Individual variation in children's early production of negation

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Abstract

The ability to express negation is an important part of early language. Despite the fact that negation is a complex and abstract concept, "No" is one of the first words that children produce. Past analyses have found that children's early negations tend to express concepts like refusal (negations expressing that a child does not want to do something) rather than denial (negations expressing that something is false). Does this mean that young children are *incapable* of expressing denial? In Study 1, we examine children's spontaneous production of negation and find that some children produce denial negation earlier and more frequently than past literature suggests. In Study 2, we examine one possible explanation for individual variation in children's negation production: differences in the joint activities that they engage in with their caregivers. A comparison of two children suggests that reading may be associated with the production of denial negation. We discuss our data in light of previous findings, and suggest that certain communicative contexts are more likely to elicit different types of negation.

Keywords: negation; language production; cognitive development; pragmatics

Introduction

Children begin producing negation at a young age. According to parent report, 64% of English-learning 16-month-olds produce "no" (Frank, Braginsky, Yurovsky, & Marchman, 2016), and "no" is some children's first word (Schneider, Yurovsky, & Frank, 2015). Negative words like "no" and "not" allow children to express many different concepts, which poses a difficult learning problem. What is the developmental trajectory of this abstract, multi-functional word?

Past research has found that preschool-aged children use negation to express at least three different concepts (Bloom, 1970) and potentially as many as nine (Pea, 1980; Choi, 1988). One of the first types of negation to emerge in children's speech is *refusal*, which occurs when children reject some object or activity. For example, a child might say "no go outside" in response to a parent asking if they want to go outside (Bloom, 1970). Refusal is one of the earliest types of negation to emerge, appearing as early as 13 months of age (Pea, 1980). Some researchers have also identified *prohibition* and *self-prohibition* (Choi, 1988; Pea, 1980) as negations that children produce when telling another person to stop doing something (e.g. "don't X") or issuing a directive to themselves to stop e.g. reaching towards a forbidden object. Refusal, prohibition, and self-prohibition are all similar in that they are used to influence their own or others' behavior in the world, rather than commenting on the true state of the world.

Children also use negation very early to express the concept of *nonexistence*. For example, a child might say "no more juice" to describe their empty juice cup (Bloom, 1970). Some researchers have identified two different types of nonexistence: *disappearance*, used to describe an object that has recently disappeared from view, and *unfulfilled expectations*, which describes the absence of an expected object (Pea, 1980). Nonexistence appears to emerge around the same time as refusal negation (Bloom, 1970; Pea, 1980).

A third type of negation, *denial* (sometimes called *truth-functional* negation), appears to be the last to emerge. Denial negations make a statement about the falsity of a proposition. For example, a child might state "no, apple" in response to the question, "Is that a biscuit?" (Pea, 1980). Past research suggests that this type of negation consistently emerges later than nonexistence and refusal negation, between 18 and 24 months (e.g. Pea, 1980, 1982). From the perspective of children's logical development, denial is the most abstract and important type of negation to emerge, and could even subsume other categories of negation (e.g., nonexistence could be expressed as "it is not the case that X contains objects").

This order of acquisition, with refusal and nonexistence emerging early and denial emerging later, has been reported in several analyses of children's early negative utterances (Bloom, 1970; Pea, 1980; Choi, 1988). What is the source of this developmental trajectory? One possibility is that the types of negation that emerge earlier are conceptually easier. Denial negation requires representing and negating a proposition and understanding the abstract concept of falsehood, whereas refusal negation could be represented in a more affective way (e.g., as an expression of "go away" or "I don't want that"), and nonexistence negation could be represented with a single concept such as "absence" or "empty." So perhaps when children first begin producing words like "no" to express refusal, they do not yet have the ability to express more complex concepts like denial. This line of reasoning would suggest a constructivist account of children's acquisition of negation, in which children learn simpler negative concepts before they develop the abstract concept of denial.

Another possibility, however, is that different contexts give rise to different functional uses of negation, and that the types of contexts that young children are typically placed in are more likely to license refusal or nonexistence compared to denial negation. For example, when a child is very young and has little control over her environment, verbally expressing what she *doesn't* want to do or *doesn't* want to eat is likely to be a salient goal. Children learn concepts like nonexistence in feeding situations (e.g, "all gone") and through games (e.g., "peekaboo"). As children get older and develop more autonomy and a broader range of communicative skills, the goal of interactions between caregivers and children may shift from a focus on the child's wants and needs towards more abstract

concepts. For example, parents may start to play games with explicit rules, or ask yes/no questions about abstract concepts (e.g. pointing to an object and saying "is this an apple?" instead of asking "do you want an apple?"). If the ways that parents engage with their children changes throughout development, then young children might be more likely to produce simple negative concepts even if they are capable of representing more abstract and logical types of negation.

In this paper, we explore children's production of negative utterances in natural contexts. Our goal is to examine how the activity or joint action (Clark, 1996) that a child engages in influences negation production. Our results suggest that the developmental trajectory of different types of negation may not be as consistent across individuals as past researchers have suggested, and that some differences in children's early production of logical language may be context dependent.

Study 1

In Study 1 we examined the production of negation in the spontaneous speech of five children. The goal of Study 1 was to explore whether the pattern of acquisition seen in past studies (refusal & nonexistence negation emerging early and denial emerging later) was consistent across children. If this order of acquisition is consistent across children, it suggests that the early-emerging negative concepts may be conceptually or linguistically simpler. If some children show diverging patterns and produce denial earlier, however, then a pragmatic explanation is possible in which children produce different types of negation depending on the communicative context.

Method

Corpus We analyzed transcripts of the natural speech of five children in the Providence Corpus (Demuth, Culbertson, & Alter, 2006). This corpus examines six children[1] between one and three years in natural interactions with caregivers in their homes. All children were raised monolingual in English-speaking homes. Each child was recorded for one hour twice monthly beginning at the onset of their first words.

Coding We created a database of all utterances in which the children produced "no", "not", or any "-n't" contraction. Utterances were presented to coders with ten preceding utterances and two succeeding utterances as context to help correctly identify the function of the utterance. Every negative utterance was double coded by author AN and a research assistant who was extensively trained on the coding scheme.

We developed a coding scheme with nine classifications to capture the wide range of meanings that can be expressed using negation (see Bloom, 1970; Pea, 1980; Choi, 1988):

Denial: A statement that a proposition is false (e.g. "that's not an X" or "Is it a triangle?" "No").

Refusal/Rejection: Negative responses to requests or demands, e.g., "You want me to read you a book?" "No".

Prohibition: Negative commands directed at another person, e.g., "Don't do that".

Self-Prohibition: Negative commands directed at the self, e.g., "No" while reaching towards a forbidden object.

Failure: A negation produced when an action doesn't go according to plan or a child is unable to execute an action, e.g. "not work" in response to a broken toy.

Disappearance: A negation expressing that an object that was recently present is no longer visible, e.g. "no juice" to describe an empty juice cup.

Unfulfilled Expectations: A negative utterance expressing surprise when an object is not in the expected places, e.g. "no cookie" when looking in a cookie jar.

Two additional codes captured utterances that did not fall into the above categories. *Repeat* was used for cases where the child imitated the caregiver's immediately preceding utterance or repeatedly produced the same word (e.g. For "No no no!" in response to "Do you want to take a bath?", only the *first* instance would be coded as refusal). *Unclear* was used when the meaning could not be inferred from the context or when the negation did not fit into the above categories.

Data Processing A total of 9,822 utterances were coded for this analysis. We removed any utterance that was coded by either coder as repeat (1,445 utterances) or unclear (179 utterances), leaving a total of 8,198 utterances. Reliability between the two coders on the remaining utterances was $\kappa = .60$, $p < .001$, 73% agreement. This reliability was consistent across age groups: For utterances produced at age one, $\kappa = .57$, $p < .001$, 73% agreement; for utterances produced at age two, $\kappa = .60$, $p < .001$, 74% agreement, and for utterances produced at age three, $\kappa = .57$, $p < .001$, 71% agreement. Agreement was highest for the two most common types of negation, denial (82% agreement) and refusal (72% agreement). These two negation types accounted for 80% of the utterances for coder 1, and 78% of the utterances for coder 2.

For the analyses presented below we only analyzed utterances where there was consensus between the two coders (5,971 utterances). Although the reliability and agreement between the two coders was relatively low due to the ambiguity of many of the transcribed utterances, the results discussed below are consistent even when analyzing the data for each coder individually; any differences between the consensus data and the individual coder data are noted.

Results and Discussion

We found notably different patterns of negation production across the five different children. Figure 1 shows the relative proportion of different types of negation for each child in a given month of their life (i.e., all proportions within the same month for a particular child sum to one). Across all children, the most common negative utterances by far were refusal (41% of all agreed utterances; 41% for coder AN and 35% for coder NP) and denial negation (44% of all agreed utterances; 40% for coder AN and 44% for coder NP). Unlike past studies, we saw very little nonexistence (disappearance or un-

[1] One child later received an Autism Spectrum Disorder diagnosis and was excluded from the current analysis.

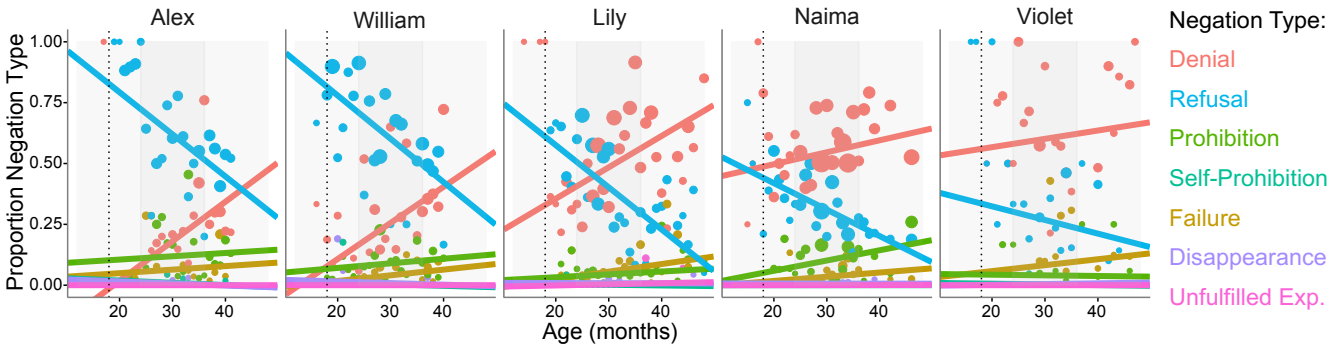

Figure 1: Relative proportion of different negation types for each child. Different colors represent different types of negation. Each point represents the proportion of that type of negation within that month of a child's life (approximately two hours of natural speech). The size of each point corresponds to the number of negative utterances of that type produced in that month (ranging from a single utterance to 156 utterances). The vertical dotted line marks 18 months for each child, and gray bands mark each year. Colored lines represent linear models fit for each negation type for each child.

fulfilled expectations) in any of the children's speech. For all children, the relative amount of refusal that children produced decreased as they got older, while the relative amount of denial that children produced increased. This pattern is consistent with the findings in past literature: refusal emerges early, while denial emerges later (Bloom, 1970; Pea, 1980).

Contrary to past findings, we found evidence that children produce denial negation prior to 18 months. Although these utterances were rare, three of the five children in our sample produce *some* denial negation before 18 months of age. Two of the five children (Violet and Naima) produced as much or more denial negation than any other type throughout the duration of the study, and a third (Lily) produced more denial negation than any other type starting at approximately 24 months. Alex and William produced a very different pattern: These two children produced almost entirely refusal in the first year, and continued to produce more refusal than any other type of negation throughout the duration of the study.

Why do some children produce denial earlier and more frequently than others? One possibility is that these children have advanced conceptual development; that is, they may be capable of forming complex representations and abstract concepts such as "falsity" earlier than their peers. Given that the recordings in the Providence Corpus begin at the onset of first words, however, these data suggest that the conceptual development required to produce denial occurs prior to or very shortly after children begin producing language.

Another possibility–one that appears more consistent with our data–is that context plays a role in the types of negation that children produce. That is, children who produce denial frequently at a very young age may be doing so because of the interactions that they are engaged in with their parents during these recorded sessions, rather than advanced conceptual development. The parents of the children who produce denial frequently may have engaged in more "naming" games (e.g., *Mother:* Is it called a circle? *Violet (2;2):* No, it's called a square) that promote the production of denial negation. This could be due to persistent differences in how parents interact with their children, or simply differences in the activities that parents happened to engage in during the videotaped sessions.

Past researchers may have found that refusal and nonexistence emerged earlier because the contexts that license these types of negation are very common for young children. For example, refusal negations may be more common when a parent is feeding a child (e.g., *Mother:* You want me to cut up an apple for you? *Violet (2;1):* No. I wanna drink my drink.) Nonexistence negation may be more common in these contexts as well, e.g., a child saying "all gone" when she has finished eating.[2] In Study 2, we test the hypothesis that the individual differences in children's negation seen in this analysis may be due to the different activities that parents and children were engaged in during the recording sessions.

Study 2

In Study 2, we examined the activities that children were engaged in during a sample of 24 videotaped sessions from two of the children in Study 1. Our goal was to explore the possibility that the differences we observed across children are associated with differences in the kinds of joint activities that children engaged in with their caregivers.

Method

Corpus Study 2 used the same corpus from Study 1 (Providence Corpus; Demuth et al., 2006). Two children (Alex and Lily) who exhibited different patterns of negation production in Study 1 were selected for this analysis (Alex tended to produce more refusal in Study 1, and Lily tended to produce more denial). Twelve videotaped sessions were selected for each child. In order to sample videos from the same developmental range for both children, we randomly selected four

[2]We did not measure this common implicitly negative expression, perhaps explaining low levels of nonexistence in our analysis.

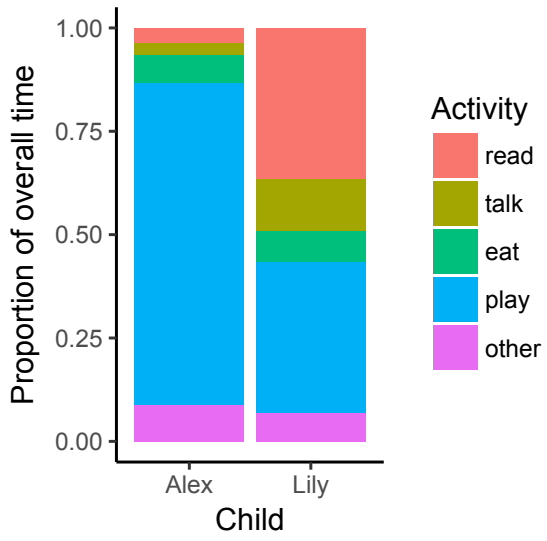

Figure 2: Proportion of time spent in different activities for each child. Colors refer to the different types of activities that children engaged in with their caregivers.

videos per child from the period when the children were between 18 and 23 months, four from the period between 24 and 35 months, and four from the period between 36 and 47 months. Within each age bin videos were randomly selected using the `sample_ n()` function in `dplyr` version 0.5.0.

Coding Videos were coded using Datavyu by a single coder using the following coding scheme. For the sake of coding efficiency, each time bin received a single code, with activities higher in the list below taking precedence. Because we were specifically examining the *joint* activities between child and caregiver (Clark, 1996), children were coded as "alone" anytime they were engaged in a solitary activity.

Alone: The adult is off-screen or not engaging with the child, even if the child is engaged in a different activity.

Eat: The child is eating food or being offered food, even if another activity is happening simultaneously.

Read: The parent and child are interacting with a book or any 2-dimensional pictures (e.g. labeling photographs).

Play-S: The parent and child are engaged in a game like patty-cake, peekaboo, or singing songs/nursery rhymes.

Play-C: The parent and child are engaged in some creative activity (e.g. drawing, playing with playdough, etc).

Play-T: Any type of play activity that involves physical objects/toys and does not fall into one of the above categories.

Play-O: Play that does not fall into an above category.

Talk: Any communicative interaction between parent and child that does not fall into the above categories.

Other: Activities that do not fall into an above category.

Unknown: Used when if the activity cannot be inferred from context (e.g. child off-screen or poor video quality).

Data Processing Because we did not see noticeable differences in negation production across the four different "play" codes, we collapsed them in the following analyses for simplicity. In the analyses below, we present only five categories:

read: The "Read" code.

talk: The "Talk" code.

eat: The "Eat" code.

play: All four of the "Play" codes

other: "Alone", "Unknown", or "Other" codes.

Results and Discussion

The goal of Study 2 was to examine whether individual differences in negation production might be associated with individual differences in the kinds of joint activities that children participated in. In Study 1, Alex tended to produce more refusal than denial, and Lily tended to produce more denial than refusal. Figure 2 shows overall differences in the types of activities that each child engaged in. Alex spent the majority of his time–78%–engaged in different types of play. Although a plurality of Lily's time was also spent in play, this only constituted 36.6% of her time overall. 36.3% of Lily's time was spent being read to, compared to 3.5% of Alex's time.

Next we incorporated the data from Study 1 to examine whether negation production varied across activities (see Figure 3). Lily produced more denial than any other type of negation. For most activities Alex showed a different pattern, producing more refusal than any other negation type. The exception to this was reading; during reading activities 72% of Alex's negations were denial compared to 9% for refusal.

Lily and Alex differ in many ways – Lily produced longer utterances earlier, perhaps leading to more opportunities to use denial. Nevertheless, both Alex and Lily use much more denial during reading. Thus, these data suggest that there might be something special about reading that elicits more denial than refusal. When parents read to children, they might be more likely to ask children questions about the *truth* of statements (e.g., "is that a doggie?"), which are more likely to give rise to denial negation compared to statements about a child's wants or needs (which might elicit more refusal).

For several of the activity categories, individual differences between the children continued to persist. This was especially striking when the children were eating: 100% of Alex's negations during eating episodes were refusal, compared to 43% for Lily. One possibility is that the caregivers engaged in different kinds of communication during eating episodes. Lily's caregiver may have asked questions about the food (e.g., "Are you eating a cookie?", which could elicit a denial negation) whereas Alex's caregiver may have asked more questions about wants and needs (e.g., "Do you want a cookie?", which could elicit a refusal negation). Another possibility is that Alex and Lily may have been engaging in other activities simultaneously. A limitation of our coding scheme is that each time bin only received a single code, and eating took precedence over other activity codes (e.g., an eating activity for Lily could involve eating and being read to at the same time).

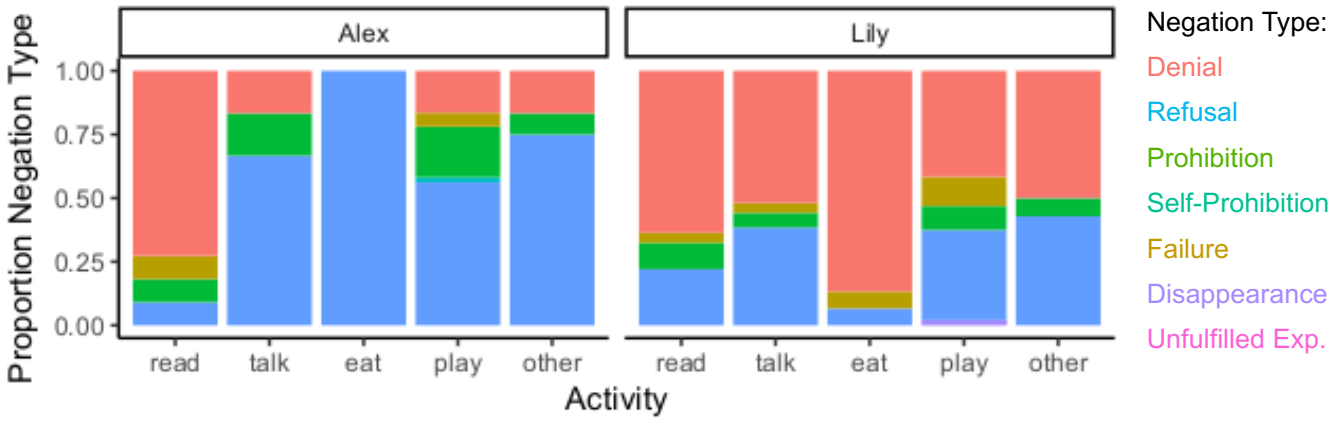

Figure 3: Proportion of different types of negation produced during different joint activities for each child. Colors represent the different negation types that children produced.

A more fine-grained analysis of the kinds of joint communication between child and caregiver could give us a clearer picture of the source of individual variation in future work.

General Discussion

Negative words like "no" and "not" allow children to express important concepts such as refusal and denial, making them important but potentially challenging for children to learn. Past literature has suggested that children first use negation to express concepts like refusal, and only later acquire denial negation. In Study 1 we examined children's natural production of negation, and found that children's acquisition of negation was not as consistent as past studies would suggest, with some children producing denial negation earlier and more frequently than others. In Study 2 we looked at the joint activities between children and their caregivers as one possible source of this individual variation, asking whether children are more likely to produce specific types of negation in different contexts. We found that reading, in particular, was associated with increased denial negation.

Why might children produce more denial when they are being read to? When parents read to children, they may be more likely to engage in "naming games" – e.g, asking a yes/no question about an object, or deliberately mis-labeling an object. Past work has found that children as young as 18 months spontaneously produce "no" or "not" in response to deliberately false statements (e.g., pointing to an apple and saying "that's the biscuit") (Pea, 1980) and yes/no questions (e.g., pointing to a dog and asking "is this a cat?") (Hummer, Wimmer, & Antes, 1993). These kinds of language games between parents and children test children's noun vocabulary and category knowledge, but also inadvertently encourage children to evaluate the truth of their parents' statement and produce denial negation when appropriate. Parents may play these naming games more often when reading books to children, in order to keep children engaged with the story.

Our analyses in Study 2 cannot fully account for all differences in children's negation production. Lily produced more denial than Alex in all activities besides reading. This individual variation might be explained by broad differences in how parents engage with their children. For example, some parents may tend to direct their child's activities rather than following their child's lead; these children may then produce more refusal in an attempt to assert their autonomy. Other parents might tend to engage in the kind of "language games" described above even outside of reading activities.

A related possibility is that children with more "advanced" conceptual development are more receptive to abstract questions about truth (e.g., pointing to a cow and asking "is that a horse?"), leading parents to engage in this kind of "naming game" more frequently. In our sample, Lily had a higher mean length of utterance (MLU) compared to Alex (Lily's MLU from ages 2-3 was 3.0 compared to 2.2 for Alex; Lily's MLU from ages 3-4 was 3.1 compared to 2.6 for Alex)[3]. Thus, it is possible that Lily was more linguistically and cognitively precocious than Alex, leading her to produce more complex negations *and* making her more receptive to reading, which could in turn elicit even more denial. Future work examining children's negation production in controlled experimental settings could help tease apart the causal role that reading might play in children's denial production.

A reasonable critique of Study 2 is whether the videotaped sessions are accurate representations of these children's day-to-day lives. For example, Lily spent 36% of her time in these videos being read to, and while reading may have been a popular activity of Lily's, it is unlikely that she actually spent a third of every day engaged in reading. Some (or many) of the differences between children may reflect differences in the types of activities parents chose to engage in during the videotaped sessions, rather than consistent differences in how

[3]MLU in words was calculated using `childes-db` (Sanchez et al., 2018)

these children spent their time.

One interesting feature of these data is that all of the children who produced more denial than refusal in Study 1 are female, and both children who produced more refusal than denial are male. Could gender be playing a role in these individual differences? We cannot determine if this generalization is reliable with such a small sample of children. Furthermore, past studies of children's production of negation examined both boys and girls, so gender cannot explain the differences between our findings and past work. It is interesting to consider, however, whether gender might interact with context. For example, parents might be more likely to issue directives to their male children, or might be more likely to play naming games with female children. Whether this is the case (and the possible causal direction of these relationships, e.g. is this driven by something innate about male vs. female children, or society's expectations about how male vs. female children should behave?) is a potential area for future work.

Our analysis of children's *production* of negation here raises questions about how much children *comprehend* about negation. Past studies have found that children as old as three have difficulty comprehending denial negation (Kim, 1985; Nordmeyer & Frank, 2014). The results of Study 1, however, suggest that children *do* understand denial negation, because they are producing it spontaneously prior to age 2. Several studies have found that 3-year-olds' ability to comprehend negative sentences depends on pragmatic context (Nordmeyer & Frank, 2014; Reuter, Feiman, & Snedeker, 2017), and recent studies of children's comprehension of denial have found comprehension in children as young as 26 months when tested in more natural, game-like contexts, (Austin, Theakston, Lieven, & Tomasello, 2014; Feiman, Mody, Sanborn, & Carey, 2017). These findings suggest that at least some of children's difficulty with the comprehension of negation is contextual. It is possible that children are capable of representing denial negation as young as 18 months, but struggle to respond correctly to tests of negation comprehension due to task demands (though see Reuter et al., 2017 for an argument that semantic processing plays an important role in 2-year-olds' difficulty with negation comprehension).

In sum, the developmental trajectory of negation is not as consistent as past work has suggested, with noticeable individual variation in children's production. Children who produce denial very early may do so in part because they are more frequently engaged in interactions that license denial (e.g., parents asking yes/no questions about objects, perhaps especially in book reading contexts). This work supports a growing body of evidence (e.g. Nordmeyer & Frank, 2014; Austin et al., 2014; Feiman et al., 2017; Reuter et al., 2017) suggesting that contextual factors play an important role in children's difficulty with negation.

Acknowledgments

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