge (independent variable) was related to neither stress appraisal nor self-efficacy, rendering planned mediation and moderation analyses no longer viable. Instead, unplanned, exploratory analyses were conducted, investigating the predictors of stress appraisal and of SE-ASC and between-group comparisons were also made between teachers and CAs to elucidate differences in knowledge, SE-ASC and PSA/NSA and add to the paucity of research on CAs.

The result that ASC-Know was not associated to any other measure was surprising and in contrast to expectations derived from previous findings that poorer teacher knowledge contributed to a higher risk of burnout (Lauermann & König, 2016), and that ASC-Know measured by way of the ASK-Q (Harrison et al., 2017) of staff based in China improved general SE (Lu et al., 2020). However, scores were at ceiling for all staff. Evidently, autism knowledge of the school staff based in the UK, as measured by the ASK-Q, was consistently high, yielding very little variation. This contrast to the Chinese study by Lu and colleagues (2020) perhaps reflects cultural variation in ASC-Know and understanding, as suggested by a recent review by (Gómez-Marí et al., 2021). Notably, the ASK-Q measures the level of ASC-Know based on typical characteristics, diagnostic criteria and stigma surrounding ASC. Thus, for cultures with high levels of ASC-Know, instruments that measure teachers' and CA's knowledge of evidence-based practices (EBPs) in autism may be more appropriate and sensitive, and would perhaps relate more directly to their stress appraisal and SE involving autistic pupils. Such a measure was recently developed and employed by Barry and colleagues (2021) who adapted a measure of EBPs for teachers, first developed for parents (Paynter & Keen, 2015), which measured teachers' knowledge and use of EBPs such as the use visual supports, social stories and modelling. The use of such a measure for future research, based on the current study paradigm, would possibly yield greater variation in knowledge and use of EBPs, within and between job roles, whilst extending the investigation of the hypothesised links between such knowledge, stress appraisal and SE. Such work is critical, as discrepancies between knowledge and SE may have adverse effects on students. For example, some individuals may have high SE-ASC but poor knowledge and understanding of autism and how to support those on the spectrum. In this case, high confidence but low knowledge could result in an overconfidence, and misinterpretations of need and poor application of strategy.

The results of the current study were, however, in line with expectations in that SE-ASC was negatively associated with NSA, even after including several other variables in the analyses, providing robust evidence that high levels of SE-ASC do lead to staff appraising stressful classroom situations involving their autistic pupils less negatively. Such findings are in line with previous findings linking SE-ASC and stress-appraisal (Boujut et al., 2017; Cappe, Bolduc, et al., 2017), and point to SE-ASC as important to staff stress appraisal and, therefore, a target for intervention. That is, improvement of staff SE-ASC and could reduce the risk of staff appraising incidents involving autistic pupils as threatening, which will in turn reduce the risk of poor staff mental health and burnout. No association was found between SE-ASC and PSA, and no other predictors of either PSA or NSA were found. Whilst the finding that SE-ASC was not related to PSA was surprising, it is possible that results were confounded by the language of the ALES (Ferguson et al., 1999) instrument. Specifically, staff may have been unlikely to consider a situation as "stimulating" or "exciting", regardless of their appraisal, if/when it involves the distress of their pupil. Additionally, the adjective "challenging" was not correlated with other PSA items, potentially due to the historic use of the term "challenging behaviour" to describe problem behaviours (for a discussion on the use of this term and suggested alternatives, see Chan et al., 2012). Furthermore, the ALES requires participants to think of a "stressful classroom event": arguably, the word "stressful" is emotionally charged and associated with negative experiences, especially within the teaching profession, such as disruptive student behaviour (Jakupi et al., 2014) and teacher performance reviews (Collins, 2004; Larsen, 2009). It may be therefore, that teachers and CAs were primed to consider events they had experienced as negative, consequently skewing results. In sum, the language of the ALES, used within a school context, may have confounded results. The field may benefit, therefore, from a new measure of stress appraisal, specific to classroom incidents and developed in collaboration with school staff to ensure the

language is clear, unambiguous, emotionally neutral and appropriate to the classroom context.

Further unplanned analyses provided the opportunity to explore SE-ASC and the factors that may influence it. PSA was unrelated to SE-ASC, possibly reflecting the discussed issues around language of the PSA items. However, NSA negatively predicted SE-ASC, implying the relationship between the constructs was bidirectional, which is line with recent work investigating the direction of the relationship between general teacher SE and burnout (Kim & Burić, 2020). Such evidence suggests that, rather than attempting to draw a linear, temporal relationship between the two constructs, it may be more useful to view the interactions as non-linear and bi-causal meaning that, improving SE-ASC will likely positively influence future stress appraisal, which will in turn improve confidence and future SE-ASC, a process that will cycle in perpetuity.

The other factors that predicted SE-ASC, included pupil age (greater age was related to higher SE-ASC scores), the type of school (in general, teachers and CAs working in specialist schools or those with enhanced provision gave higher SE-ASC scores than mainstream schools) and autism training (staff who had received training within the last two years gave significantly higher SE-ASC score than those who had not). The positive association Pupil age with SE-ASC was included on an exploratory basis, however, there is some evidence to suggest that autism symptoms can reduce with age (Bal et al., 2019; Elias & Lord, 2021) although this was not reflected in positive association of autism severity in the current study. The finding that those working in more specialist/enhanced provision schools gave higher SE-ASC is in line with previous work showing higher levels of burnout in mainstream schools compared to specialist schools (Cappe et al., 2017), although, interestingly, this same paper found no between-group differences in levels of general SE. It would be interesting, however, to investigate whether SE differences would have been found

by Cappe and colleagues (2017) had they employed the SE-ASC specific measure TSEAS (Love et al., 2019) as used in the current study. However, the study did suggest that factors such as colleague and emotional and informative support were important factors that differentiated school settings. Furthermore, the implementation of autism training is clearly indicated.

Interestingly, Job Role and Job Experience were not predictive of SE-ASC, suggesting that Teachers and CAs were parallel in their levels of SE-ASC, a notion supported by subsequent teacher-CA comparisons, suggesting that the type of school setting and training are more important for higher SE-ASC than job and experience. However, whilst important for stress appraisal and, therefore, risk of burnout, more effective, sensitive measures of knowledge and autism best practice are necessary to elucidate cognitive mechanisms underlying levels of SE-ASC.

Given the importance of SE-ASC to stress appraisal, and of factors such as school-type and autism training to SE-ASC, consideration must be given to ways in which interventions and strategies could be designed that incorporates these factors to promote and optimise teacher and CA confidence and ability and encourage more positive stress. One such approach may be reflective practice, an evidence-based practice now common in initial teacher training (Ruffinelli et al., 2020). Reflective practice could be implemented to support ongoing professional development for in-service teachers and CAs. For example, the use of video to observe own practice has been show to change teachers' beliefs (for a review, see Hamel & Viau-Guay, 2019). Reflective practice groups have been reported as helpful for professionals working in difficult working conditions and supporting people with complex needs, for example, psychiatry nurses working in a hospital emergency department (O'Neill et al., 2019) and inpatient mental health units (Thomas & Isobel, 2019). Evidence for reflective practice groups in teaching is rare, but has shown that groups help develop

supportive environments for new and experienced teachers (Cady et al., 1998) with teacher-developed professional reflection groups seen as positive and helpful to teaching practice (Glazer et al., 2004). In light of the current evidence regarding between-school-type SE differences, such groups could be run inter- as well as intra-school to enable communication and to share difficulties, successful and less successful responses and strategies, and to facilitate continuous learning and knowledge growth. This should lead to increased SE and according to current results and previous studies, less negative appraisal of stressful classroom events and, therefore, less risk of burnout and improved sense of well-being. The implementation of such reflective groups would also provide the opportunity for intervention research to measure the impact of the groups on autism knowledge, SE, stress appraisal and staff mental health.

Theoretically important to both SE and stress appraisal is teachers' and CAs' regular *appraisal* of all aspects of the situation, and *appraisal* of their ability to cope. Such appraisal processes align closely with the concept of metacognition, which has been posited as critical to teacher and student performance and learning (Hiver et al., 2021; Prytula, 2012) and has been related to trainee teachers' general self-efficacy (Wei et al., 2020). School staff's metacognition, their capacity for reflection and self-awareness, would arguably impact the SE and stress appraisal process and so work including measures of staff metacognition, for example the Teacher Metacognition Inventory (Jiang et al., 2016), may prove a fruitful avenue for future research,

The novel inclusion of CAs in the present study underscores the importance of their consideration and inclusion in research, and indeed, of the appropriateness of the TSEAS (Love et al., 2019) to measure their SE-ASC.

A notable limitation of the study was the lack of sufficient power to justify examination of interactions within the regression analyses. Decisions to exclude interactions

were based on power calculations, and was thus felt to be the most parsimonious course of action. The inclusion of predictor variable interactions in future work would provide greater insight into the predictors and their relationships, further informing intervention. For example, it may be that autism training is only a significant predictor of SE-ASC for mainstream schools, but not for enhanced and specialist schools, differentiating needs and targets for autism training.

## Conclusion

The current study highlights the important potential impact of teacher *and* CA SE-ASC on the appraisal of classroom incidents, confirming the value of the recently developed autism-specific measure of teacher self-efficacy TSEAS and its validity for use with CAs. Important factors that potentially contribute to teacher and CA SE-ASC were identified, such as school-type and autism training, that should be considered when designing and implementing strategies to optimise SE-ASC in schools, which may reduce the risk of burnout. Limitations emerging from the instruments employed point to the need for the development of new classroom-based measures of stress-appraisal.

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# Appendices

## Appendices A: Survey Information sheet

THE UNIVERSITY of EDINBURGH

Welcome to the survey!

Teacher and classroom support staff experience of supporting autistic pupils at school.

Thank you for following the link to this study. We are very pleased to invite you to take part. Please read this Participant Information Page before you decide whether or not you wish to take part.

What is the purpose of the study?
Teachers and classroom support staff often experience significant levels of stress at work, which can lead to mental health problems, including burnout. It is therefore critical to the well-being of those who teach and support pupils in class to better understand the sources of such stress. It is well known that the atypical and complex needs of autistic pupils can be particularly difficult to understand and support, especially within a class of other pupils, and so are likely such a source of stress. This study aims to better understand such difficulties, and the factors that may underlie/affect the stress they provoke, such as one's confidence and ability in supporting autistic pupils. It is hoped that such improved understanding will lead to improved training and support of teachers and classroom support staff, leading to their better mental health and, consequently, improved learning and well-being of their pupils.

**Who can take part?**
All qualified Teachers and classroom support staff who:

- Are at least 18 years old
- Are employed in any primary/secondary/specialist school situated in Perth, Dundee or Angus
- Since the beginning of the Autumn Term 2020, have supported a pupil **in class**:
    - Aged 4 to 18

- ***With*** a clinical diagnosis of autism
- ***Without*** a clinical diagnosis of a moderate or severe learning disability

Those who are below the age of 18, or those whom have additional support needs will be excluded from taking part in the study.

**What will the survey ask?**

- It will direct you first to a consent page where you will be asked to provide your consent should you wish to participate in the study
- The survey will then ask: some information about yourself e.g. age, job role, level of autism training, school employment experience
- The survey will ask you to describe your experience of difficult classroom situations involving autistic pupils
- About your confidence in your ability to understand and support the needs and learning of autistic pupils
- To describe the characteristics of the autistic pupils you have worked with
- Some general questions about autism

Completing the survey will take approximately 20 minutes.

**Do I have to take part?** No, it's up to you whether you would like to take part. Participation is voluntary and you can stop at any time, without giving a reason and without adverse consequences, by closing the browser window. As your participation is anonymous, it will not be possible to remove your data. Once you start the survey you will have 1 week to complete it. If you do not complete it within this time the survey will automatically close and your data will be recorded as a partial response.

**Are there any potential benefits?** It is hoped the results of this study will lead to schools and other services, including psychology services, better understanding the needs of teachers and classroom support staff and how best to support them in supporting the needs and learning of their autistic pupils.

**Are there any possible disadvantages to taking part?** There are no known risks for you in this study. However, we are aware that recalling difficult classroom situations may lead to some difficult emotions, especially if they relate to ongoing situations with young people, potentially made even more difficult in the current pandemic situation, which is particularly difficult for everyone at school, pupils and staff alike. Please do seek such support from the school leadership team should you feel distressed and remember that you can also exit the survey at any time by exiting the browser.

**Will my taking part in the study be kept confidential?** YES. All of the information collected from the survey will be kept confidential and processed in accordance with the Data Protection Law. The survey software does not collect information that would allow us to identify any information about you. All information collected will be stored in a single secure data centre which complies with UK standards.

**What will happen to my data?**
The research data collected during the study may be looked at by project researchers from the University of Edinburgh. The University of Edinburgh is the sponsor for this study based in the United Kingdom. We will be using information from you in order to undertake this study and will act as the data controller for this study. This means that we are responsible for looking after your information and using it properly. The University of Edinburgh will keep anonymised information about you for a minimum of 5 years after the study has finished. This anonymised data may be used by other researchers in future ethically approved research. For general information about how we use your data go to: https://www.ed.ac.uk/records-management/privacy-notice-research

**What will happen when the study is finished?** Once the study is completed, the researcher will prepare a report which will summarise the findings of the study. You will not be identifiable in any report or publication. This report may be published in a scientific journal and/or disseminated to the wider research community. Additionally, all participating schools will receive a brief summary of the results.

**Who is organising and funding the research?** The study has been sponsored by the University of Edinburgh and funded by NHS Education Scotland as part of their support for the East of Scotland Clinical Psychology Doctoral Training Programme.

**Who has reviewed the study?**
This project has been approved by the Ethics Review Committee at School of Health in Social Science at the University of Edinburgh.

**If you would like further information, please contact the Chief Investigator:** Dr Daniel Sheppard at

**If you wish to discuss the study further with the project's academic supervisor, please contact:**
Dr Ethel Quayle, University of Edinburgh at ethel.quayle@ed.ac.uk

**If you would like to discuss the project with someone independent of the study, please contact:**
Dr. Angus MacBeth, University of Edinburgh at

**If you would like to make a complaint about the study, please contact:** The University of Edinburgh Research Governance Team at cahss.res.ethics@ed.ac.uk

If reading this has raised any questions or made you feel uncomfortable in any way, you can find support from the following services:

- Your GP
- NHS 24 (dial 111)
- Samaritans – confidential listening service (dial 116 123)
- Breathing Space – confidential listening and signposting to other services (dial 0800 838 587)

**Self-care tips:**

You may also want to try the following acts of self-care to help yourself feel more settled:

- Take time out to quietly enjoy a warm drink;
- Go for a gentle walk;
- Take a bath;
- Speak to a friend who makes you feel understood.

If you have read and understood the information provided in the participant information page and wish to continue please proceed to the next page where you will be asked to indicate whether or not you consent to participating in the study.

**Appendix B: Survey consent form**


Consent Page

**Title of Study:** Teacher and Pupil Support Assistant experience of supporting autistic pupils at school.

Clicking on the "agree" button below indicates that you give your consent to the following:

1. I confirm that I have read and understand the information sheet (version X dated XX August 2020) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
2. I am participating voluntarily and understand that I am free to withdraw from the study at any time, without giving any reason, and without adverse consequences or academic penalty.
3. I understand that the research data collected during the study may be looked at by project researchers from the University of Edinburgh. I agree to give permission for these individuals to access my data.
4. I agree to give permission for my anonymised responses to the survey to be used in the researcher's publications on this topic.
5. I understand that relevant sections of my data collected during the study may be looked at by individuals from the Sponsor (University of Edinburgh), where it is relevant to my taking part in this research. I give permission for these individuals to have access to my data
6. I understand that my anonymised data collected will be retained for a duration of 5 years following completion of the study and may be used in future ethically approved research
7. I agree to the above consent points and agree to participate in the above research study

If you do not wish to participate, please decline participation by clicking on the "disagree" button or exit the survey by closing your browser.

**Appendix C: Survey ethical approval**


University of Edinburgh, School of Health in Social Science
Research Ethics, Integrity and Governance

Subsequent to submission of this form, **both the applicant and their supervisor should review any alterations in the proposed methodology of the project.** If the change to methodology results in a change to any answer on the form, then a resubmission to the Ethics subgroup is **required.**

The principal investigator is responsible for ensuring compliance with any additional ethical requirements that might apply, and/or for compliance with any additional requirements for review by external bodies.

ALL forms should be submitted in electronic format. Digital signatures or scanned in originals are acceptable. The applicant should keep a copy of all forms for inclusion in their thesis.

| | Daniel Sheppard | 18.01.21 |
|---|---|---|
| Applicant's Signature | Applicant's Name | Date signed |

| | Ethel Quayle | 13.01.21 |
|---|---|---|

*Supervisor Signature[1] Supervisor Name Date

*NOTE to Supervisor: Ethical review will be based only on the information contained in this form. If countersigning this check-list as truly warranting all 'No' answers, you are taking responsibility, on behalf of the HSS and UoE, that the research proposed truly poses no ethical risks. 7

| ISSUES ARISING FROM THE PROPOSAL |
| --- |
| Thank you for your application, in which you have addressed key ethical and data protection considerations. Two independent reviewers have now review it and the review process has generated several questions that require your attention. Please consider these carefully, discuss them with your supervisor, revise the application highlighting revisions throughout. Please also provide a note underneath each comment letting us know how you have addressed them.<br><br>confirmation is needed that the project doesn't need other approvals (p. 2) ; including sponsorship<br>with respect to sponsorship please include an e-mail confirming this is not required or a sponsorship letter<br>Section 9 (Q56) – further details on copyrighted materials is needed<br>The form needs to be signed by student and supervisor (p. 29)<br>Consent form – wording for data retention should be 'a minimum of 5 years' (i.e. it could be longer if archive and used in future research)<br>Information sheet – make it clear that participants can only stop taking part, but they can't withdraw (i.e. have data provided deleted) because you won't be able to identify it.<br>Complete and attach with your resubmission the Covid risk-assessment form<br><br>Signature: Ingrid Obsuth (sig)<br><br>Position: Ethics & Integrity Lead<br><br>Date: 20 Nov 2020 |
| CONCLUSION TO ETHICAL REVIEW (if required) |

[1] Not required for staff applications

The applicant’s response to our request for further clarification or changes has now satisfied the requirements for ethical practice and the application and the requested amendments have therefore generated a favorable opinion.

Signature: Ingrid Obsuth (sig)

Position: Ethics & Integrity Lead

Date: 29 Jan 2021

AMENDMENT/S: REQUEST FOR APPROVAL

Required changes:

1. confirmation is needed that the project doesn't need other approvals (p. 2) ; including sponsorship

    a. Sponsorship indicated and letter attached.

    b. Added info (p2) regarding consent from Angus council

        i. Research request approval letter

            1. Attached - Sheppard SE_ASC Angus Council 1_Research Approval

        ii. Emailed consent message attached

            1. Attached - Sheppard SE_ASC Angus Council 2_Emailed consent after conditions met

2. with respect to sponsorship please include an e-mail confirming this is not required or a sponsorship letter

    a. Sponsorship indicated and letter attached.

        i. Sheppard SE_ASC Edin_Uni Sponsorship letter D Sheppard 25 Sep 2020 CAHSS200904

3. Section 9 (Q56) – further details on copyrighted materials is needed

    a. Added info to Section 9.

    b. Email threads of instrument author permission

i. Attached - Sheppard SE_ASC Permission to use TSEAS and ASK-Q_email thread

4. The form needs to be signed by student and supervisor (p. 29)

    a. Signed

5. Consent form – wording for data retention should be ‘a minimum of 5 years’ (i.e. it could be longer if archive and used in future research)

    a. Wording changed. Revised form attached.

        i. Attached - Sheppard SE_ASC Consent form R1 DS 06 Dec 2020_v3

6. Information sheet – make it clear that participants can only stop taking part, but they can’t withdraw (i.e. have data provided deleted) because you won’t be able to identify it.

    a. Changed the wording in revised info sheet

        i. Attached -Sheppard SE_ASC Info sheet R1 DS 19 Jan 2021 v5)

    b. New wording:

        i. Participation is voluntary and you can stop at any time, without giving a reason and without adverse consequences, by closing the browser window. As your participation is anonymous, it will not be possible to remove your data

7. Complete and attach with your resubmission the Covid risk-assessment form

    a. Cannot find

Additional minor amendments to form

Ethnic groups question:

8. Have reduced options in ethnic groups as previous level of detail not necessary for analysis (demographics form attached). Groups reduced to:

    - White
    - Black
    - Asian
    - Mixed or multiple ethnic group
    - Other
    - Prefer not to say

School job role terminology:

9. In consultation with local authorities, have changed the terminology from “Pupil Support Assistant” to “Classroom Support Staff” (changes highlighted).

Information sheet text changes:

10. In consultation with local authorities, have changed text under **“are there any possible disadvantages to taking part?”** section.

11. Have changed the inclusion criteria: can take part if have support autistic pupil since the beginning of Autumn Term 2020 (changed from “within last 3 months”).

a. Attached -Sheppard SE_ASC Info sheet R1 DS 19 Jan 2021 v5) Changes tracked and highlighted.

Very brief outline of study in the email to staff containing anonymous online survey link:

12. Have added brief study outline, inviting email recipients to follow link to survey and information sheet

    a. Attached - Sheppard SE_ASC Message in email to staff containing survey link 19 Jan 2021 v1

Signatures: Daniel Sheppard (sig)

Date: 26 Jan 2021

CONCLUSION TO ETHICAL REVIEW OF AMENDMENT

The applicant's response to our request for further clarification or amendments has now satisfied the requirements for ethical practice and the application has therefore been approved.

Signature: Ingrid Obsuth (sig)

Position: Ethics & Integrity Lead

Date: 29 Jan 2021

Acronyms / Terms Used

NHS: National Health Service

SHSS: School of Health in Social Science

IRAS: Integrated Research Applications System

Section: The SHSS is divided into Sections or subject areas, these are; Nursing Studies, Clinical Psychology, C-PASS.

Ethics Administrators

Nursing Studies: nursing@ed.ac.uk

Counselling, Psychotherapy and Applied Social Science: CPASS.ethics@ed.ac.uk

Clinical Psychology: Submitting.Ethics@ed.ac.uk

A in Health, Science and Society: mahssug@ed.ac.uk

## Appendix D: University sponsorship confirmation letter

University of Edinburgh
College of Arts, Humanities and Social Sciences
Research Governance Office
55 George Square
Edinburgh
EH8 9JU

25th September 2020

Dr Daniel Sheppard
c/o School of Health in Social Science
University of Edinburgh

Dear Dr Sheppard,

Study Title: Teacher and Pupil Support Assistant experience of supporting autistic pupils at school

**Sponsor number:** CAHSS2009/04

Under the requirements of the UK policy framework for health and social care research, the University of Edinburgh agrees in principle to act as Sponsor for this project. Sponsorship is subject to you obtaining institutional ethics for the project.

As Chief Investigator, you must ensure that the study does not commence until all applicable approvals have been obtained. Following receipt of all relevant approvals, you should ensure that any amendments to the project are notified to the Sponsor.

Yours sincerely

Charlotte Smith

Research Governance Manager

**Appendix E: Survey study proposal (R1)**

Doctorate in Clinical Psychology

Thesis Research Proposal

(For Methodological Review Only)

This form is for methodological review of projects that are **not** being submitted as assessed work for Research 1. (e.g. where a trainee has already received a pass mark for Research 1, but subsequently changed the intended thesis project)

The form will be reviewed by a member of the academic team and will receive feedback including an evaluation of the viability of the project and any recommended adjustments. Significant concerns about viability will be flagged to the Programme Director and Research Director and a decision made about whether the project can proceed in its current form.

We expect 2-3 pages A4 for sections 1-8

| Trainee Name |
| --- |
| Daniel Sheppard |

| Provisional Thesis Title |
| --- |
| Teachers' and teaching assistants' self-efficacy and stress in working with autistic pupils |

| Proposed Setting |
| --- |
| Schools with the Dundee and Angus localities |

| Allocated Thesis Project Supervisors |
| --- |

| | |
|---|---|
| Clinical | Louise Loughran |
| Academic 1 | Ethel Quayle |
| Academic 2 | |
| Others Involved | |

| Anticipated Month / Year of Submission (Usually May of final year) |
|---|
| May 2021 |

| Date Form Submitted / Version |
|---|
| |

**Please Note:** Whilst this is not an ethics review process, where questions have some similarities to questions contained in the NHS IRAS Research Ethics form, the corresponding IRAS question numbers are given in parentheses. This is intended to facilitate completion of NHS ethics where such approval is needed.

| Section 1: Introduction |
|---|
| Provide a brief overview of the rationale and scientific justification for the research<br><br>500 words maximum<br><br>Relevant to IRAS A12 |
| The way in which stressful classroom situations are perceived by teachers has been linked to serious consequences for teacher mental health (e.g. burnout, Boujut et al., 2017; Cappe, Bolduc, et al., 2017; Wisniewski & Gargiulo, 1997). Poor teacher mental health can, in turn, impact a range of student outcomes (Herman et al., 2018). The perception of stressful situations by Pupil Support Assistants (PSAs) has not, however, been investigated, despite the potentially positive (Alborz et al., 2009; Farrell et al., 2010) and negative (Blatchford et al., 2009) influence PSAs can have on student outcomes. It is therefore critical to better understand factors that influence both teachers' *and* PSAs' perceptions of stressful classroom situations, particularly those situations that are known to be difficult, such as supporting pupils with learning and developmental disabilities (Busby et al., 2012; Wisniewski & Gargiulo, 1997).<br><br>A population known to have atypical and complex needs are those on the autism spectrum, and have been reported to present to particular difficulties within class (Ruble & McGrew, 2013). It is possible therefore, that supporting autistic pupils may present |

particular difficulties to teachers and PSAs, thus increasing the risk that the stress is perceived negatively. Thus, the purpose of the current study is to better understand the factors that affect the way in which teachers and PSAs perceive the stressful situations that arise when supporting autistic pupils, factors such as self-efficacy (SE; Bandura 1997).

Teachers' SE, defined as "teachers' belief or conviction that they can influence how well students learn, even those who may be difficult or unmotivated" (Guskey & Passaro, 1994, p. 628), is of fundamental importance to teaching effectiveness (e.g., use of positive behavioural strategies and classroom management techniques (Zee & Koomen, 2016). Importantly, teachers' mental health is also strongly related to their teaching SE, e.g.: positive SE associations with well-being (Zee & Koomen, 2016); and, conversely, lower SE related to greater risk of teacher burnout (Cappe, Bolduc, et al., 2017) and, of particular pertinence to the current study, higher levels of stress (Boujut et al., 2017).

Very little research has been published to date investigating teacher SE in relation to supporting autistic pupils (henceforth, SE-ASC), and none investigating PSA SE-ASC. That which has been published has produced evidence for a positive relationship between teacher SE-ASC and perceiving stressful events as threatening (Boujut et al., 2017) and emotional exhaustion, with some differences between educational settings (Cappe, Bolduc, et al., 2017). In terms of better understanding this relationship, recent evidence by Lu and colleagues (2020) has demonstrated a strong positive correlation between teacher SE-ASC and knowledge of autism, as measured by the Autism Stigma and Knowledge Questionnaire (ASK-Q; Harrison et al., 2017). Furthermore, a recent study has found evidence for general teaching pedagogical knowledge and burnout, linked to SE (Lauermann & König, 2016). Taken together, these studies indicate that autism knowledge may mediate the relationship between SE-ASC and stress. To date, no such work has been published regarding PSAs and their SE-ASC, stress and autism knowledge.

Therefore, it is important to continue the work investigating teacher SE-ASC, and, for the first time, investigate PSA SE-ASC, to understand how it relates to stress and to see if the relationship is mediated by knowledge and understanding of autism, and by educational setting (e.g. mainstream vs special needs).

| Section 2: Research Questions / Objectives |
| --- |
| What are the principal and secondary research questions / objectives?<br>IRAS A10 |
| **1a:** Is school staff SE-ASC predictive of staff appraisal (negative or positive) of stressful events with autistic pupils?<br>**1b:** To what extent is this relationship mediated by staff's level of autism knowledge and understanding? |

**2:** Is the SE-ASC and stress relationship moderated by job role and educational setting? That is, are the relationships between variables stronger/weaker for teachers than for pupil support assistants (PSAs), and for mainstream schools vs specialist schools?

Section 3: Methodology

Give a summary of your design and methodology

This should be clear enough for reader to know what will happen at each stage of the project. Include **principal inclusion and exclusion criteria and how data will be collected or identified.**

IRAS A13

Participants and procedure:

Participants

Inclusion criteria:

- All qualified teachers and PSAs employed by primary and secondary mainstream/special needs schools within Dundee and Angus
- Teachers and PSAs of children aged 4-19
- Must have supported a pupil with a clinical diagnosis of autism in class, within the past 3 months (as per Love et al, 2019)

Exclusion criteria:

- Diagnosis of learning disability

Recruitment:

Janette Kerr and Sharon Preston, the managers of the Additional Support Needs (ASN) departments for Dundee and Angus, respectively, support the project in principle. Once they have approved the project proposal, they have agreed to distribute the electronic link to the study survey to Headteachers/Lead ASN teachers (as they deem appropriate) who will, in turn, cascade the emailed link out to all potential teacher/PSA participants.

The planned date of survey distribution is the 2nd November, as this is considered a period of relatively low stress for school staff; pupils will have had some time to settle back in to school after the half term break, without it being too close to the run up to the Christmas break.

Procedure:

The survey will be conducted via Online Surveys (formerly Bristol Online Surveys) meaning the survey distribution and data collection will all be done electronically. The electronic survey will be accessed via an online link and will contain an information page and consent form, followed by a page to capture participant characteristics, and ending with the three instruments to measure: (TSEAS; Love et al., 2019) 2) perceived stress in

supporting an autistic pupil; perceived self-efficacy in supporting the same autistic pupil; and autism knowledge and understanding.

The first page of the electronic survey will detail the information of the study and what participation would entail (20-25min survey). Inclusion criteria will be emphasised, as will the fact the survey is entirely voluntary and anonymous.

The subsequent page will include the consent form. In addition to checking boxes to confirm understanding of/agreement to participation, respondents will also check boxes to confirm they meet inclusion criteria before continuing on to the survey questionnaire.

The final section will start with a page to capture participant characteristics, including: age, gender, number of years' as a teacher/PSA, number of years working with autistic pupils, highest education qualification, type of school/context in which they supported the autistic pupil and whether and when they have had specific training on autism. This page will be followed by the three aforementioned instruments measuring stress, SE-ASC and autism knowledge. Participants will then be thanked for their time and contribution.

Measures:

Perceived stress:

Perceived stress will be measured using the Appraisal of Life Events Scale (ALES; Ferguson et al., 1999), which has been employed in several recent studies investigating the way in which the appraisal of stressful situations with students was related to teaching self-efficacy (e.g., Boujut et al., 2017; Cappe, Bolduc, et al., 2017; Cappe, Poirier, et al., 2017). Participants will be asked to describe a stressful classroom situation involving an autistic student that has occurred within the last three months. They will then be asked to describe the score 20 adjectives on the extent they describe the situation, on a 6-point Likert-type scale (1 = not at all; to 5 = very much so). Two sub-scale scores will then be calculated: stress perceived negatively (as a threat and a loss: "threatening", "intolerable"); and stress perceived positively (as a challenge: "stimulating", "challenging"). The internal consistency for both negative and positive sub-scales has previously been high (Cronbach's alpha, 0.89 and 0.88, respectively; Boujut et al., 2017).

Perceived self-efficacy:

Perceived self-efficacy in relation to supporting autistic pupils will be measured using the recently developed Teacher Self-Efficacy for Students with Autism Scale (TSEAS; Love et al., 2019). The TSEAS is a 12-item scale designed to specifically measure self-efficacy in relation to supporting autistic students, that has demonstrated a robust score reliability (coefficient omega, 0.91) and has been shown to discriminate from instruments measuring general teaching self-efficacy (Love et al., 2019). Participants will be asked to consider the same autistic student they thought of for the previous stress measure. This will ensure consistency between the two measures, whilst also helping to

control for a potentially biased selection of autistic students; for example, a social desirability bias that might influence participants to select an autistic student they feel most confident about, a limitation recognised by the authors of the measure (Love et al., 2019). Items are scored using a 4-point Likert-type response (1 = *not certain at all* to 4 = *very certain).*

Autism knowledge and understanding

Autism knowledge will be measured using the Autism Stigma and Knowledge Questionnaire (ASK-Q; Harrison et al., 2017)which has demonstrated high internal consistency (Cronbach's alpha, 0.88, Harrison et al., 2017) been employed many times since it's development, including to measure trainee teachers' knowledge of autism (Vincent & Ralston, 2020) and, pertinent to the current study, to relate autism knowledge to teacher self-efficacy when supporting autistic pupils (Lu et al., 2020). Participants indicate their agreement (Yes or No0 to 49 statements about autism, each of which pertain to one of four subscales, namely: knowledge of diagnosis/symptoms; etiology; treatment; and stigma.

Section 4: Sample Size

What sample size is needed for the research and how did you determine this?

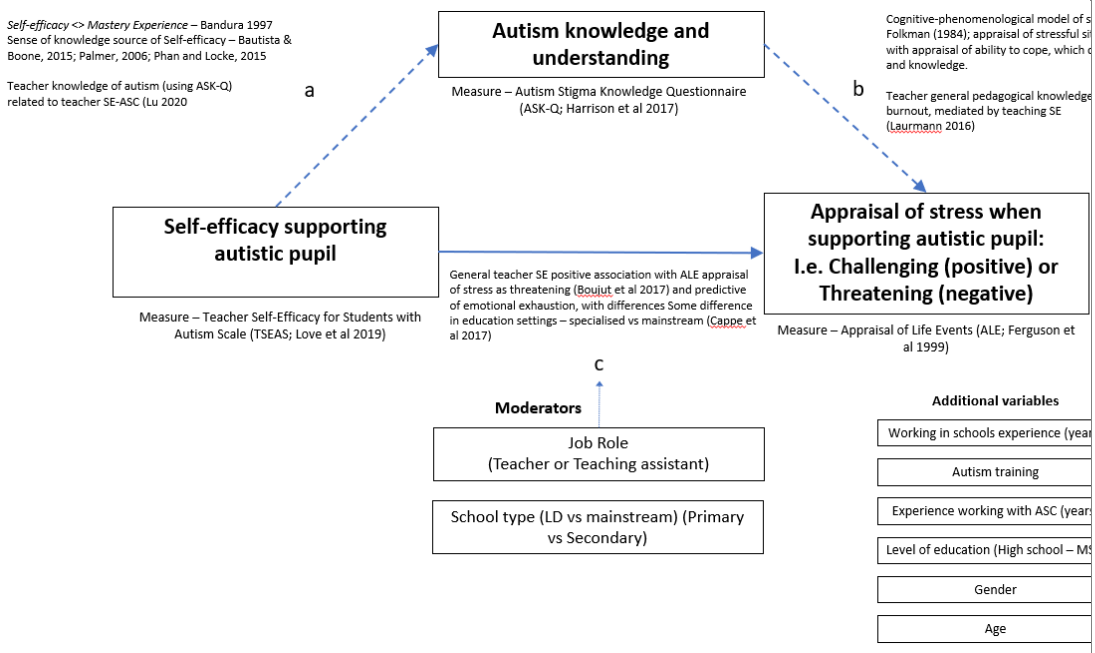
For quantitative projects, outline the relevant Power calculations and the rationale for assuming given effect sizes. For qualitative projects, outline your reasoning for assuming that this sample size will be sufficient to address the study's aims. If data is to be collected outline reasons for your confidence in being able to achieve a sample of at least this size.

IRAS A59 and IRAS A60

In order to determine the sample size for a mediation analysis, a power analysis was conducted using G*Power (Faul, Erfelder, Bucnhner, & Lang, 2014). The analysis was based on the multiple linear regression that will be used for this study, but it is the most involved analysis in the study. With a medium effect size ($f^2$) of .06, an alpha of .05, a standard power level of .80, and a total of 2 predictors, the results of the power analysis showed that a minimum of 197 participants would be needed to achieve an appropriate power level for this study.

Managers of the Additional Support Needs services at both Angus and Dundee councils have assured me that, once the study has been approved, all Headteachers of the 102 (primary, secondary and special needs) schools in the areas will be emailed the electronic link to the study and encouraged to participate, who will, in turn, email the link to all teachers and teaching assistants. According to the government published census (REF), as of 2018, the number of full-time teachers employed in both Angus and Dundee totalled 2481. According to Scottish Government Publication NAME (REFS) there were 519 pupil support assistants. In total, therefore, the total possible pool of teacher and pupil

support assistants, as of 2017/2018 was 3000. Therefore, just 6.6% of teachers and PSAs would need to respond to the survey to achieve the desired power for the study.

| Section 5: Analysis |
|---|
| Describe the methods of analysis (statistical or other appropriate methods, e.g. for qualitative methods) by which the data will be evaluated to meet the study objectives<br>IRAS A62 |
| Mediation analysis.<br>  <br><br>Mediation analysis will be conducted using the Process tool (http://www.processmacro.org/index.html) an add-on to SPSS. |

| Section 6: Project Management / Timetable | |
|---|---|
| Outline a timetable for completion of key stages of the project<br>E.g. ethics submission, start and end of data collection, data analysis | |
| Activity | Submit by: |
| New thesis proposal submission | 31 July 2020 |
| University ethics submission | 31 August 2020 |

| | |
|---|---|
| Angus and Dundee local authority project proposal submissions (agreed already in principle) | |
| Data collection start date: send out electronic survey to teachers/PSNs; 3rd week of Autumn Term 2 | 2 November 2020 |
| Data collection end date: end of autumn term | 23 December 2020 |
| Methodology write up, 1st draft by | 23 December 2020 |
| Data analysis start date | 11 January 2021 |
| Results write-up, 1st draft by | 12 February 2021 |
| Full project write-up 1st draft by | 31 March 2021 |
| Full project write-up 2nd draft by | 15 April 2021 |
| Full project hand-in | 1 May 2021 |
| | |

| Section 7: Management of Risks to Project | | |
|---|---|---|
| Please summarise the main potential risks to your study, perceived likelihood of occurrence of these risks, and how you will respond to identified risks if they should occur (you do not need to repeat information provided in section 4). | | |
| Risk | Perceived likelihood | Proactive/reactive response |
| Missing critical survey start date (in principle, agreed with local authorities and Educational Psychologists) | Medium risk | Important to ensure ethical approval is given. Must submit ethics application by planned date |
| Delay to ethical approval, eg missing date, amendments, ethics board on summer annual leave etc | Medium risk | • Planned submission date is only 8 weeks away, inc one week of annual leave. Must complete within this time.<br>• I will be in regular communication with local authorities to keep them updated regarding university ethic approval. Will discuss possibility of sending survey out at later dates.<br>• Worst case, survey can be sent out in new term, possibly 18 January 2021<br>o May need to request thesis deadline extension |
| | | |

| Section 8: Are the any potential costs for the project?<br>Outline any potential financial costs to the project and justify why these are necessary; including how costs will be met. Please separate these into potential costs for the University and potential costs for your NHS Board. You should ask your NHS Board to meet stationery, printing, postage and travel costs. |
|---|
| No costs identified. |

| Section 9: Confirmation of Supervisors' Approval | |
|---|---|
| "I confirm that both my Academic and Clinical Thesis Supervisors have seen and approved this research proposal and have both completed the supervisors' appraisal forms below."<br>Delete as appropriate | |
| Yes | No |

Main Academic Supervisor's Appraisal of Project Risk

| Supervisor's Name |
|---|
| Ethel Quayle |

| Date |
|---|
| 31 July 2020 |

| Do you consider that the project should proceed in broadly its current form?<br>Delete as appropriate | | |
|---|---|---|
| Yes | Yes, subject to the revisions outlined below | No |

| Outline the reasons for the above response<br>Highlight any areas of risk to the completion of the project that have not been fully addressed within the proposal and any steps that could be taken to reduce risks |
|---|
| This methodological approach is new to the trainee but additional support has been sought in relation to this and DG will be providing tutorials in relation to this analysis. The challenge with regard to the study is the time available to complete data collection and analysis and the challenges that may come from a low response rate. I am satisfied that the trainee has liaised with appropriate staff to mitigate against this. |