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A million is more than a thousand: Children's acquisition of very large number words

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Research Highlights

1. When do children acquire meanings for very large number words such as “hundred”, “thousand”, “million”, “billion”, and “trillion”?
2. We tested 5- to 8-year-olds on a verbal number comparison task, and found that by 6, children understand the relative order of large numbers.
3. Using the CHILDES database, we also analyzed the frequency and contexts in which adults use very large numbers.
4. Adults were more likely to use large numbers to reference units of quantification for money, weight, and time, than for discrete, physical entities.

Abstract

Very large number words such as “hundred”, “thousand”, “million”, “billion”, and “trillion” pose a learning problem for children because they are sparse in everyday speech and children’s experience with extremely large quantities is scarce. In this study, we examine when children acquire the relative ordering of very large number words as a first step towards understanding their acquisition. In Study 1, 125 5- to 8-year-olds participated in a verbal number comparison task involving very large number words. We found that children can judge which of two very large numbers is more as early as age 6, prior to entering first grade. In Study 2, we provided a descriptive analysis on the usage of very large number words using the CHILDES database. We found that the relative frequency of large number words does not change across the years, with “hundred” uttered more frequently than others by an order of magnitude. We also found that adults were more likely to use large number words to reference units of quantification for money, weight, and time, than for discrete, physical entities. Together, these results show that children construct a numerical scale for large number words prior to learning their precise cardinal meanings, and highlight how frequency and context may support their acquisition. Our results have pedagogical implications and highlight a need to investigate how children acquire meanings for number words that reference quantities beyond our everyday experience.

Keywords: number words, large numbers, CHILDES, math curriculum

Words such as “thousand”, “million”, “billion”, and “trillion” pose a special learning problem for children because the frequencies of these words are sparse in adult speech (Dehaene & Mehler, 1992; Willits, Jones, & Landy, 2016) and our experience with large quantities is scarce, making it difficult to form a mapping between very large number words and their corresponding quantities. How do we acquire meanings for numbers that reference quantities that are beyond everyday experience? Much of the literature on number word acquisition has not examined this question, as previous studies tend to focus on how children learn that number words within children’s count lists, such as “five” or “six”, refer to exact cardinalities (Carey & Barner, 2019; Wynn, 1990, 1992; See Cheung & Ansari, for a review). Even studies that have examined the acquisition of meanings for number words outside of children’s count lists have only included numbers in the tens or hundreds (Miller, Smith, Zhu, & Zhang, 1995; Cheung, Rubenson, & Barner, 2017; Schneider et al., 2020; Barth, Starr, & Sullivan, 2009; Sullivan & Barner, 2014). Few studies have examined the acquisition of very large number words. In this study, we ask when children can place very large number words (termed VLNW) – “hundred”, “thousand”, “million”, “billion”, and “trillion” – in numerical order. We reason that before children learn the precise cardinalities represented by VLNW, ordinal meanings form the first meanings acquired by children.

Previous studies on very large numbers have focused on whether we understand the relative magnitudes of them. For example, Landy and colleagues (2013) show that adults mistakenly treat “thousand”, “million”, and “billion” as equally spaced on a number line. Similar findings have been shown in undergraduate students enrolled in science programs who can order major events on earth (e.g., origin of life, appearance and disappearance of dinosaurs, and

appearance of humans), but have difficulty indicating the distance between these events on a timeline (Libarkin, Kurdziel, & Anderson, 2007; Resnick, Newcombe, & Shipley, 2017). Studies with children have also examined similar questions but typically on smaller numerical scales (Thompson & Opfer, 2010; Siegler & Opfer 2003). For example, Thompson and Opfer (2010) found that third-graders, but not second-graders, can estimate where numbers in the hundreds go on a 0-1000 number line, and that accuracy of numerical estimation on larger numerical scales (e.g., 0-10,000, 0-100,000) improves throughout the primary school years. These results suggest that at least by third grade, children know the numerical order of some large numbers. Nevertheless, previous studies tend to present large numbers primarily in Arabic notation, and number line estimation tasks assess participants' understanding of the numerical distance between numbers, which requires knowledge that integrates both ordinal and cardinal aspects of numbers. Thus, questions about whether younger children understand the ordinality of VLNW remains largely unknown.

In the handful of studies that have examined children's understanding of the infinite nature of numbers, 4- to 7-year-old children sometimes responded with numeral phrases that include VLNW when asked to think about very large numbers (e.g., "nineteen thousands", "one hundred billion"; Cheung, et al., 2017; see also Chu, Cheung, Schneider, Sullivan, & Barner, 2020; Hartnett & Gelman, 1998), suggesting that they may recognize these number words as referencing very large quantities. This raises the possibility that young children may know the ordinality of VLNW before learning the precise cardinalities denoted by these words. In this study, we test whether the numerical ordering of "hundred", "thousand", "million", "billion", and "trillion" forms one of the first meanings of VLNW for children.

The present study

The goal of the present study is twofold. First, we ask when children acquire the relative ordering of VLNW. Importantly, we focus on a sample of children who have not yet been taught the definitions of VLNW (e.g., “thousand” is “ten times a hundred”) according to the Ontario Math Curriculum (Ontario Ministry of Education, 2005): kindergartners and early primary school children. We predicted that children would acquire the rank ordering of VLNW in steps, first recognizing that “hundred” represents the smallest quantity but not differentiating among other VLNW, and sometime later, being able to distinguish “thousand” from words that end with the -llion suffix (“million”, “billion”, “trillion”), which may remain undifferentiated until later in development. We thus predicted an interaction between age and type of VLNW.

Second, we ask how children may acquire the ordinal meanings of VLNW. While children often like to count to a “hundred”, we rarely count to a thousand or beyond. Our experience with large quantities beyond a “thousand” is limited. In addition, VLNW are not formally taught until later in primary or secondary school. Yet, past studies show that children do interpret them as number words, suggesting that they can potentially draw on input provided outside of the classroom to learn their meanings. In this study, we examine the contexts in which adults use VLNW in conversations to shed light into this question. Specifically, we analyze the frequency and context in which adults use VLNW in everyday speech using Child Language Data Exchange System (CHILDES; MacWhinney, 2000).

Study 1

Method

Participants

We tested 125 5- to 9-year-old children ($M = 7;1$, $SD = 13.6$ months, range = 4;9 to 9;3;

60 females) recruited from schools in Southwestern Ontario, Canada in the spring of the school year. We planned to recruit 128 children for this study, with 32 children from each age group. The study was pre-registered at <https://osf.io/myz2p/>. Due to COVID-19, we terminated our study before we reached the target sample for 5-year-olds. Our final sample included 23 5-year-olds ($M_{\text{age}} = 5;5$, $SD = 3.9$ months), 33 6-year-olds ($M_{\text{age}} = 6;5$, $SD = 2.0$ months), 35 7-year-olds ($M_{\text{age}} = 7;6$, $SD = 3.6$ months), 31 8-year-olds ($M_{\text{age}} = 8;6$, $SD = 4.0$ months), and 3 9-year-olds who were younger than 9;3 were combined with the 8-year-olds in this study.

Verbal Number Comparison Task.

We assessed when children can place VLNW in numerical order using a verbal number comparison task. Stimuli were presented on a laptop computer, via PsychoPy2 (Peirce, et al., 2019), and the instructions were recorded. On each trial, children saw Big Bird on the left and Cookie Monster on the right, and were asked to choose the character who had more - e.g., “Big Bird has [a hundred] [keys] and Cookie Monster has [a thousand] [keys]. Who has more [keys]?” No objects were shown. Participants indicated which character had more by pressing a yellow key on the left for Big Bird, or a blue key on the right for Cookie Monster.

On each trial, children heard a pair of VLNW. Each pair was formed by comparing two of five VLNWs: hundred, thousand, million, billion, and trillion. To test whether children understand the relative ordering of VLNW, we combined pairs of VLNW to create three types of comparisons: hundred-comparison, thousand-comparison, and billion-comparison. Hundred-comparison consists of pairs including hundred vs. thousand, hundred vs. million, hundred vs. billion; thousand-comparison includes thousand vs. million, thousand vs. billion, thousand vs. trillion; billion-comparison consists of million vs. trillion, billion vs. trillion, million vs. billion.

There were nine comparison pairs in total, and the only possible pair not included was hundred vs. trillion. The determiner ‘a’ always preceded the VLNW.

Each comparison pair appeared once in each of four blocks of test trials, for a total of 36 test trials. Nine monosyllabic nouns for common objects were used: blocks, balls, cars, hearts, hats, trucks, trains, keys, and rings.

Procedure

The study began with four practice trials (1 vs. 2, 99 vs. 11, 2 vs. 1, and 11 vs. 99), followed by four blocks of test trials. Because of the odd number of test trials, there were 5 correct answers on the left and 4 on the right for two of the blocks, and 4 correct answers on the left and 5 on the right for the other two blocks. For each pair, the larger VLNW was presented on the left for half of the blocks and on the right for the other half of the blocks. The order of pairs of VLNW was pseudo-randomized, and there were two item orders.

Results and Discussion

The preregistered analysis plan, analysis code, and data are available at <https://osf.io/myz2p/>. Exploratory analyses were noted in the manuscript. Multiple comparisons were corrected using Holm-Bonferroni.

We asked whether children acquire the rank ordering of VLNW in a 3 Comparison Type (hundred-, thousand-, and trillion-comparison) x 4 Age Group (5-year-olds, 6-year-olds, 7-year-olds, 8-year-olds) mixed ANOVA. We found a main effect of Age Group, $F(3, 121) = 25.8$, $MSE = 0.04$, $p < .001$, $\eta p^2 = .39$, and a main effect of Comparison Type, $F(1.9, 229.67) = 13.8$, $MSE = 0.02$, $p < .001$, $\eta p^2 = .092$. Children were more accurate on hundred-comparisons than thousand- and trillion-comparisons, $t(124)$'s > 4.08 , p 's $< .001$, but the latter did not differ from each other, $t(124) = 1.39$, $p = .17$. Contrary to our prediction, there was no interaction between Type and

Age Group, $F(5.69, 229.67) = 1.65$, $MSE = 0.02$, $p = .14$, $\eta p^2 = .039$. Table 1 shows that children across all age groups performed better on hundred-comparisons relative to llion- and thousand-comparisons.

Next, we examined at what age children begin to acquire the rank ordering of VLNW in a planned analysis. The probability of being correct by guessing on the 2AFC Verbal Number Comparison Task is 50%. We found that all age groups performed significantly above chance (50%) on the Comparison Task, all t 's > 3.60 , p 's $> .0015$. We conducted exploratory analyses comparing each age group to its younger group. We found a significant difference in average proportion correct between the 5- and 6-year-olds, $t(54) = 2.35$, $p = .022$ (adjusted $alpha = .025$), $d = 0.48$, and the 6- and 7-year-olds, $t(66) = 3.92$, $p < .001$ (adjusted $alpha = .017$), $d = 0.68$ ($M_{7yo} = .78$). The 7- and 8-year-olds were not significantly different from each other, $t(67) = 1.84$, $p = .070$ (adjusted $alpha = .050$), $d = 0.29$ (see Table 1).

Table 1. Means (SDs) for each comparison type.

Age Group	Hundred	Thousand	-llion	Overall Average
5-year-olds	.61 (.17)	.55 (.15)	.59 (.17)	.58 (.16)
6-year-olds	.70 (.20)	.63 (.20)	.67 (.13)	.67 (.18)
7-year-olds	.87 (.11)	.71 (.18)	.77 (.14)	.78 (.16)
8-year-olds	.87 (.13)	.82 (.17)	.79 (.17)	.83 (.16)

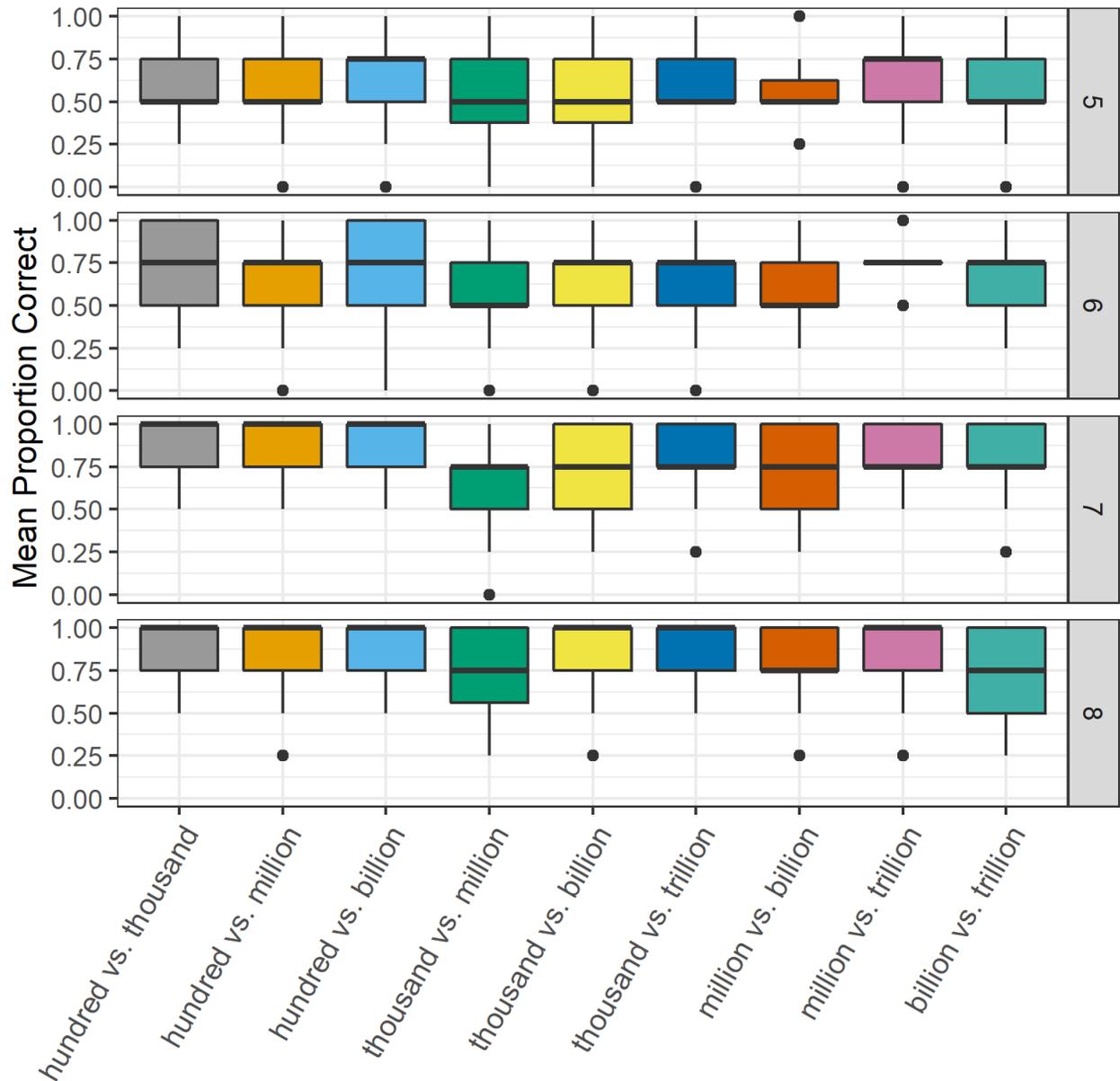


Figure 1. Boxplots for individual comparison pair by age group.

These findings suggest that the acquisition of ordinal meanings of VLNW undergoes rapid development before children turn 7. To probe the robustness of early knowledge, we asked whether 5- and 6-year-olds can perform numerical judgments on each Type. In an exploratory analysis, we found that 6-year-olds were above chance on hundred-, thousand-, and billion-

comparisons, $t(32)$'s > 3.67 , p 's $< .001$, d 's > 0.64 (Table 1). Five-year-olds, on the other hand, were significantly above chance on hundred-, $t(22) = 2.98$, $p = .007$ (adjusted $alpha = .017$), $d = 0.62$, and billion-comparisons, $t(22) = 2.52$, $p = .019$ (adjusted $alpha = .025$), $d = .53$, but not on thousand-comparisons, $t(22) = 1.64$, $p = .11$ (adjusted $alpha = .05$), $d = 0.34$.

Did 5-year-olds recognize “hundred” represent the smallest quantity and thus have partial knowledge of the numerical order of VLNW? To test this, we asked whether 5-year-olds were above chance on each pair of hundred-comparisons. In an exploratory analysis, we found that they did not consistently judge that “hundred” represents the smallest quantity: hundred vs. billion was significantly above chance, $t(22) = 2.73$, $p = .012$, $d = 0.57$, but hundred vs. thousand, $t(22) = 2.31$, $p = .031$ (adjusted $alpha = .025$), $d = 0.48$, and hundred vs. million, $t(22) = 1.04$, $p = .31$, $d = 0.22$, were not (see Figure 1). Their above-chance performance on billion-comparisons also were driven by million vs. trillion ($t(22) = 3.27$, $p = .0035$, adjusted $alpha = .017$, $d = 0.68$). The other two billion-comparison pairs were not different from chance, t 's < 1.16 , p 's $> .25$, d 's $< .24$ (see Figure 1). Six-year-olds were above chance on all individual pairs (t 's > 2.15 , p 's < 0.039).

In our final analysis, we asked how children's performance may be related to educational levels. This analysis was not preregistered. Our sample included 34 kindergartners ($M_{age} = 5;9$, Range = 4;9 to 6;4), 38 first-graders ($M_{age} = 6;9$ months, Range = 5;7 to 7;4), 30 second-graders ($M_{age} = 7;11$ months, Range = 7;5 to 8;6), and 23 third-graders ($M_{age} = 8;7$ months, Range = 7;8 to 9;3). Age group was significantly correlated with grade, $tau = .82$, $p < .001$. Kindergartners were above chance on each of the three comparison types ($t(33)$'s > 2.34 , p 's $< .025$); nevertheless, they continued to show significant linear improvement until the second grade ($M_{kindergarten} = .59$, $M_{G1} = .71$, $M_{G2} = .82$; t 's > 4.22 , p 's $< .00018$).

Results from Study 1 thus showed that children acquire the relative ordering of VLNW during the kindergarten years, or around age 6. In Study 2, we examine one potential source of input that may help children learn the ordinal meanings of VLNW. Using the Child Language Data Exchange System (CHILDES; MacWhinney, 2000), we provide a descriptive analysis of how adults use VLNW in everyday conversations. Study 2 was not preregistered.

Study 2

Method

Included Transcripts

Given the low frequency of VLNW in adult speech (Willits, et al., 2016), we selected a wide range of corpora ($N = 25$) from the North American English CHILDES database (MacWhinney, 2000). Corpora were selected if they included children older than age 3. We used 3 years old as a conservative cut-off because Study 1 showed that ordinal knowledge of VLNW emerges around ages 5 to 6. The selected corpora included a range of settings (e.g., free play, meal times, classroom interactions). Appendix A lists the CHILDES corpora searched. Two corpora did not contain any VLNW.

Utterance Search and Exclusions

We searched for utterances containing “hundred”, “thousand”, “million”, “billion”, “trillion”, and their plural form (e.g., “hundreds”, “thousands”). We excluded words such as “hundredth” and “millionaire” ($n = 6$). The initial search yielded 1015 utterances. We removed utterances in which the speaker could not be identified ($n = 13$). Upon coding, we noticed that in one of the sub-corpora (HSLLD database; Dickinson & Tabors, 2001), all parents were asked to read the same books (“What Next, Baby Bear!”, “Animals in the Wild: Elephant”) that contained

phrases such as “millions of stars” or “two hundred pounds”. We removed the book reading sub-corpora from our analyses. The final dataset yielded 365 utterances (403 tokens) of VLNW by adults and 241 utterances (262 tokens) by target children aged between 3 and 9.

Analysis and Coding

We performed three analyses. First, we calculated the overall frequency of VLNW in adult and child speech. Then we performed our main analysis on whether adults contrast VLNW in speech. We hypothesized that numerical contrasts of VLNW may help children learn its numerical order. We coded whether adults contrast VLNW within the same utterance and across utterances in a conversation. For contrasts within the same utterance, we coded how often adults contrast VLNW with other VLNW or number words (e.g., that’s not a hundred, it’s a thousand) and called this *explicit semantic contrast*. We also coded similar contrasts that appear across utterances in a conversation, defined as 20 lines before or after a target utterance, and called this *implicit semantic contrast*. In addition, we examined how often adults use different VLNW in a numeral phrase (e.g., two hundred thousand), and called this *syntactic contrast*. We reasoned that children may be able to infer the order of magnitudes of VLNW through their order of appearance in a complex numeral phrase (e.g., two hundred thousand; Hurford, 1975). In our final analysis, we coded the context of use for each VLNW, including nominal use (e.g., a bus number), adjectival use (e.g., “a hundred-watt bulb”), cardinal use (e.g., “a million books”), counting, and so on. Appendix C lists the contexts of use and number of instances for each. We focused on cardinal uses of VLNW and coded whether the noun refers to an “easy” unit of quantification that include discrete physical entities such as animate and inanimate objects (e.g., people, books) and temporal intervals (e.g., jumps), or an “abstract” unit of quantification that

include collections (e.g., families) and units of measurement (e.g., feet, pounds; see Le Corre et al., 2016 for a similar coding scheme). To ensure accuracy of the noun reference, the coder read 20 lines before and after the target utterance.

The first author coded all transcripts. A second coder not aware of the study objectives double-coded all instances for the analyses. Agreement averaged 96.0 % (range: 90.0% to 99.5%) for the analyses and kappa's averaged .68 (range: .46 to .93). The two coders resolved all discrepancies through discussion, and the dataset for analysis included resolved discrepancies.

Results

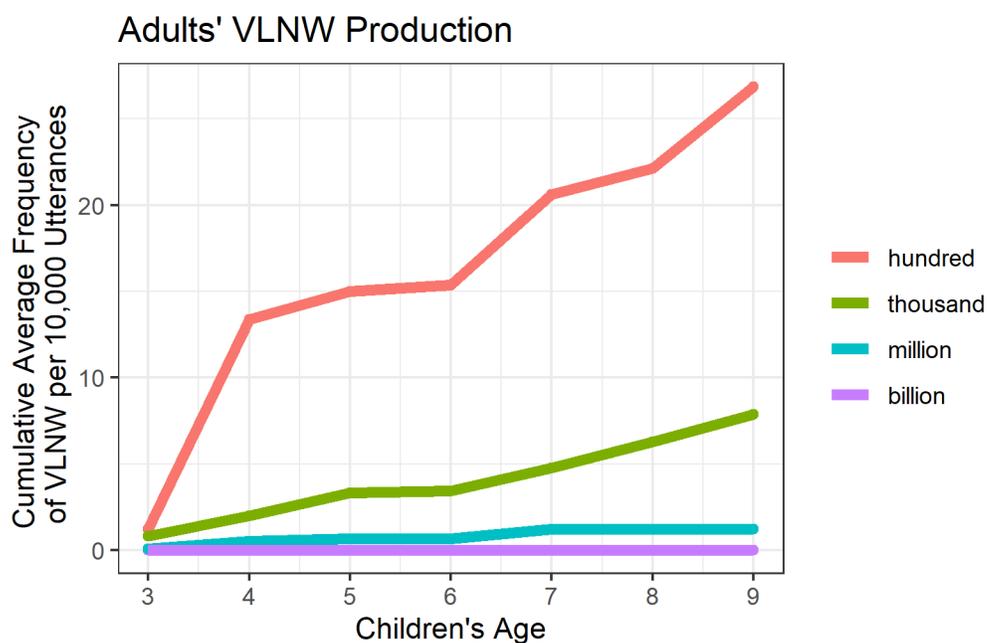
Overall Frequencies of VLNW in Adult and Child Speech

We calculated frequency as the number of occurrences of each VLNW per 10,000 utterances across all adult speakers within each corpora. Given the low frequency of the plural form of VLNW (0.44 tokens/10,000 utterances), we focused our frequency analysis on singular VLNW (14.4 tokens/10,000 utterances). Table 2 presents average frequency and raw counts by word and shows that the average frequency of singular VLNW follows the cardinal order.

Table 2. Average frequency per 10,000 utterances and number of tokens.

	Adults (<i>n</i> = 329 tokens)	Children (<i>n</i> = 248 tokens)
Hundred	13.06 (<i>n</i> = 206)	11.41 (<i>n</i> = 170)
Thousand	1.40 (<i>n</i> = 84)	1.2 (<i>n</i> = 53)
Million	0.59 (<i>n</i> = 33)	0.39 (<i>n</i> = 23)
Billion	0.059 (<i>n</i> = 6)	0.062 (<i>n</i> = 2)
Trillion	0	0

To examine how adult production of VLNW varies across development, we averaged across the frequency of VLNW by age of child in years and computed cumulative frequency of each VLNW. We removed corpora that had average frequencies more than 3SDs above the mean for each VLNW because corpora with relatively few total utterances would result in overestimated average frequencies.¹ We conducted the same frequency analysis on children's utterances. Figure 2 shows that adult and child production of VLNW largely mirrors each other, with “hundred” uttered more frequently than others by an order of magnitude. Notably, these data show that the relative frequency of VLNW does not change drastically across the ages for both adults and children.



¹ For adults (children), 1(1) corpus was removed for “hundred”, 1(1) was removed for “thousand”, 4(3) were removed for “million”, and 3(1) were removed for “billion”.

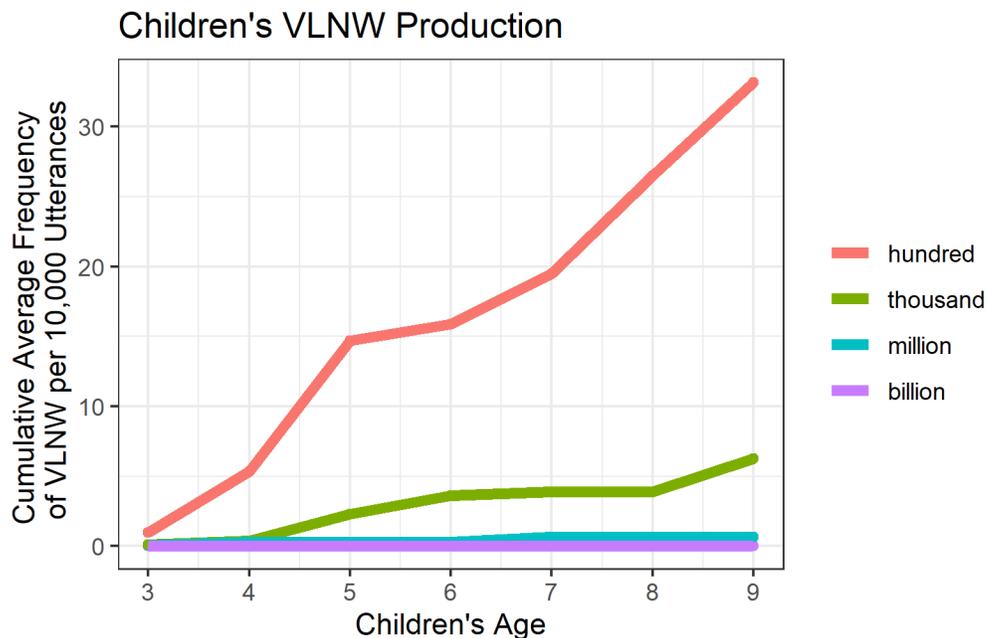


Figure 2. Cumulative average frequency per 10,000 utterances across ages 3 to 9 in the CHILDES North American corpora, for adults and children. No instances of “trillion” were found in the corpora.

Numerical Contrasts of VLNW in Adult Speech

We found that explicit semantic contrast was infrequent ($n = 10$ utterances; contrasts with VLNW, $n = 4$, with other number words, $n = 6$). Implicit semantic contrast occurred slightly more frequently, for a total of 36 utterances (contrasts with VLNW, $n = 16$, with other number words, $n = 20$). Syntactic contrast was rare in adult speech ($n = 11$ instances). See Appendix B for examples of numerical contrasts.

Contexts of Use of VLNW in Adult Speech

Finally, we analyzed how often adults used VLNW to refer to an “easy” or “abstract” unit of quantification. We extracted 196 nouns that pair with VLNW (including 28 partitive noun phrases). We found that adults were more likely to use VLNW for “abstract” units (e.g., dollars, pounds, times, years; $n = 145$) than “easy” ones (e.g., people, ladybugs; $n = 51$). See Appendix C for examples and a list of contexts.

General Discussion

Our experience with quantities represented by very large number words such as “thousand” and “million” is extremely limited, but children utter these number words early in development. In this study, we probed children’s first meanings of these words by asking whether 5- to 8-year-olds can numerically order “hundred”, “thousand”, “million”, “billion”, and “trillion”. We found that children can place VLNW in a correct order at around age 6, and can do so consistently approximately a year later. Children thus have ordinal meanings of VLNW long before they are taught their cardinal meanings.

How may children acquire the rank ordering of VLNW? Study 2 provides three insights into this question. First, the frequency data from CHILDES show that children heard “hundred” more often than other VLNW by an order of magnitude. This suggests that children need not receive the same amount of input for all VLNW to learn their numerical order. Rather, it is possible that once children understand $\text{hundred} < \text{thousand}$, they may use pragmatic reasoning to infer that the less frequent VLNW denote even larger quantities. This can explain why knowledge of the numerical order of VLNW appears to emerge holistically. Second, the analyses on adult-child interactions show that adults were more likely to use VLNW to refer to abstract units of quantification for money, weight, and time (i.e., “dollars”, “pounds”, and “years”), and

this could signal to children that VLNWs reference quantities that cannot easily be counted. Finally, we found that numerical contrasts of VLNWs are rare. Adults in our speech sample were highly unlikely to use syntactically complex numeral phrases (e.g., two hundred thousand) or contrast VLNWs with each other in conversations. It is possible that children draw on multiple sources of input to learn the ordinality of VLNW, which may include conversations with older children or siblings about large numbers, the stress adults place when contrasting VLNWs (e.g., emphasizing “trillion” by saying “TRillion”), or the association with Arabic digits (e.g., a number with more zeroes is larger than one with fewer zeroes). Future studies can use qualitative methodologies such as the case study approach to explore how children integrate multiple sources to learn VLNW meanings.

Previous studies have only examined when children understand the numerical distance between large numbers (Thompson & Opfer, 2010; Siegler & Opfer 2003) or transcode large numbers across formats (e.g., “1,000,000” as “one million”; Skwarchuk & Anglin, 1993; Skwarchuk & Betts, 2006), but have not examined how children acquire their meanings. Our study addresses this by focusing on VLNW -- one of the symbolic representations of large numbers -- and ask when children acquire the ordinality of VLNW. Our data show that children can place VLNW in numerical order prior to Grade 1 and suggest that children may first acquire the ordinal meanings of VLNW before learning the precise cardinalities denoted by these number words. The pattern that ordinal knowledge may support later acquisition of more precise meanings can also be found in children’s acquisition of time and duration words – e.g., “second”, “minute”, and “hour” (Tillman & Barner, 2015; Tillman, Marghetis, Barner, & Srinivasan, 2017). Studies on time word acquisition show that children’s knowledge of duration words improves holistically across the board, with no item differences between different words, like our

findings on VLNW. Together, these results indicate that at least for some words that lack a clear word-to-world mapping, children may construct an ordinal structure as a first step towards acquiring their meanings. Drawing on the ordinal structure, children may learn the precise meanings of VLNW all at once, rather than word-by-word.

Our findings have curriculum and pedagogical implications. We found that 7-year-olds can reliably place “hundred”, “thousand”, “million”, “billion”, and “trillion” in numerical order, suggesting that teachers may introduce these concepts earlier than previously thought. More importantly, our results suggest that teachers need not introduce these concepts one at a time, but can introduce them as categories of words for very large quantities that fall on a scale (Landy, Charlesworth, & Ottmar, 2017; Resnick, et al., 2017). Furthermore, given that children are familiar with the numerical order of VLNW, associating the verbal scale of these words with Arabic digits may facilitate their number transcoding abilities. In sum, our results reveal that children have emergent knowledge of VLNW as early as age 6, highlighting a need to further investigate the acquisition of number words that reference quantities beyond our everyday experience (Cheung, Dale, & Le Corre, 2015).

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Appendix A. CHILDES corpora searched and references

Corpus	Ages	Availability of data
Bliss	3 to 10	
Braunwald	1;0 to 6;0	
Brown	1;6 to 5;1	
Demetras-Trevor	2;0 to 3;11	
Ellisweismer	2;6, 3;6, 4;6, 5;6	
Garvey	2;10 to 5;7	
Gathercole	2;10 to 5;7	
Gelman	1;6 to 7;0	
Gillam	5 to 12	
Gleason	2;1 to 5;2	
Hall	4;6 to 5;0	
HSLLD	2 to 6	
Kuczaj	2;4 to 4;1	
MacWhinney	0;7 to 8;0	
Nicholas-TD	1;0 to 4;0	
POLER-controls	5 to 12	
Peters / Wilson	1;7 to 4;1	
Rondal-TD	3 to 12	No data

Sachs	1;1 to 5;1	
Sawyer	3;6 to 4;11	
Snow	2;3 to 3;9	
Sprott	4 to 6	No data
Van Kleeck	3;0 to 4;0	
Warren-Leubecker	1;6 to 3;1; 4;6 to 6;2	
Weist	2;1 to 5;0	

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Appendix B. Examples of Numerical Contrasts of VLNW

Type of Contrasts	Examples
Explicit Semantic Contrast	“One thousand instead of three hundred” (Gleason, susan.cha, line 697)
Implicit Semantic Contrast	<p><i>Mother</i>: how many beans are there? <i>Mother</i>: you know? <i>Mother</i>: hundreds? <i>Child (4;5)</i>: hee hee hee <i>Mother</i>: thousands? <i>Child</i>: xxx <i>Mother</i>: How many? <i>Mother</i>: Looks like there’s about four beans. (TD_Nicholas, cosmo.cha, line 133)</p>
Syntactic Contrast	“Say like a hundred and seventy thousand” (Hall, BlackPro, trh.cha, line 20698)

Appendix C. Number of utterances of cardinal and non-cardinal uses of VLNW.

Type of use	Description	Number of utterances (<i>n</i> = 365)
Nominal use	Names for locations, classroom number, bus number (e.g., “ <i>a hundred and thirty-fifth street</i> ”)	45
Adjectival use	E.g., “ <i>a hundred-watt bulb</i> ”, “ <i>a two-thousand dollar loan</i> ”	11
Count routine	As part of a count sequence (e.g., “ <i>hundred and one, hundred and two</i> ”)	16
Numerical symbols	Naming Arabic digits or discussions about numbers (e.g., “ <i>when you see two zeros together say hundred</i> ”, “ <i>you wanna know a thousand times a thousand?</i> ”)	13
Periods of time / year	Referring to year or period of time (e.g., “ <i>June the first nineteen hundred and seventy seven</i> ”).	10
Cardinal use		
a. Overt noun / partitive noun phrases	Overt noun phrase (e.g., “ <i>a million books</i> ”, “ <i>sixty hundred miles</i> ”)	196
b. Implied noun / partitive noun phrases	Bare numerals with noun reference inferred in the conversation (e.g., “ <i>he’s about three hundred and fifty [pounds]</i> ”)	51
c. Cannot be determined	Noun reference cannot be determined from the conversation (e.g., “ <i>I guess she had about two thousand</i> ”)	23