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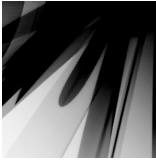
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Maternal uses of non-object terms in child-directed speech: Color, number and time

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ABSTRACT

Non-object terms including color, number and time words pose a challenge for word learning due in part to non-obvious word-referent mappings. Finding early word-word knowledge for such terms, Shatz has suggested that exposure to them in varied conversational contexts might facilitate word-word mappings. To address whether input feasibly carries such information, we examined longitudinal transcripts from the CHILDES database for the frequency and uses of subsets of color and number words in mothers' speech to toddlers and of time words to preschoolers. All the mothers studied made varied uses of the terms from these lexical categories. The findings support the argument that varied conversational input provides useful data for children to create early word-word mappings for non-object terms.

KEYWORDS

child-directed speech; preschoolers; word learning

There is a strong tradition of research on children's acquisition of object terms and the heuristics that aid in the interpretation of words referring to objects (e.g., Clark, 1993; Markman, 1992). Research on word learning has also included children's

acquisition of non-object terms such as verbs (e.g., Hirsh-Pasek & Golinkoff, 2006; Tomasello & Merriman, 1995). Lexical items such as these seem more abstract than object labels in the sense that their referents are not as easily identified or individuated in the world. Gleitman, Cassidy, Nappa, Papafragou & Trueswell (2005) propose that there is a degree of 'concreteness' to words that renders them easier or harder to acquire, with more concrete object terms being acquired first and other words – such as the verbs Gleitman et al. studied – being more difficult and requiring more information to determine their meaning.

One proposal for easing the burden of acquiring more abstract terms such as those found in the lexical categories of color, number and time is that children develop elementary lexical groupings by creating word-word mappings for items they hear in common discourse contexts (Shatz, 1993). For example, hearing typically constrained utterances about color such as 'that color is red', 'that's the color green' and 'what color is that ... red?' might cause children to relate *red* and *green* as both being terms of *color*, without even knowing what *red* or *green* or even the word *color* refers to. If so, children should manifest early organization of such words into proto-categories or lexical domains (see Backscheider & Shatz, 1993). Shatz (2005) reported on multiple experiments on color, number and time terms in which young children aged 1;7 to 5;4 showed some evidence of early lexical-domain knowledge by using a range of terms in category-appropriate ways, but without full understandings of their meanings.

If children do create lexical domains for more abstract words prior to having conceptual knowledge of them, the impetus for doing so is likely to be participation in discourse involving such words. Obviously, input is necessary for the acquisition of words of any level of concreteness. But the mapping of words to words and creating lexical domains may be aspects of a different word-acquisition trajectory from the one characterized by the *word-to-world* mapping typical for labels of more tangible referents. Certain characteristics of input may be especially relevant for children expanding their lexicon to include more abstract terms. In this paper, we examine the conversational content and contexts of maternal use of color, number and time words to young children to understand better what children hear of such terms and to consider how such input might relate to the domain-based child behavior summarized in Shatz (2005).

BACKGROUND

Evidence for word-word mappings

Recent studies by Shatz & Backscheider (2001) and Shatz (2005) examined lexical organization and the strategy of word-word mapping that young word learners seem to use when asked specific questions about letters and numbers. English-learning children aged 1;10 to 2;0 were shown pictures of U.S. symbols for letters or numbers and asked either 'What *letter* is this?' or 'What *number* is this?', with the spoken lexical-category cues matching the category of the accompanying visual symbol, or simply 'What is this?' Responses were coded as appropriate if the children provided a letter name when seeing a letter and a numeral term when seeing a number. Children

produced few correct responses overall but offered more category-appropriate responses when given spoken lexical-category cues than when hearing only 'What is this?' Follow-up studies showed the same influence of spoken category labels even with unfamiliar visual symbols (Chinese characters). Because in these cases the visual information was unfamiliar, a mapping strategy of word to object was not helpful. However, in all cases, for children using a word-word mapping strategy, the spoken cue of 'letter' or of 'number' in the question would have helped them respond appropriately, if not necessarily correctly, that is, with a word taken from the labeled lexical-category cue word. The findings that children were helped to give category-appropriate responses when asked questions with spoken lexical-category cues mirrored the findings of Backscheider & Shatz (1993) that children aged 1;7–1;10 often responded with color names to the question 'What color is this?' even when the responses were not the correct terms. As a group, these studies provide evidence that toddlers use word-word strategies and early lexical organization in discourse about abstract concepts.

Tare & Shatz (2005) asked whether preschool-aged children would give evidence of a similar word-word mapping strategy for an abstract lexical domain not yet well-learned, namely time (see Harner, 1981; Shatz, 1994). Time terms such as *minutes*, *hours* and *days* are also relatively abstract, and strategies such as 'fast-mapping' which are useful for object-term learning cannot be readily employed (Clark, 1993). Using the method of assessing the category-appropriateness versus correctness of answers to verbally-cued questions, Tare & Shatz (2005) asked children aged 3;9–5;4 about the durations of various everyday activities, asking either 'How much time does it take to ...?' or 'How long does it take to ...?' They found that the majority of preschoolers' responses were at least partially relevant to the lexical category, using either time words or numeral terms. Further, while few of the children's responses were correct, almost half were in the appropriate format of numeral plus a conventional time word (e.g., responding 'one hundred minutes' to the question 'How long does it take to eat breakfast?'). Although the question including the word *time* was no better than the 'how long' question in facilitating category-appropriate answers, preschoolers, nonetheless, like toddlers, revealed that they know which words belong in a lexical domain before they know the precise meanings of the words.

Parental input for non-object categories

Several studies addressing the role of input in the acquisition of number, color and time terms have found that the use of such terms can be quite varied. With regard to number terms, Durkin, Shire, Riem, Crowther & Rutter (1986) examined early number experiences and found that mothers use number words across contexts, including nursery rhymes and stories and counting activities. The authors consider many of these contexts to be pedagogical and interactive, for example, encouraging the child to imitate. Bloom & Wynn (1997) looked more closely at the child-directed speech of three mothers for evidence that it illustrates the rather complex syntactic and semantic constraints on the use of number words.² They found that mothers did provide evidence of the uniqueness of number terms (compared with other adjectives).

Recently, Sandhofer & Smith (2007) suggested that other adjectives also involve varied input that may make them difficult to learn. They examined a variety of

adjectives including color, size and texture words in parental input to toddlers. They found, for example, that parents' talk using adjectives can be unclear in that sentences often do not include a clearly modified noun (e.g., 'This is red.' vs. 'This is a red bear.'). Expressions of time can also be difficult in that they combine numbers and time words and some are ambiguous, with phrases such as 'wait a minute' often not meant literally.

Is there evidence that young children make use of the data provided to them for these lexical categories? In one study examining young children's ability with numbers, Lefevre, Clarke & Stringer (2002) found that French- and English-speaking children's counting skills were related to parents' teaching habits in the home, with parents' report of less teaching in French-speaking homes associated with their children's lower counting skills and knowledge of numbers. Bloom & Wynn (1997) found in their study that children observed many of the illustrated constraints on numbers (e.g., used with count nouns only, ordered before adjectives) in their own speech. Eisenberg (2006) examined children's developing knowledge of time in relation to parental input. Studying dinner-time talk between parents and preschool-aged children, she found that mothers' frequency of use of time language predicted children's frequency of use. Although much of these data are correlational and not causal, at least they suggest that children are sensitive to parental talk about these abstract categories.

It is possible that experience in conversation itself may encourage a strategy of word-word mapping, as an understanding of the need to reply differently to different types of questions develops. Researchers have proposed that young children use their limited conversational experience or partial lexical knowledge to determine what is being asked in a question and what is required for a contextually appropriate response (Bartlett, 1978; Shatz & McCloskey, 1984). As discussed in Shatz & Backscheider (2001), the child's knowledge about lexical relations and the conversational demands of answering a question may result in the use of a strategy that allows at least a discourse-appropriate answer to a question until the correct answer is known. Such proposals suggest the need for more research into the nature of the input about abstract lexical domains and its feasibility as a source of data for the sort of partial lexical knowledge revealed in the experimental studies. In this paper we examine how some mothers use color, number and time terms in conversation, and we ask whether the complexities of use in these categories may feasibly encourage mappings of word to word before individual word understanding.

More particularly, how much do parents address these abstract lexical terms to children of the ages found to demonstrate word-word knowledge in the experimental studies? In what conversational contexts and with what variety do parents use words from the color, number and time lexicons and how might these be related to what the children seem to know about how to respond in the experimental tasks? Our study used longitudinal corpora from the CHILDES database (MacWhinney & Snow, 1990) to examine maternal speech directed to children of the relevant ages. We examined mothers' use of lexical items in the categories of color, number and time words because these were the non-object terms used by Shatz and her colleagues in the experimental studies revealing word-word knowledge in young children. In the current study, we characterized the contexts of their use with regard to the kinds of meanings in discourse the mothers intended to

convey. This analysis of maternal speech in child-directed discourse helps to reveal the raw material from which children may begin to create word-word mappings and build early lexical organization for abstract lexical domains.

METHOD

Participants

Maternal speech directed to six native English-speaking children whose transcripts were available in the CHILDES child language database was examined. Corpora were selected so that the ages of the child listeners corresponded to the ages of the participants in the experiments described in Shatz (2005), that is, the ages where the children seem to have word-word knowledge but not the precise meanings of the words. The younger sample, with a total of 9,204 conversational turns examined for color and number word input, included mothers of Eve, 1;11-2;3 (Brown, 1973), Peter, 1;11-2;3 (Bloom, Hood & Lightbown, 1974) and Nina, 1;11-2;3 (Suppes, 1974). The older sample, with 26,548 conversational turns examined for time word input, included mothers of Adam, 3;0-5;2 (Brown, 1973), Sarah, 3;0-5;1 (Brown, 1973) and Abe, 3;0-5;0 (Kuczaj, 1976).

Procedure

Using the Computerized Language Analysis (CLAN) program, we searched the transcripts for instances of mothers' use of color, number and time words. In order to increase the amount of data, we expanded the color and number terms from the Shatz and Backscheider studies to include a broader range of words. The color words searched were *black, blue, brown, green, orange, pink, purple, red, white, yellow* and *color*. The number words searched were the labels *two* through *twenty* and *number*. The number *one* was excluded because of its ambiguity: *one* is a commonly used pronoun, and distinguishing its use as a number is difficult. It could be used in counting as a number (see Table 1) or in phrases such as 'here's one', where its status as a number or pronoun is difficult to determine. The time words searched were *minute(s), hour(s), day(s), year(s)* and *time*, based on the experimental study by Tare & Shatz (2005). We chose not to expand this list because a previous search of CHILDES data in preparation for the experiment had suggested these words as most frequent in speech to young children.

Within the transcripts, one line preceding and one line succeeding each instance of a target word were excerpted in order to code the context of each use. Descriptive statistics, including frequency of each word's use and percentage of use out of total maternal conversation turns, were also calculated.

Coding

We developed three sets of contextual codes, one for each of the lexical categories, color, number and time; every instance of an identified target word in each lexical

Table 1 Coding designations for color, number and time word category codes

<i>Coding designations</i>	<i>Definition</i>	<i>Example</i>
Color		
Identifying a color	Initiates color talk with an adjective	'red boots', 'Is he purple?'
Color correction	Corrects a color statement made by the child	'that's not blue, sweetie'
Color question	Asks a question using the word 'color'	'What color is this?', 'What color do you want?'
Other-color	Uses color word differently (as an object label or verb)	'orange peel', 'How did you color that picture?'
Number		
Counting	Uses term to count	'one, two, three'
Labeling a number	Uses term to label a numeral symbol	'There's your three', 'And there's an eight'
Identifying quantity	Specifies the quantity of items	'There's two soldiers', 'Two pieces of bread'
Clock time number	Indicates a specific time with a number word	'three o'clock'
Duration	Uses number word for an amount of time	'they're coming in two weeks'
Number correction	Corrects a number statement made by the child	'no, there are two balls'
Other-number	Unclear use	'two what?'
Time		
Activity duration	Refers to event duration	'about twenty five minutes', 'all day'
Past activity	Refers to past event	'last year', 'the other day'
Future activity	Refers to future event	'next year', 'some day'
Clock time	Refers to clock time	'five minutes after five'
Frequency	Indicates frequency of recurrent activity	'every day', 'once a year'
Age	Refers to someone's age	'he's six years old'
Time instruction	Explicitly instructs about time/clock	'that's the minute hand and that's the hour hand'
Waiting	Request for patience	'wait a minute', 'just a minute'
Other-time	Common expressions with a time component	'Christmas day', 'good day'

Note. Coded lexical items are in italics.

category received one code designation. The coding designations were developed to take into account the kinds of intents expressed in mothers' speech. Some mirrored the intent behind the questions in the experimental studies. For example, the color code included a designation *color question* for mothers asking 'what color is this?', and the time code included an *activity duration* designation, for mothers speaking about the length of an event ('about 25 minutes'). Some were added to account for the sorts of instances we found in the transcripts, for example, the *waiting* designation ('just a minute') in the time code. The coding designations are listed in Table 1.

Reliability

Initial reliability was calculated on 10.5% of the data overall. Ten percent of the data from each of the two children with a sufficient number of color and number instances (Eve and Nina) was coded for reliability. Average reliability was 96% for color word coding and 100% for number word coding. Ten percent of the time word instances for each of the three older children was coded for reliability; initial reliability was at 80%. Time word coding categories were refined, and then another 10% for each child was coded for reliability, yielding an average of 94% reliability overall. Disagreements between the two coders were resolved by discussion.

RESULTS

Table 2 shows the percentage of conversational turns that included color, number and time terms for all the children. However, only the color and number terms used by mothers of the younger children and time terms used by mothers of the older children were coded for the context of use. This was done in order to examine input at the ages at which children demonstrate word-word knowledge. Although frequency percentages of target words are low, the transcripts of every one of the

Table 2 Maternal conversational turns and word frequency data, in percentages

<i>Corpus (ages)</i>	<i>No. maternal turns</i>	<i>Color words (%)</i>	<i>Number words (%)</i>	<i>Time words (%)</i>
Eve (1;11–2;3)	3201	3.2	1.9	1.4
Peter (1;11–2;3)	432	0.5	1.4	0.2
Nina (1;11–2;3)	5571	7.4	0.9	0.2
Adam (3;0–5;2)	9846	1.5	2.4	0.4
Abe (3;0–5;1)	4647	1.3	2.8	1.2
Sarah (3;0–5;0)	12055	2.7	5.3	3.1

Note. Data in bold were coded for contexts of maternal use.

mothers included at least some of the target words produced during the child-age period studied. The corpus for one child (Peter) had far fewer maternal conversational turns and instances of target words than those for the other five children. Despite this, the rate of number term usage (but not color term usage) falls within the usage rates found in the other two corpora searched for number terms.

For each mother of a younger child, the percentage of words in each coding designation was calculated for the color category and for the number category, using the total instances of a particular designation over total instances of words coded from that lexical category. Although the two color and six number terms Peter's mother produced received coding designations, there were too few instances to compare categories; thus, Table 3 presents the data for color and number term coding designations for the other two mothers only.

Although overall there were more color than number terms found in the corpora of mothers talking to their young children, only four designations were needed to describe the intentional discourse contexts for the color words, whereas seven were needed for the number terms. Both mothers produced terms in all four color contexts and both did so for all but one of the seven number contexts. By far the most common type of talk about color was identifying a color, and although both mothers asked color questions, one did so much more than the other. Both mothers used all 10 of the specific color terms searched for, as well as the term *color*, but unsurprisingly, *color* was much more frequent in the speech of the mother who asked many color questions.

Table 3 Percentage of maternal color and number words, by coding designations, used to younger children

<i>Coding designations</i>	<i>To Eve</i>	<i>To Nina</i>
Color		
Identifying color	75.5	59.2
Color question	2.9	34.0
Color correction	8.8	4.4
Other-color	12.8	2.4
Number		
Identifying quantity	58.1	66.0
Clock time number	1.6	12.0
Labeling a number	16.1	2.0
Counting	12.9	10.0
Duration	9.7	0.0
Number correction	1.6	6.0
Other-number	0.0	4.0

Note. Total no. color code designations: Eve = 102, Nina = 412; total no. number code designations: Eve = 62, Nina = 50.

Table 4 Percentage of maternal time words, by coding designations, used to older children

<i>Coding designations</i>	<i>To Adam</i>	<i>To Abe</i>	<i>To Sarah</i>
Activity duration	12.5	38.2	34.8
Past activity	37.5	10.9	17.8
Future activity	17.5	9.1	4.0
Waiting	15.0	0.0	13.5
Clock time	2.5	0.0	1.3
Age	2.5	7.3	4.6
Frequency	0.0	1.8	3.5
Time instruction	0.0	10.9	1.6
Other-time	12.5	21.8	18.9

Note. Total no. time code designations: Adam = 40, Abe = 55, Sarah = 371.

The most common type of number talk was identifying the quantity of objects. While both mothers participated in a fair amount of counting and both identified number symbols, they varied on the rate at which they did the latter, as well as on the frequencies of other uses of number terms. Searched-for numbers over 10 almost never occurred, but one mother used all nine of the others and one used five. The term *number* did not occur in either mother's data; possibly the term is rarely directed to such young children because when their mothers ask about quantity, they ask 'how many ...' (Durkin et al., 1986) or possibly because there was, compared with color, less talk overall about number directed to the young children.

Table 4 shows the percentages, by mothers of older children, of the words coded from the time category that were given each designation. The time terms from the mothers required nine coding designations in all, with five of them used by all three mothers, and the other four used by two of the three mothers. For two of the mothers, activity duration was by far the most common use of time terms; for the third, it accounted for more than 10% of her usages. That mother signaled past and future events with time terms at a greater rate than did the other two mothers. Two mothers used all four of the time terms searched for, and one used three; all the mothers used the word *time* on multiple occasions.

DISCUSSION

We found evidence that maternal input of color, number and time words is available to children at ages that correspond to the times when children give evidence of these early lexical categories. While the rate of use was not high, all mothers used words from the lexical categories and, with the exception of numbers above 10, they were uniform in using almost all the searched-for terms. There was also

remarkable commonality in the contexts in which the words were used, although apart from the most frequent uses, there was individuality in context frequencies as well. In short, despite their relatively low frequency, children are hearing a variety of terms from these categories before they themselves can use them correctly (as evidenced by the experimental studies) and they hear them in a variety of linguistic and intentional contexts. In addition to the kinds of linguistic variation that Bloom & Wynn (1997) and Sandhofer & Smith (2007) examine, we add here that mothers have different conversational intents in using these words.

Interestingly, much of what young children hear for color and number terms are adjectival uses: labeling a specific color of an object or specifying the quantity of objects. Frequent 'identifying' input might be expected to facilitate correct color term usage if such usage were based on simple associations between, say, the word *red* and the percept of a particular wavelength or range of wavelengths. However, the relative frequency of maternal identifying uses does not seem to account for what toddlers are doing when they give category-appropriate, but not correct, responses to color and number questions in experimental settings. Other research on color, number and time acquisition suggests that concept-to-word mappings for color, number and time may be difficult for a number of reasons: not only are they more abstract than object-label mappings, but they require different sorts of perceptual, linguistic and cognitive understandings than do object-label mappings. For example, some researchers have suggested that color terms may pose a particular problem because a continuous perceptual spectrum must be accurately categorized into discrete lexical items (Shatz, Behrend, Gelman & Ebeling, 1996). Regarding number terms, Bloom & Wynn (1997) argue that numbers are special cases of property terms because they refer to sets of items rather than individuals, making them more abstract. Finally, Nelson (1996) discusses how children must reconcile both the definite (e.g., five minutes) and indefinite (e.g., just a minute) uses of time words in order to come to a complete understanding of these words and phrases.

Nonetheless, the 'identifying' input might still be useful for creating word-word relations both between superordinate category labels and subordinate terms as well as among subordinate terms. Consider, for example, excerpt (1) from Nina's corpus. In just a few turns, her mother uses the superordinate term *color* when asking about the clothing Nina is wearing, as well as using two subordinate terms with similar phrasing.

(1) Nina, 2;2

*MOT: what color is it?

*CHI: it's green.

*MOT: it's green.

*MOT: you have a green sweater on but you have a white turtleneck on.

Such interchanges could encourage children to group some words together under the rubric of a broader term that seems to refer to each of them.

To get a sense of how the children responded to their parents' use of these abstract lexical items, we examined children's utterances that immediately followed parents' coded utterances. Although in over 80% of the cases there was either no

immediate response or an unrelated one, occasionally we found evidence of children's limited understanding. In excerpt (2) from Eve's corpus when she is 2;1, we see how children might be relating lexical items to each other and using them in an appropriate, but not correct, way.

(2) Eve, 2;1

- *MOT: more than two cups.
- *MOT: count them.
- *MOT: how many?
- *CHI: three four seven eight nine two.

Here Eve shows her knowledge of the lexical category of numbers by listing several terms in a row after her mother has requested that she 'count', but she also demonstrates her limited understanding of the rules of counting.

In the lexical category of time, Sarah (excerpt 3), at age 3;6, also demonstrates that she has associated the superordinate term *time* with other words and phrases in the lexical category.

(3) Sarah, 3;6

- *CHI: can we have a game?
- *MOT: why don't cha wait a few minutes?
- *MOT: whyn't cha tell time?
- *CHI: time o'clock.
- *MOT: what time is it?
- *CHI: ten o'clock.
- *MOT: ten o'clock?

Sarah's mother's query of her answer suggests Sarah's second attempt at telling time ('ten o'clock') was not correct; in any case, it was certainly an appropriate answer to the time question. Her first attempt ('time o'clock') also demonstrates how she might have associated related lexical items. Thus, although often the discourse initiated by parents did not continue on a relevant topic, child responses did sometimes offer evidence of early lexical organization.

Although early exposure to these varied intentional and linguistic contexts may seem to complicate the learning task, it may in fact make it more realistic for complex concepts, helping the child first to identify the groups of words that express aspects of abstract concepts which the child has yet to understand fully. The varied uses of time words are a case in point. Children hear time words used not just as measures of activity durations but in vague references to time, as idioms ('wait a minute') or statements about the past or future ('the other day'). Unsurprisingly, then, they appear to group time words together before they know which time words signal which precise values on the time dimension. A word-word mapping strategy might be particularly useful in these cases where children are gleaning relevant lexical information, perhaps in order to respond appropriately.

It is important to note that we argue on the basis of our data only that the characteristics of child-directed speech we have described make feasible the patterns of word-word mapping or lexical category organization reported in Shatz (2005), not

determine them. Our data show that the lexical items in question appear relatively infrequently, but they do appear in varied contexts and in combination with different words from their respective lexical category. The fact that children do not map words to percepts directly in these cases, but seem to group words together, suggests that the children themselves appear to bring some organizational strategies to the input. The experimental data and the excerpts above give evidence of children picking up on the specific lexical categories before the meanings of specific terms.

One limitation of this study is that we do not know precisely how the children used the input. Further, we have studied only a few examples of abstract categories; there may be others where children might discern the relationships among words and the requirements of discourse early on. Nonetheless, this perspective on the importance of input in conversational contexts is in line with recent research suggesting that children use a variety of cues to word-learn (Diesendruck, 2007). In this sense, the input may be richer than previously thought, but also children are seen as capable of making use of that richness (Shatz, 2007).

One further limitation of this study is that we have examined only English-speaking mothers. Whether and where children learning other languages might use word-word mapping strategies, and whether early word-word mapping is a general word-learning strategy or is confined to more abstract lexical categories, are empirical questions. Indeed, like Bloom & Wynn (1997) for number, we suspect that children exposed to languages with different linguistic characteristics from English for abstract lexical-category terms will show different early usage patterns for them from English-learning children.

In sum, our mothers used a range of terms from abstract categories in varied contexts, including color words to describe objects, number words to quantify sets, and time words to talk about the durations of events. They also did some overt teaching with these words by asking questions about color, by counting and by labeling number symbols. Thus, our data suggest that in conversations with their children, English-speaking mothers provide the varied lexical items in varied constructions and content that young English-learning children need to be able to create word-word mappings and to start building lexical categories of words that refer to non-obvious concepts.

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NOTES

1. Now at Wayne State University, Detroit, MI.
2. Bloom & Wynn (1997) examined the CHILDES transcripts of Eve and Peter, who are also examined in the present study. However, their study addressed specifically how syntactic

and semantic constraints on the use of number words afforded conceptual information that children may use in their eventual understanding of the specific meanings of number words. They did not discuss the percentages of maternal utterances containing number words or code for all the uses of number words, as we do in the present study, with an eye to the feasibility of child-directed speech for early lexical-category groupings.

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