Post-lexical intonation use in early speech

by

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Abstract

The present study sought to confirm claims by previous researchers (e.g. Crystal, 1979; Halliday, 1975; Galligan, 1987) that in children's early productions intonation functions as part of the child's word-level phonology rather than being dissociated from the words with which it is produced, and to characterize the development of post-lexical intonation use from lexically bound intonation. Unexpectedly, given its documentation in previous work, no evidence was found of a stage of lexically bound intonation in early speech; possible sources of the discrepancy between studies include the use of instrumental rather than perceptual measurement of the intonation contours, different classification system s of intonation contours, individual developmental differences between the children studied, sampling error, not obtaining data from children at an early enough stage of linguistic development, and the decision not to collect information about the pragmatic and attitudinal meanings communicated by the children's intonation patterns. Additional research with more children, and preferably with speech data collection beginning at an earlier age, is needed to clarify the discrepant findings.

1.0 Introduction

1.1 Intonation Development

Prosodic development, and in particular the acquisition and development of intonation in the speech of young children acquiring English, has been the subject of some study in recent years. Of the three major descriptive features of prosody, length, loudness, and pitch, intonation is primarily concerned with variations of pitch, a perceptual correlate of fundamental frequency (f_0) which reflects the rate of vibration of the vocal cords (Cruttenden, 1997). Intonation conveys the pragmatic and attitudinal meanings of utterances as well as functioning grammatically as a boundary marker of speech units such as clauses; these meanings are communicated through the interaction of the key tonal features of directionality (falling or rising) of the pitch change, complexity or degree to which the prominent directional change is preceded or followed by a smaller pitch change in the opposite direction, and magnitude of pitch change or accent range (Cruttenden, 1997; Snow & Balog, 2002). The acquisition and development of intonation is of especial interest within the larger context of language acquisition because it appears to be among the earliest aspects of speech to be acquired, with at least some aspects of intonation apparently in place during the single-word stage of language development prior to the onset of expressive syntax. Some researchers have even reported adult-like intonation patterns during the babbling period, although others have concluded that the onset of intonation coincides with the production of children's first words or occurs even later (Snow & Balog, 2002).

Developmental intonation research seems to indicate that although intonation use begins to develop early relative to other aspects of language, the pitch patterns of early speech do not necessarily represent intonation as it is understood in adult language. The very early use of pitch patterns in babbling between 3 and 9 months, for example, reflects basic form-meaning associations but appears to be driven more by respiratory patterns and associations between pitch and emotion than from an adult-like understanding of the various functions of intonation, with a regressive pattern of development as children shift to a more linguistic use of intonation as they begin to produce their first words. Children do appear to shift to a more purposive, linguistic use of intonation during the single-word period, indicating that this may be the first expressive feature of grammar acquired, and there is considerable development and stabilization of many core features of intonation during the second year of life. However, other aspects of intonation do not fully develop for several years; rising contours, for example, do not seem to be fully acquired for several years, with only a gradual shift to an adult-like accent range for rising intonation (Snow & Balog, 2002). Although most features of intonation are productively controlled at a relatively young age, then, this aspect of language does not seem to be fully acquired until well into the preschool years.

1.2 Lexically Bound and Post-Lexical Intonation

Although deviations from adult-like intonation use in the early speech of young children is typically exemplified in the developmental intonation literature by such atypical features as the comparatively narrow accent range of the more slowly developing rising contours, there are other potential ways in which children represent intonation differently from adults. In particular, early pitch contours could function as part of the child's word-level phonology rather than being dissociated from the lexical items with which they are produced, with children failing to understand intonation as a suprasegmental system. If such a lexically bound representation is indeed true of children's early intonation patterns then the onset and shape of adult-like, "post-lexical" intonation development would be of particular interest in determining the course of intonation acquisition.

There are some indications that early pitch patterns are lexically bound rather than functioning independently of individual lexical items. Crystal (1979), for example, claims that in early speech intonational features cannot be distinguished from what he terms "prosodic idioms," fixed prosodic patterns accompanying set lexico-grammatical utterances. He consequently asserts that intonation patterns can only be considered productive and systematic in children's speech when the same lexical items are produced with a variety of patterns. Halliday (1975) presents a similar view of early language in which intonation patterns are initially fused with the phonetic forms of words and lacking the pragmatic and affective values they express in adult speech; in his view, the transition to a post-lexical understanding of intonation is linked to advances in semantic awareness, such that once children comprehend that word meanings are independent of context they will begin to combine words with other words or with intonational patterns in order to better convey their precise meaning. Unlike Crystal, who simply asserts the proposed early stage of lexically bound prosody as part of a more general theory of tonal development without the citation of any studies demonstrating the existence of such a stage and appears to have observed but not systematically studied lexically bound pitch patterns in early speech, Halliday reports early use of lexically bound intonation in the speech of the child whose development he details, and links the transition to post-lexical intonation to other advances in expressive grammar such as early word combinations.

Galligan's (1987) study of the function of intonation during the single-word stage of early language development provides further direct evidence of lexically bound intonation in early speech. Based on the work of Crystal (1979) and, more particularly, Halliday (1975), Galligan assumed that children's earliest productions incorporate intonation patterns into the word-level phonology and that intonation cannot be considered productive until individual lexical items are produced with multiple pitch patterns; the point at which individual words appear with a variety of intonation patterns could thus be used to assess the transition from what she termed a "pragmatic" use of intonation to a "grammatical" use of intonation, although children could begin to recognize the pragmatic import of using different intonation patterns with some words before the grammatical use of intonation became productively controlled and extended to a larger vocabulary. As a result of this assessment criteria, the study provides concrete evidence that early word productions are tied to specific intonation patterns in fixed combinations of segmental and suprasegmental forms. Both of the two children studied had acquired the "grammatical," or post-lexical, use of intonation by 17 months of age, using different intonation patterns with the individual words to achieve different communicative purposes. The children thus appeared to understand that intonation patterns were independent of individual words while still in the single-word stage; since the onset of grammar in child speech is typically determined to occur when children progress from holophrastic one-word utterances to two-word combinations, evidence that children productively use intonation grammatically in the single-word stage is particularly interesting, and corroborates suggestions that prosodic features of expressive grammar are acquired earlier than syntactic ones (e.g. Snow, 1995; Snow & Balog, 2002).

Galligan's argument that the appearance of post-lexical intonation indicates grammatical use of pitch patterns in early speech is consistent with the developmental intonation literature since, although some aspects of intonation are not fully controlled until well into childhood, certain features appear to begin stabilizing in child language at very early stages in development and even before the onset of two-word combinations (e.g. Snow, 1995; Snow & Balog, 2007). There is some evidence, then, that at this age (approximately 17-18 months) young children represent intonation as an autosegmental, post-lexical system. That the reported transition from lexically bound intonation appears to occur at this age is also significant since this coincides with the timing of one of two major discontinuities in intonation development, when children at 18-20 months of age begin to actively control pitch features; this period of intonation acquisition is associated with the development of expressive syntax through word combinations (Snow, 2006), and the reported emergence of post-lexical intonation use in child speech just before the onset of the two-word period would seem to fit nicely within the established trajectory of intonation development.

1.3 The Present Study

The reported use of lexically bound intonation in early speech and transition to post-lexical intonation has not been the subject of further study, and so a precise characterization of how post-lexical intonation develops is not available. Halliday (1975) based his characterization of lexically bound intonation in early speech on observations of only one child, and Galligan's (1987) study relied on data from only two children, making any generalizations to the larger population tenuous at best. Developmental patterns were described for each child, but these simply recounted a transition from lexically bound to post-lexical intonation—in Galligan's (1987) case, by the age of 17 months—rather than attempting to quantify the changes. Both researchers also relied primarily on perceptual judgments to categorize the pitch patterns rather than more precise instrumental analysis. This previous work verified the existence of lexically bound intonation in early speech, but the estimated onset of the transition has been derived from an extremely small sample size, and precisely *how* post-lexical intonation develops remains an open question. Is the transition gradual or sudden, linear or regressive? Do different contour patterns develop at different rates?

The present study attempted to address such questions, seeking to first confirm Halliday's (1975) and Galligan's (1987) finding that early words are bound particular intonation patterns, and then to characterize the progress of the acquisition of post-lexical intonation. This was carried out by using instrumental analysis of previously recorded speech data from one-year-olds to classify utterances of single words according to the contour inventory developed by Balog & Snow (2007). It was expected that evidence of lexically bound intonation would be found, confirming claims that children initially represent intonation as part of the word-level phonology and thus helping to establish an important stage in the trajectory of intonation development.

The transition to post-lexical intonation was expected to occur at approximately 17 months of age, the age reported by Galligan (1987) for the shift from lexically bound intonation. The precise timing of this transition was of interest because of the many developments in speech during the second year of life, any of which could influence such a transition, and because it could help to further refine the timing of the more general transition from a prelinguistic to a linguistic intonation system that appears to occur between 9 months and 24 months (Snow & Balog, 2002). If post-lexical intonation appeared prior to the onset of word combinations, this could indicate that at least some aspects of grammar are productively controlled by children in the single-word stage; since researchers have frequently linked the acquisition of intonation with grammatical, and particularly syntactic, development, with dramatic gains in the productive use of intonation associated with the onset of combinatorial speech (e.g. Snow & Balog, 2002; Snow, 2006), the precise relationship between the development of these two aspects of language could be further refined if the onset of post-lexical intonation occurs only before or after two-word combinations appear, as such a result could indicate that one development precludes the other.

The "shape" of the development of post-lexical intonation was also of interest in attempting to characterize how and why a transition from lexically bound pitch patterns occurs. The transition could be either gradual, with one or two words appearing with multiple pitch patterns at an early age but further development of post-lexical intonation beyond these isolated examples delayed for some months, or it could be very abrupt. A gradual acquisitional course was expected because this was the pattern reported by Galligan (1987), although she discusses the difficulty of determining whether the early productions of words with multiple intonation patterns are a by-product of other factors rather than examples of post-lexical use. If the children did appear to follow a gradual course, this would suggest that at least some awareness of the independence of segmental and suprasegmental form was present at a fairly young age. The other major component of the "shape" of the development concerns whether the acquisition of post-lexical intonation is linear or subject to regression. It was predicted that the shift from lexically bound to unbound intonation would develop in a linear fashion, with children progressing from the use of only one pitch pattern for each lexical item to using multiple pitch patterns for each item rather than producing multiple patterns and then regressing and reorganizing. It was also considered likely that the pitch contours or accent range might be less stable when the children first shifted to post-lexical usage, since they were transitioning to a more functional use of intonation. Such a result would accord with the general developmental pattern of regression and reorganization that marks the acquisition of intonation, since this regression seems to coincide with the switch from a prelinguistic system to a linguistic system.

A further area of interest regarding post-lexical intonation development is the relative development of different contours, an aspect of development that the use of the large, descriptive inventory potentially allowed for more detailed investigation of than did the less sensitive scales used in previous studies. It was expected that a comparison of the developmental patterns of the different contour types in the inventory would provide insight into whether young children shift more quickly to post-lexical intonation with words initially associated with one pitch pattern than those associated with another, with a strong possibility that the general pattern of earlier acquisition and control of falling than of rising contours (e.g. Snow, 1998; Snow & Balog, 2002) might be reflected in differential patterns of development of post-lexical intonation for words initially associated with falling contours and for those initially associated with rising contours. As a consequence of the predominance, in terms of both frequency and stability, of falling contours in child language, it was considered likely that most exemplars of lexically bound intonation would involve falling rather than rising contours. If no words were ever produced only with a rising contour, the apparent pattern of transition to post-lexical intonation could simply be the result of children finding rising contours more difficult to produce. Such a result was not expected, however, both because Galligan (1987) reports that some of the early, lexically bound intonation in her data involves rising contours, and because exclusive rather than merely predominate use of falling contours by infants has not been reported in the literature. The expected result was of a differential rate of post-lexical intonation development based for words initially tied to falling versus rising contours, such that children would be quicker to add falling contours to the repertoire of pitch patterns used with a given word than vice versa, which would be consistent with the general trend towards greater use of falling contours and slower development of rising contours.

2.0 Method

2.1 Corpora

The present study investigated the development of post-lexical intonation by analyzing previously recorded spontaneous speech data from one-year-old children acquiring American English, using longitudinal data obtained from the Child Language Data Exchange System (CHILDES) database (MacWhinney, 2000). Audio files and transcriptions were available for spontaneous speech data from children of the appropriate age range in the MacWhinney and McCune corpora (MacWhinney, 2000).

The McCune corpus contains videotaped mother and child play sessions collected by Lorraine McCune; transcription of all the sessions from twelve children between nine and thirty-six months had not yet been completed at the time of the present study. Video was available for three children at that time: Alice, Jase, and Rala. Both video and transcripts were available of sessions at ages 17 months, 18 months, 19 months, 20 months, 21 months, 22 months, 23 months, and 24 months for both Alice and Jase. Video but not transcripts were available of sessions at ages 12 months, 13 months, 14 months, 15 months, and 16 months for Alice and at ages 12 months, 15 months, 16 months, 18 months, 20 months, 21 months, and 24 months for Rala. Each recorded mother and child play session lasted approximately 30-40 minutes and took place in the children's respective homes. The experimenter provided a range of age-appropriate toys, such as a ball, baby doll, *Pat the Bunny* book, and puzzle. Mothers were encouraged to play with their children as they would naturally.

The MacWhinney corpus consists of data from the experimenter's diary study of his own sons' development, and thus provides examples of fairly typical daily child-parent interactions. There is very little speech available for the younger child during the period of interest, but there is a good deal of speech data available for the older child, Ross, at the ages of 16 months, 17 months, and 18 months. Both audio files and transcripts are available at these ages.

2.2 Intonational analysis

Since the intonation patterns associated with individual lexical items were the object of interest, the analysis was restricted to the children's single-word utterances to avoid the complication of an effect of a word's position within a phrase or sentence on the prosodic pattern. These utterances are also very common in the speech of young children, and should provide a representative sample of the children's vocabularies. Likewise, since the association of intonation and individual words was of interest, only meaningful utterances were analyzed. Assessment of whether or not a child's utterance was meaningful was, following Snow (2002), based on phonetic resemblance to a targeted adult word form, appropriate contextual use of the word, and consistency of repeated productions of the word, as well as parental confirmation that the utterance represented the child's form of the targeted word. In order to be eligible for analysis, lexical items must have been produced at least twice, both to meet the consistency of phonetic form requirement of meaningful utterance classification and to ensure that the extent to which individual words are bound to specific pitch patterns could be examined. Only non-imitated meaningful utterances were considered for analysis to ensure that the intonation patterns analyzed were typical of the children's spontaneous productions. Additionally, candidates for analysis needed to be produced without overlapping parental speech or other background interference.

Instrumental acoustic analysis of those child utterances that met these criteria was carried out using the Praat phonetic analysis program (Boersma & Weenink, 2007). Since the program cannot read video files, in order to be able to analyze data from the children from the McCune corpus, for whom only video files were available, the video files were transcoded to .wav audio format using the VLC media player (VideoLAN, 2007). The Praat phonetic analysis program could then be used to create f_0 contours for the utterances selected for study. In cases where the f_0 contour generated by the program was interrupted due to factors such as voicing, estimates of the missing f_0 values were based on visual analysis of each cycle in the waveform. The minimum and maximum f_0 values, contour direction, and contour shape were calculated based on the nuclear tone, as measured by using the first and last clear and periodic cycles of the vocalic nucleus.

These measures were then used to classify the utterances into different contour types; after classification, different productions of individual lexical items could be compared for each child to determine whether the pitch contours produced appeared to be lexically bound in early speech. If the children uniformly produced words with only one pitch pattern at the earliest ages examined, treating intonation as a part of word-level phonology, a comparison of productions at different ages could determine the point at which words began to be produced with a variety of intonation contours, whether certain contours are most likely to appear in the early lexically bound productions, and whether the post-lexical use develops earlier with certain contours than with others.

2.3 Contour Inventory

The inventory of contours used was that developed for the analysis of young children's intonation by Balog & Snow (2007), which includes contour types typical of child but not adult speech, and consequently appears to be more sensitive to variations and developments in the production of intonation by one-year-olds. The sixteen contour types in this inventory were characterized by directionality, contour shape (based on complexity), and degree of pitch change. The assessment of directionality was based on the relationship of the minimum and maximum f_0 values, with contours in which the maximum f_0 preceded the minimum f_0 considered falls and those contours in which the minimum f_0 preceded the maximum f_0 considered rises. Contours were also classified as either wide or narrow based on the degree of pitch change of the major portion of the nucleus (points *b* to *c* in Figure1 below), or accent range; wide contours had a pitch change greater than four semitones for falls or three semitones for rises.[1]

[1] Many studies of intonation development report a high level of a third class of directional contours, "level" contours, in addition to falling and rising contours. However, the distinguishing characteristic of level contours is not so much directionality but a very low degree of pitch change; level contours are essentially very shallow rises or falls (Snow & Balog, 2002). In the contour inventory used in the present study, contours are classified as either "wide" or "narrow" based on the accent range or degree of pitch change of the prominent portion of the contour, with the threshold values for classification as wide (4 semitones for falling contours and 3 semitones for rising contours) representing the minimum degree of pitch change necessary for an utterance to be perceived as either a fall or a rise rather than level (Balog & Snow, 2007). The degree of pitch change measure in the present study, rather than directionality, thus corresponds with this often reported contour type in child speech.

Figure 1 Description of points *a*, *b*, and *c* on intonation contours
Taken from Balog & Snow (2007: 125)

Measurements of any smaller pitch changes in the less prominent portions of the contours, delineated by points *a* and *b* on the contours in Figure 1, were used to determine contour shape, with a change of at least one semitone indicating greater complexity (e.g. rise-fall or fall-rise rather than a simple rise or fall). The inventory used measurements in semitones because they best reflect the perception of pitch change; the values of pitch change used to categorize intonation contours were chosen to reflect the minimal amount of pitch change generally necessary to be perceived as communicative (Balog & Snow, 2007: 125-6). Following Balog & Snow (2007), measurements of pitch change in semitones were calculated using the following formula: $[12 / \log (2)]*[\log (f_{01} / f_{02})]$. The complete contour inventory, with a summary of the major characteristics of each contour, can be found in Table 1 below.

Table 1 Contour Inventory and Description

Contour type	Prominent Direction	Degree of Pitch Change	Complexity
Simple wide fall	Fall: Maximum f_0 first	*b-c* $\geq$ 4 semitones	*a-b* < 1 semitone
Simple narrow fall	Fall: Maximum f_0 first	*b-c* < 4 semitones	*a-b* < 1 semitone
Wide rise-fall	Fall: Maximum f_0 first	*b-c* $\geq$ 4 semitones	*a-b* $\geq$ 1 semitone
Narrow rise-fall	Fall: Maximum f_0 first	*b-c* < 4 semitones	*a-b* $\geq$ 1 semitone
Wide fall-rise	Fall: Maximum f_0 first	*b-c* $\geq$ 4 semitones	*a-b* $\geq$ 1 semitone
Narrow fall-rise	Fall: Maximum f_0 first	*b-c* < 4 semitones	*a-b* $\geq$ 1 semitone
Wide rise-fall-rise	Fall: Maximum f_0 first	*b-c* $\geq$ 4 semitones	*a-b* $\geq$ 1 semitone at each end of contour
Narrow rise-fall-rise	Fall: Maximum f_0 first	*b-c* < 4 semitones	*a-b* $\geq$ 1 semitone at each end of contour
Simple wide rise	Rise: Minimum f_0 first	*b-c* $\geq$ 3 semitones	*a-b* < 1 semitone
Simple narrow rise	Rise: Minimum f_0 first	*b-c* < 3 semitones	*a-b* < 1 semitone
Wide rise-fall	Rise: Minimum f_0 first	*b-c* $\geq$ 3 semitones	*a-b* $\geq$ 1 semitone
Narrow rise-fall	Rise: Minimum f_0 first	*b-c* < 3 semitones	*a-b* $\geq$ 1 semitone
Wide fall-rise	Rise: Minimum f_0 first	*b-c* $\geq$ 3 semitones	*a-b* $\geq$ 1 semitone
Narrow fall-rise	Rise: Minimum f_0 first	*b-c* < 3 semitones	*a-b* $\geq$ 1 semitone
Wide fall-rise-fall	Rise: Minimum f_0 first	*b-c* $\geq$ 3 semitones	*a-b* $\geq$ 1 semitone at each end of contour
Narrow fall-rise-fall	Rise: Minimum f_0 first	*b-c* < 3 semitones	*a-b* $\geq$ 1 semitone at each end of contour

Adapted from Balog & Snow (2007: 125-6)

Figures 2 and 3 below provide further explication of the classification of intonation contours according to the inventory. Figure 2 depicts the waveform and f_0 contour for one of Alice's productions of the word "mom" at age 17 months. Under the contour inventory, the f_0 contour is deemed a simple narrow rise. The prominent direction of the contour is considered rising because the minimum f_0 value (286.89 Hz) precedes the maximum f_0 value (329.39 Hz). The degree of pitch change (2.39 semitones) does not exceed three semitones, leading to a classification of this rising contour as narrow. The complex portion of the contour had a pitch change of less than one semitone (0.55 semitones), which is not perceptually relevant, leading to classification of the contour as simple rather than complex.

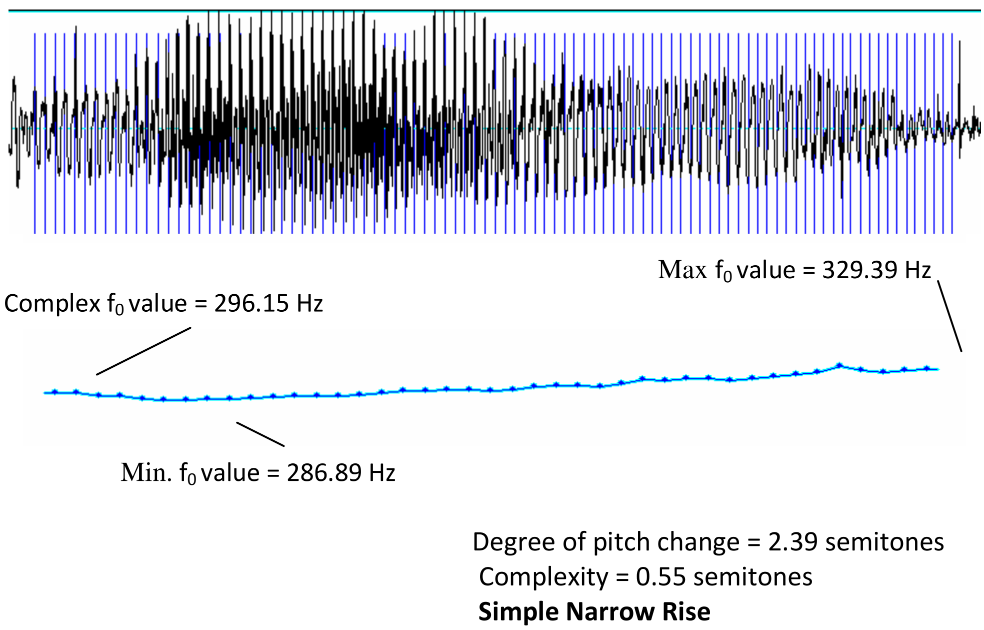

Figure 2 Time waveform and f_0 contour for "mom" (Alice, 17 months old)

Similarly Figure 3 below depicts the waveform and f_0 contour for one of Ross's productions of the word "no" at age 18 months. Under the contour inventory, the f_0 contour is deemed a wide rise-fall falling contour. The prominent direction of the contour is considered falling because the maximum f_0 value (465.81 Hz) precedes the minimum f_0 value (310.46 Hz). The degree of pitch change (7.05 semitones) exceeds four semitones, leading to a classification of this falling contour as wide. The complex portion of the contour had a perceptually relevant pitch change (2.89 semitones) of more than one semitone, leading to a complex classification of the contour as a wide rise-fall.

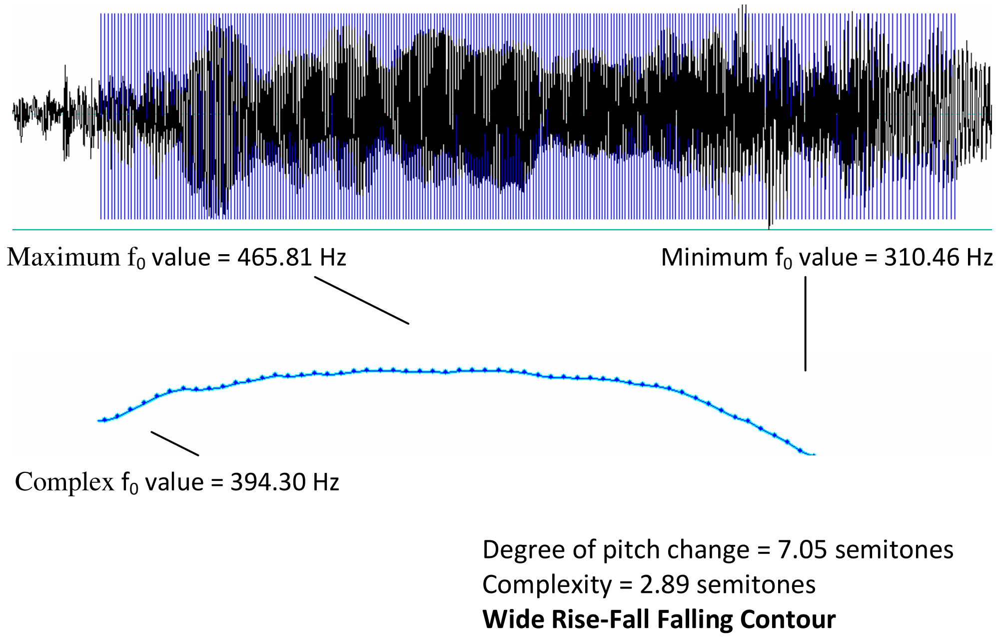

Figure 3 Time waveform and f_0 contour for “no” (Ross, 18 months old)

3.0 Results

The production of individual words with one or multiple intonation contours was not significantly correlated with age, $r_s = .01$, p (one-tailed) > .05, indicating a lack of a relationship between age and lexically bound intonation patterns; contrary to all expectations, the children were not more likely to use only one intonation contour with an individual lexical item in early speech before progressing to the use of multiple contours with the same lexical item. This lack of a significant correlation between age and the association of individual lexemes with a single intonation contour was true not only of the group as a whole but for each individual: Alice ($r_s = -.06$, p (one-tailed) > .05), Jase ($r_s = -.03$, p (one-tailed) > .05), Rala ($r_s = .37$, p (one-tailed) > .05), and Ross ($r_s = -.06$, p (one-tailed) > .05). Each individual also produced post-lexical intonation, with a single word produced with multiple intonation contours, at the earliest age at which their speech was analyzed, further militating against an age effect on post-lexical intonation use.

Nor did there appear to be large individual differences in the relative frequency of use of multiple or single contours with particular words. For each child, the majority of words produced multiple times did *not* occur with only a single intonation contour at a given age (Alice = 81.43% of words produced, Jase = 73.47% of words produced, Rala = 71.43% of words produced, Ross = 86.21% of words produced). Of those words that did occur with only a single intonation contour at one of the ages sampled, this frequently occurred after the word in question had already been produced at an earlier age, either with multiple contours or only once but with a different intonation contour; such cases, in which the use of a single intonation contour with a single word at a particular age does not seem to indicate lexically bound intonation use, account for approximately half of all the instances in which a word appears with only one contour at a given age (50.00% overall, 57.14% for Alice, 46.67% for Jase, 40.00% for Rala, 50.00% for Ross).

The discrepancy between this study and the results reported elsewhere most likely does not result from the use of the larger contour inventory as opposed to a simple classification system of rising and falling contours because the production of individual words with only falling or rising contours, or with both falling and rising contours, was also not significantly correlated with age, $r_s = -.12$, p (one-tailed) > .05. This was also true of each of the individual children: for neither Alice (r_s = -.16, *p* (one-tailed) > .05), Jase (r_s = .07, *p* (one-tailed) > .05), Rala (r_s = -.02, *p* (one-tailed) > .05), nor Ross (r_s = .18, *p* (one-tailed) > .05) was there a significant correlation between age and the production of individual lexical items with contours of only one directional class. A variety of other aspects of the children's intonation patterns were investigated to attempt to determine whether the sampled population was atypical; non-parametric tests, although less sensitive, had to be used for the much of the data due to a non-normal distribution.

One aspect of intonation that was investigated was the children's use of accent range, measured in semitones; because older children and adults have been shown to produce a consistently wider accent range than younger children, utterances were sorted into two age groups (12-17 months and 18-24 months) for easier comparison of production over time. The children produced a significantly wider accent range at 18-24 months of age (*Mdn* = 7.05) than at 12-17 months of age (*Mdn* = 4.36), $z = -11.67$, $p < .001$. A significantly wider accent range was produced for rising contours at 18-24 months of age (*Mdn* = 5.98) than at 12-17 months of age (*Mdn* = 4.06), $z = 2.81$, $p = .005$. Children also produced a wider accent range for falling contours at 18-24 months of age (*Mdn* = 4.76) than at 12-17 months of age (*Mdn* = 4.58), but this difference was not significant, $z = -1.04$, $p > .05$. A wider accent range was produced for rising contours (*Mdn* = 4.92) than for falling contours (*Mdn* = 4.66), but this difference was not significant, $z = -.12$, $p > .05$. A wider accent range was produced for falling contours (*Mdn* = 4.58) than for rising contours (*Mdn* = 4.06) at 12-17 months of age, but this difference was not significant, $z = -1.31$, $p > .05$. A wider accent range was also produced for rising contours (*Mdn* = 5.98) than for falling contours (*Mdn* = 4.76) at 18-24 months of age, but this difference was also not significant, $z = -.25$, $p > .05$.

The proportion of the children's utterances that used falling contours and rising contours were also analyzed since falling contours are generally considered to be earlier acquired than rising contours. The children produced relatively more falling contours (*Mdn* = 57.73) than rising contours (*Mdn* = 42.28), but this difference in frequency of production was not significant, $z = -1.10$, $p > .05$. Relatively more falling contours were produced at 18-24 months of age (*Mdn* = 64.92) than at 12-17 months of age (*Mdn* = 52.34), but this difference was not significant, $z = -1.83$, $p > .05$. Relatively more rising contours were produced at 12-17 months of age (*Mdn* = 47.66) than at 18-24 months of age (*Mdn* = 35.09), but this difference was not significant, $z = -1.83$, $p > .05$. At 12-17 months of age the children produced relatively more falling contours (*Mdn* = 53.34) than rising contours (*Mdn* = 47.66), but this difference was not significant, $z = -.37$, $p > .05$. The children also produced relatively more falling contours (*Mdn* = 64.92) than rising contours (*Mdn* = 35.09) at 18-24 months of age, but again this difference was not significant, $z = -1.46$, $p > .05$.

The size of the children's contour inventories was also analyzed to determine if a greater variety of falling contour types or rising contour types were produced. The children had slightly larger contour inventories of falling contours (*M* = 7.75, *SE* = .25) than of rising contours (*M* = 6.75, *SE* = .48), but this difference was not statistically significant ($t(3) = 1.73$, $p > .05$). Within the two age groups, the contour inventories were on average of equal size at both 12-17 months of age (*M* = 5.75, *SE* = 1.44 for falling contour inventory size and *SE* = .95 for rising contour inventory size) and at 18-24 months of age (*M* = 6.25, *SE* = .85 for falling contour inventory size and *SE* = .75 for rising contour inventory size). There was a slight increase in the size of the falling contour inventory between 12-17 months of age (*M* = 5.75, *SE* = 1.44) and 18-24 months of age (*M* = 6.25, *SE* = .85), but this increase was not significant ($t(3) = -.42$, $p > .05$). There was likewise a slight increase in the size of the rising contour inventory between 12-17 months of age (*M* = 5.75, *SE* = .95) and 18-24 months of age (*M* = 6.25, *SE* = .75), but this increase was not significant ($t(3) = -.78$, $p > .05$).

The complexity of the children's produced contours were also analyzed to determine if there was a higher frequency of simple or complex contours produced, or any effects of age or directionality on the complexity of intonation contours. The children produced slightly more simple rises and falls (*Mdn* = 13.00) than more complex contours (*Mdn* = 13.00), but this difference in the rate of production of contour types was not significant, $z = -.86$, $p > .05$. There was also a higher production rate for less complex contours within the category of complex contours, with a significantly higher production frequency of rise-fall and fall-rise contours (*Mdn* = 11.00) than of rise-fall-rise and fall-rise-fall contours (*Mdn* = 2.00), $z = -4.78$, $p < .001$. There also appeared to be an effect of directionality on overall frequency of production. There was no significant difference between the production rates of simple falls (*Mdn* = 8) and simple rises (*Mdn* = 5), $z = -.42$, $p > .05$. There was a significant effect of directionality on the more complex contours, however. The children produced significantly more complex falls (*Mdn* = 9) than complex rises (*Mdn* = 3) overall, $z = -3.92$, $p < .001$. This was true of both the rise-fall and fall-rise complex contours (*Mdn* = 8 for falls, *Mdn* = 3 for rises, $z = -3.69$, $p < .001$) and the highly complex rise-fall-rise and fall-rise-fall contours (*Mdn* = 1 for falls, *Mdn* = 0 for rises, $z = -3.40$, $p = .001$). There did not appear to be an effect of age on the relative complexity of contours produced, as the production rate of complex contours at age group 12-17 months (*Mdn* = 7) and at age group 18-24 months (*Mdn* = 5) did not differ significantly, $z = -.24$, $p < .05$.

4.0 Discussion

The present study attempted to confirm reports from Crystal (1979), Halliday (1975), and Galligan (1987) that in early speech intonation functions as part of the child's word-level phonology and pitch contours are not yet understood to function independently of individual lexical items, with lexically bound intonation only later yielding to the more adult-like post-lexical intonation use of multiple pitch contours with individual lexical items. Contrary to expectations, however, the reported pattern of lexically bound intonation in early speech was not found, with no significant relationship between whether or not a word appeared with multiple intonation contours apparent. Additionally, each individual child used multiple pitch patterns with the same lexical items at the earliest age for which data was available for him or her (12 months for Alice and Rala, 16 months for Ross, and 17 months for Jase) and neither Alice nor Jase produced any words with only one intonation contour at the earliest age for which data was available for them, two circumstances which further militate against an interpretation of early lexical binding in the speech of the sampled children.

Although Galligan (1987) reported a linear developmental pattern of exclusive use of lexically bound intonation followed by post-lexical intonation use, there was a possibility that the development of post-lexical intonation is regressive, with words appearing with a variety of intonation contours in early speech and then becoming associated with only a single intonation contour for a brief period before the onset of more adult-like post-lexical intonation use. Such a regressive rather than linear pattern would fit with the general finding of a pattern of regressive intonation development as regards such features as accent range width (e.g. Snow, 2006), and could explain the lack of an overall correlation between age and the association of words with either single or multiple intonation contours. The children in the present study did not appear to follow such a regressive course of acquisition, however, as they produced a much higher proportion of words with multiple contours than with only a single contour at every age sampled.

This lack of corroboration of previous studies' reports of a stage of lexically bound intonation could result from a number of factors, including the use of instrumental rather than perceptual measurement of the intonation contours, the more fine-grained classification system of intonation contours, individual developmental differences between the children studied, sampling error, not obtaining data from children at an early enough stage of linguistic development, or the decision not to collect information about the pragmatic and attitudinal meanings communicated by the children's intonation patterns.

4.1 Use of instrumental measurement

One of the most obvious potential sources of the discrepancy with the literature is methodological: the use of instrumental rather than perceptual measurements to classify the intonation contours of the children's utterances, and the use of a larger and more fine-grained classification system of intonation contours than in Halliday's (1975) and Galligan's (1987) studies, could conceivably have contributed to the failure to confirm the existence of lexically bound intonation in children's early productions. It is difficult to assess the potential effect of using instrumental rather than perceptual measurements, particularly since earlier studies did not provide any criteria for assessing intonation contour type; indeed, instrumental analysis was chosen for the present study in order to avoid such vagueness and possible subjectivity in classifying intonation contours. However, the difference in measurement types is mediated by the fact that the contour inventory based its criteria of assessment on the minimum differences in pitch change necessary to be considered communicative (Balog & Snow, 2007). Since the inventory was based on perceptually relevant instrumental measurements, the classification used in the present study should be roughly commensurate with a classification system based on perceptual judgments. Although the different classification systems cannot be eliminated as a source of the discrepancy, it seems unlikely to have been an important factor.

It is also possible that the finer distinctions made between different contour types in the rather large contour inventory used in the present study resulted in utterances being classified as occurring with multiple intonation contours in this study which under a broader classification schema would be considered to occur with only a single intonation contour. Galligan (1987), for example, relied on a classification system of only five intonation contours, with no provision of criteria for classification: falling, level, rising, rising-falling, and falling-rising. Although relative pitch heights were also noted and classified as either low, mid, high, or very high, this factor does not appear to have entered into her determination of whether or not a word was produced with multiple contours; in the present study such finer distinctions were made, and this could have resulted in the production of multiple intonation contours being assessed where earlier studies might have assigned a single intonation contour. This possible explanation of the different finding from that reported elsewhere was addressed by examining the effect of using a very broad classification system based on directionality. However, the children's productions of individual words was no more tied to a single prominent direction of intonation contour than it was to one of the identified contours from the inventory, with no significant relationship between age and the production of a word with only falling contours or only rising contours as compared to both types of contours. As with the more detailed contour inventory, each individual child produced single lexical items with multiple patterns at the earliest age at which data was available for him or her. Since the finding of a lack of lexically bound intonation remains when a broad classification system of falling contours and rising contours replaces that of the large, detailed contour inventory relied upon in the present study, it seems unlikely that a difference in the classification systems used could be driving this unexpected result.

The use of instrumental measurements rather than perceptual judgments in the classification of individual contours into types, and of a larger and more detailed contour inventory than was used in previous studies, then, does not seem a highly probable cause of the lack of confirmation in the present study of the lexically bound intonation stage of development reported elsewhere. Further research with more children and a direct comparison of the results of using the two different types of measurement would be necessary to attempt to fully resolve this issue.

4.2 Individual Differences

Another potential source of the disparity between the present study and previous research indicating the existence of a stage of lexically bound intonation in early child speech is that of extreme individual differences among the relatively small population sample obscuring general tendencies. One or two individuals who failed to use lexically bound intonation at the ages for which data was available for them could skew the results and obscure such a stage in other children. In the present study, however, this does not appear to have been the case. None of the individual children deviated from the overall group pattern of a lack of any correlation between age and the likelihood of producing individual words with a single intonation contour rather than with multiple intonation contours, whether this was measured using the contour inventory or a simple notation of the prominent direction of the contours. Nor did any of the individual children fail to use post-lexical intonation; indeed, each child produced lexemes with multiple contour types at the earliest age at which data was available for him or her, and both Alice and Jase failed to produce any words with only a single intonation contour at the earliest age for which data was available for them (12 months for Alice and 16 months for Jase). For each individual, as well as overall, the majority of words produced multiple times failed to be produced with only a single intonation contour at any of the sampled ages of speech production. Additionally, when children did produce a given word with only one contour at a particular age, they had often produced that word with either multiple intonation contours or a different intonation contour at an earlier age. These two cases account for half of the total instances of a single contour being associated with a word at a given age, and this proportion was similar for each of the individual children; thus, in the speech of each child, many of the instances of a one-to-one correspondence between an intonation contour and an individual lexical item at a particular age do not appear to represent examples of lexically bound intonation. Each child follows a similar pattern of intonation production, which is very different from that described by earlier researchers (e.g. Galligan, 1987). There is no evidence of a developmental stage of lexically bound intonation in any of the individual children, suggesting that the unexpected result of the present study is most likely not attributable to individual differences in post-lexical intonation development among the sampled population obscuring larger effects.

4.3 Sampling Error

There is also some possibility that the lack of any demonstrable period of lexically bound intonation in the present study is attributable to sampling error, with the children used representing an atypical population. In an attempt to assess the likelihood of this as an important contributing factor to the discrepancy between the present study and previous reports, the children's productions were analyzed to determine whether or not they appeared to follow the general course of intonation development reported in the literature. One of the most frequently noted aspects of intonation acquisition concerns the earlier control of falling contours as opposed to rising contours; falling contours have been repeatedly demonstrated to predominate in child language, in terms of both frequency and stability (e.g. Snow, 1998; Snow & Balog, 2002). The tendency to produce a higher proportion of falling contours than rising contours has been particularly well-documented from at least three months of age throughout the first year of life, and is especially strong in the speech of children acquiring English compared to those acquiring other languages (e.g. Kent & Murray, 1982; Kent & Bauer, 1985; Whalen et al., 1991; Snow & Balog, 2002). The children in the present study appear to behave in a similar manner to that reported elsewhere in this respect, producing a proportionately larger amount of falling contours than of rising contours, although this difference in frequency of production was not significant. When the data for the children was split into two age groups of 12-17 months and 18-24 months to investigate developmental change across age, a higher proportion of falling contours than of rising contours was also found within each age group, although again this frequency difference was not significant. In this respect, then, the children in the present study appeared to be following the general developmental trend of a higher rate of production of falling contours than of rising contours. The children also appeared to produce a higher proportion of rising contours within the earlier age group of 12-17 months than within the older age group of 18-24 months, however, which does not fit the general trend, although this difference was not significant. In fact, the lack of any significant differences in the relative production rates of falling contours and rising contours makes it difficult to conclude on this basis that the children are behaving typically in terms of intonation development, despite appearing to follow the general trend of relatively greater production of falling contours.

Other sources of potential differences in the production of falling and rising contours were consequently examined. In addition to the general bias towards a higher frequency of falling contours than of rising contours, the claims that falling intonation contours are acquired earlier than rising intonation contours reflects the greater stability of falling contours in child speech. Accent range, for example, appears to develop more quickly in falling contours than in rising contours, with young children producing an accent range statistically indistinguishable from that produced by older children or adults for falling contours before they do so for rising contours; this larger, more adult-like production of accent range has in fact been used in previous studies to assess the acquisition of intonation contours within a given directional class. Falling contours are typically produced with a greater, or wider, accent range than are rising contours, and older children produce a wider accent range than do infants (Snow 1998; Snow, 2002). When analysis was limited to one-year-olds, however, accent range production did not appear to differ significantly by either age (12-17 months of age vs. 18-24 months of age) or directional class, although the older children did appear to better distinguish rises and falls by the use of a larger accent range (Balog & Snow, 2007). The children in the present study produced a significantly wider accent range at the slightly older ages of 18-24 months than at 12-17 months, with both falling contours and rising contours accompanied by significantly larger degrees of pitch change when the children were older. This result was actually stronger than in previous work with children of this age, which had shown a statistically significant difference between the accent range of one-year-olds and four-year-olds, but only a nonsignificant trend towards larger accent range production among older than younger one-year-olds. The lack of an age effect in the previous study was, however, unexpected, and despite their nonsignificant results the authors speculated that children began to better differentiate their accent range after 18 months of age, so the fact that the children in the present study produced a significantly larger accent range when previous studies showed such differences to be less pronounced should not be taken as an indication of an atypical population. The children in the present study appear to follow the reported general tendency to produce a wider accent range with age, and in this respect provide more concrete evidence of development of accent range within the second year of life than has previously been found.

There did not appear to be an effect of directionality on accent range productions, with very similar values produced for both rising contours and falling contours. The two directional classes of contours were not produced with significantly different accent ranges either overall or within or between age groups of 12-17 months and 18-24 months. In this respect, then, there was no evidence of an earlier development of accent range for falling intonation contours commensurate with the general trend of earlier acquisition and development of this type of contour. No real advantage appeared of a wider, more adult-like accent range for falling contours, although there was a small, nonsignificant advantage for accent range for falling contours at 12-17 months of age and for rising contours at 18-24 months of age. However, the lack of such an effect does not necessitate a conclusion that the present sampled population was atypical, since earlier studies also reported a lack of a statistically significant distinction between the accent ranges of rising and falling contours in children of this age range (e.g. Balog & Snow, 2007).

A further attempt to assess whether or not the children followed the general pattern of earlier development of falling contours involved comparing the size of their contour inventories, a measure which in a previous study proved more sensitive than measures of accent range to differences in the production of the two directional classes of contours (Balog & Snow, 2007). In the present study, however, this measure was as unsuccessful as accent range at demonstrating any significant differences in the production of falling contours and rising contours. The children had slightly larger contour inventories of falling contours than they did of rising contours, and the size of the inventories of both falling and rising contours increased from 12-17 months of age to 18-24 months of age, but a significantly larger number of falling contour types were not produced. Thus, although they appeared to follow a trend towards greater differentiation of falling contours than rising contours, this distinction between directional classes was not as pronounced as it has been in earlier research. In this respect, the pronounced tendency towards earlier development of falling contours was not as strongly apparent in the sampled population as in previous research, but there was likewise no evidence of highly atypical behavior.

One last attempt at investigating whether or not the children in the present study appeared to be following a general tendency towards the earlier acquisition and development of falling contours than of rising contours involved the analysis of the complexity of their contours, since earlier control of falling contours could be reflected in an effect of directionality on the complexity of the contours produced. The slightly higher production rate of simple contours than of complex contours was not significant, but there was a very highly significant difference in the relative production rate of complex contours, such that less complex contours (i.e. rise-fall contours and fall-rise contours) were produced far more than were highly complex contours (i.e. rise-fall-rise contours and fall-rise-fall contours); there was not a significant age effect on the frequency of production of different levels of complexity. While accent range and directionality have frequently been used in describing intonational development in young children, less attention has been given to the relative complexity of children's utterances (see Snow & Balog, 2002), making it difficult to determine whether or not the children's less frequent production of increasingly complex contours is typical. The tendency seems likely to be shared by the general population, however, given that the highly complex intonation contours (i.e. rise-fall-rise contours and fall-rise-fall contours) produced only very infrequently by the children in the present study are typically not included among the contour types reported in studies of developmental intonation, which usually describe simple falling, simple rising, fall-rise, and rise-fall contours; the absence of these highly complex contours from many previous analyses could be taken as an indication of their very infrequent appearance in child productions in general. Speculatively, then, the production rate of relative levels of complexity in the intonation contours of the sample children is comparable to that of the general population.

There also appeared to be an effect of directionality on the complexity of the children's productions. Although there was no significant difference in the frequency with which simple falls and simple rises were produced, there was an effect of directionality on the more complex contours, with a significantly higher production rate of complex falls than of complex rises. This interaction between directionality and contour complexity in the productions of the sampled population would seem to reflect the reported trend of differential development rates of falling and rising intonation contours, with the more readily acquired falling contours more likely to be complex than the less productively controlled rising contours. This use of more complex contours—which, based on their relative frequency, appear to be more difficult for children to produce than contours of less complexity—with falling contours than with rising contours could indicate earlier acquisition and stabilization of falling intonation. If the effect of directionality is taken to indicate greater facility with falling contours than with rising contours, then the relative complexity of the children's productions can be seen as evidence that they are following the typical trajectory of intonation development n which falling contours develop earlier than rising contours.

In summary, the apparent absence of lexically bound intonation among the children in the present study does not appear particularly likely to result from a sampling error, as the children behave typically as regards other aspects of their intonation development. In particular, they seem to adhere to the general pattern of earlier development of falling intonation contours than of rising intonation contours, although this advantage was not always statistically significant. Additionally, there was a significant age effect on accent range, with a wider accent range being produced as the children grew older; there was thus some evidence of intonation development over time. Since the sampled population appeared to follow the general trajectory of intonation development reported in the developmental intonation literature, sampling error does not seem a particularly likely explanation of the lack of a stage of lexically bound intonation, although it cannot be eliminated as a contributing factor.

4.4 Age

There is also a possibility that the failure to confirm the existence of a developmental stage of lexically bound intonation production in the present study results from not obtaining data from children at a sufficiently early stage of linguistic development. The children whose speech was examined could have passed through a stage of lexically bound intonation prior to the point at which the analyzed speech data was collected, in which case the finding of a lack of such a developmental stage in the present study should not be taken to indicate its total absence among young children. Although this possibility cannot be eliminated without further research and replication of the study with a larger sample of children across a wider age range, it is not considered especially likely that the lack of concord with previous researchers' reports of lexically bound intonation in early speech results from sampling children when too old and at too advanced a stage of linguistic development since these reports placed the productive use of post-lexical intonation at approximately 17 months of age. In the case of Galligan (1987), the two children whose speech was monitored each began to produce a few isolated words with multiple intonation contours at 14-15 months of age, but this usage did not increase until approximately 17 months of age, and the process of gradual dissociation of individual words from specific intonation contours was ongoing at the end of her data collection at 21 months of age. The children in the present study predominately produced multiple intonation contours with individual words at the approximate age when this pattern was earlier reported to only begin to be used with a variety of words, 17 months, and produced multiple contours with single words at the earliest age for which data was examined, 12 months. In fact, not only did they produce post-lexical intonation at an earlier age than had been previously reported, but the proportion of words produced with multiple contours was greater than the proportion of words produced with only a single contour at the early ages of 12-16 months when either no such post-lexical use or only a few isolated examples of such use had been previously reported. Although the children in the present study could have displayed a pattern of lexically bound intonation prior to this point, it is not clear why they should have developed post-lexical intonation several months earlier than has been reported elsewhere; the small sample sizes of most of this research could be a contributing factor, and studying a larger sample might indicate that the children investigated by Galligan (1987) were simply late to develop post-lexical intonation. Alternatively, if the children in the present study did appear to use lexically bound intonation only at a much earlier age than has been previously reported, use of some measure of linguistic development rather than age to time the onset of post-lexical intonation development (i.e. if the onset of post-lexical use coincided with reaching a certain vocabulary size or the onset of two-word combinations) could reveal a roughly similar onset and trajectory of post-lexical intonation development.

4.5 Pragmatic/attitudinal meaning

One final potential source of the discrepancy between studies regarding the existence of stage of lexically bound intonation lies in the restriction of the analysis in the present study to evidence of lexical binding in terms of the association of individual words with single or multiple intonation contours; previous reports of lexically bound intonation had dealt with other aspects of intonation development as well. In particular, Galligan (1987), who provides the clearest and most detailed account of this stage, also examined the children's development in terms of using intonation to communicate pragmatic and attitudinal meanings. One consequence of this additional focus appears to have been a somewhat different conceptualization of post-lexical intonation, such that some early examples of multiple contours being produced with a single word were not considered examples of post-lexical use of intonation. In cases where Galligan interpreted a child's use of a rising contour with a word typically produced with a falling contour to be communicating a request for confirmation of an object name, she apparently still considered phonetic form and intonation to be fused and did not count this association of a word with multiple contours as an example of post-lexical intonation production. It is not entirely clear why she deemed the object naming context a special case, such that the use of multiple contours with a single word was considered indicative of a dissociation of pitch patterns from individual words when the "new" intonation contours were used to ask questions but not when the additional contours were used to communicated requests for confirmation of object names. Precisely because the motivation for this partialling out of certain contexts of multiple contour production with a single word was not clear, such a distinction was not used in the present study. As a consequence, the absence of lexically bound intonation reported here, and particularly its absence at ages when previous studies have reported no instances of post-lexical intonation use, could be attributed in part to the classification of utterances in this study as post-lexical which Galligan (1987) might have deemed lexically bound. However, only one of Galligan's two subjects is reported to have frequently requested confirmation of object names, and so the relative impact of eliminating these contexts from classification as post-lexical intonation use is difficult to assess.

4.6 Future directions

Future research is needed to clarify the source of the discrepancy between the present study and earlier reports regarding the existence of a stage of lexically bound intonation production in the early speech of young children. Further efforts to confirm reports of such a stage should be attempted with a larger sample of children and with data collection beginning at a younger age to attempt to ameliorate the possible effects of a small sample and possibly too linguistically advanced participants discussed in regards to this study. Since the use of the larger contour inventory and instrumental measurements rather than a small contour classification system based on perceptual judgments does not appear to account for the different result in this study than that reported in previous research, these more sensitive and precise measures should continue to prove useful in future research.

If the source of the discrepancy could be identified, and if future studies confirmed reports of early use of lexically bound intonation patterns, then characterizing the development of post-lexical intonation would warrant further attention. At that point, researchers could isolate the onset of post-lexical intonation use in children and determine whether this shift in understanding of the function of intonation is timed to coincide with other major developmental milestones such as the onset of expressive syntax or reaching a threshold vocabulary size; if, as Galligan (1987) indicated, the shift to post-lexical intonation occurs while children remain in the single-word stage, this would point to an earlier control of at least some aspects of grammar than is usually admitted by the use of the onset of two-word combinations as marking the beginning of expressive syntax in child speech. The shape of the development in terms of speed and whether or not acquisition of post-lexical intonation is linear would also be interesting to investigate, and to compare this aspect of intonation development with the general pattern of regression and reorganization of intonation reported elsewhere (e.g. Snow, 2006). The relative development of different contour types is also of some interest, in particular whether the bias towards earlier production and stabilization of falling contours would be reflected in a differential rate of acquisition for words initially tied to falling contours than for those initially bound to rising contours.

5.0 Conclusion

The present study sought to confirm claims by previous researchers (e.g. Crystal, 1979; Halliday, 1975; Galligan, 1987) that in early speech children's productions of intonation is significantly non-adult-like in the sense that early pitch contours function as part of the child's word-level phonology rather than being dissociated with which they are produced, in the hope of characterizing the developmental trajectory of post-lexical intonation use from these early lexically bound intonation and of relating this developmental pattern to the pattern of acquisition of other aspects of intonation. No evidence was found of such a developmental stage of lexically bound intonation in early speech which later yields to a more mature post-lexical use of intonation among the sampled population, however. The absence of such a stage in the present study was unexpected given its documentation in previous work, and the source of the discrepancy between studies is not entirely clear, although possible causes include the use of instrumental rather than perceptual measurement of the intonation contours, the more fine-grained classification system of intonation contours, individual developmental differences between the children studied, sampling error, not obtaining data from children at an early enough stage of linguistic development, and the decision not to collect information about the pragmatic and attitudinal meanings communicated by the children's intonation patterns. However, additional research with more children, and preferably with speech data collection beginning at an earlier age, is needed to determine the source of the difference between the present study and previous research and, if future studies do find a stage of lexically bound intonation in early speech, to characterize the course of the development of post-lexical intonation use in young children and situate this within the larger context of intonation acquisition more generally.

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