Children's Fact but not Word Learning is Affected by Context Variability

By

Nicholas Tippenhauer

Thesis

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE

In

Psychology

May 11, 2018

Nashville, Tennessee

Approved:

Megan Saylor, Ph.D.

Duane Watson, Ph.D.

ACKNOWLEDGMENTS

I thank members of my graduate lab group for insightful comments, my undergraduate research assistants for aiding in data collection, and my participants for making this research possible.

TABLE OF CONTENTS

Abstract

There are conflicting accounts of how context variability affects children's word learning. In some instances, children show learning independent of context variability (e.g., Akhtar, 2005). There may also be cases where context variability promotes label learning (e.g., Goldenberg & Sandhofer, 2013a; Twomey, Ma, & Westermann, 2017). However, toddlers and preschoolers' word learning can also be disrupted by context changes (e.g., Goldenberg & Sandhofer, 2013a; Vlach & Sandhofer, 2011). Inconsistent findings in this literature could be the result of children's inability to suppress irrelevant context features and to focus on relevant input, both of which are factors that can contribute to the size of context effects on memory (Smith & Vela, 2001). Studies that demonstrated context dependent word learning may have relied on fairly demanding tasks, which may have prevented participants from dedicating cognitive resources to suppressing contexts or attending to inputs. We investigated context effects in word and fact learning using a design intended to reduce task load. Under these conditions, fact learning was affected by context variability, but word learning was not.

Introduction

The effects of context on adults' memory retrieval have been widely studied (e.g., Godden & Baddeley, 1975; Herz, 1997; Smith, 1985; Smith & Vela, 2001). Whether context variability affects children's memory and word learning is less well established. There is mixed evidence for the effects of context variability on word learning. There are instances where context features have no effect on word learning (e.g., Akhtar, 2005; Vlach & Sandhofer, 2011). However, there are also cases where variable contexts actually promote label retention (e.g., Goldenberg & Sandhofer, 2013a; Twomey, Ma, & Westermann, 2017) or where context variability disrupts word learning (e.g., Goldenberg & Sandhofer, 2013a; 2013b; Vlach & Sandhofer, 2011). It is unclear why these differences emerge. In addition, there is little work exploring how context variability may affect children's fact learning, although this is a common focus in work with adults. In the current study, we investigate context dependent word and fact learning in 2.5-year-old children.

Previous work has established a clear relation between background context and memory retrieval in adults (e.g., Godden & Baddeley, 1975; Herz, 1997; Smith, 1985; Smith & Vela, 2001). In one classic study, adult participants learned lists of words either on dry land or underwater before their recall was tested in the original learning environment or the other environment. Participants recalled more words when the test conditions matched the context in which the information was learned (Godden & Baddeley, 1975). In addition to physical location, context features like ambient odor (Herz, 1997) or background music (Smith, 1985) have been shown to affect adults' performance on memory tasks. Regardless of which context feature is being manipulated, however, empirical evidence for context dependencies converges on one key finding: Enhanced performance is often the result of similarities between training and test conditions, while reduced performance results from dissimilarities between the conditions (e.g., Smith & Vela, 2001). Additionally, distributing learning instances across varied contexts seems to buffer performance against context dependencies when testing occurs in a new environment. For example, studying a list of items in three separate classrooms before being tested in a fourth improves memory for the list compared to consistently studying in one classroom before being tested in a new location (e.g., Smith, 1982).

It is important to note that the magnitude of context effects is up for debate. One meta-analysis revealed that context manipulations had a modest – though reliable – effect on memory (Smith & Vela, 2001). The effect size of context on memory depended on which context feature researchers manipulated and, crucially, whether background context was suppressed during learning or at test. In other words, failure to encode aspects of the context during learning reduces context dependent memory at test. Relatedly, there is some evidence that shallow processing of input during learning may result in more pronounced context dependencies (e.g., Smith, 1988; 1994; Smith & Vela, 1986; 2001). Together, these findings suggest that dedicating cognitive resources to attending to relevant input or suppressing irrelevant ambient information can improve memory across contexts.

While work with adults has focused primarily on memory for facts and lists of items (e.g., Godden & Baddeley, 1975; Herz, 1997; Smith, 1982; 1985), recent attention has been given to the potential for context effects in word learning in toddlers and preschoolers (e.g., Akhtar, 2005; Goldenberg & Johnson, 2015; Goldenberg & Sandhofer, 2013a; 2013b; Perry, Samuelson, & Burdinie, 2014; Twomey et al., 2017; Vlach & Sandhofer, 2011). Evidence for these effects is mixed. In some cases, children seem capable of learning words regardless of contextual information during learning or test (e.g., Akhtar, 2005), though this ability may emerge over the course of development (e.g., Vlach & Sandhofer, 2011). For example, in one study 2-year-olds were presented with novel labels and objects in the context of a distracting background activity or no such activity. Regardless of the background context, toddlers learned novel object labels (Akhtar, 2005). Similarly, 4- to 5-year-olds show robust word learning irrespective of context variability (Vlach & Sandhofer, 2011). In some cases, children appear able to decouple label information from the background context to learn words successfully.

There are other cases where context variability may actually promote label learning. Goldenberg and Sandhofer (2013a) tested whether mixing familiar and novel contexts during training resulted in increased performance. Their main finding was that interleaving a consistent context with novel contexts during training (e.g., Context A, Context B, Context A, Context C) promotes generalization to new contexts during test trials (e.g., Context D) compared to consistently learning in the same context (e.g., Context A) before being tested in a new context (e.g., Context D). This could be the result of an ability to aggregate and decontextualize object labels (Goldenberg & Sandhofer, 2013a). Additional work suggests that generalization to new contexts may be the result of more structured variability in background context during learning, often requiring a combination of familiar and new contexts (Goldenberg & Johnson, 2015). These findings replicate research with adults showing that varying learning contexts results in increased performance when tested in a new environment (e.g., Smith, 1982).

Context variability has also been shown to promote label retention (Twomey et al., 2017). In this study, 2-year-olds witnessed triads of one novel and two familiar objects paired with a novel label. In one condition, triads were always presented on white backgrounds. In the other, triads were presented on different colored screens each time. There were no differences between conditions during immediate referent selection trials, but only children in the variable background condition exhibited an ability to correctly recognize targets after a delay (Twomey et al., 2017). This suggests that differences in background context may provide additional support for young children's early word learning. More specifically, there may be a relationship between context variability and longer-term retention.

However, context variability has also been demonstrated to interfere with word learning. In one study, Vlach and Sandhofer (2011) exposed children to eight novel object/label pairings in different contexts. Each of the eight trails was divided into a training, distractor, and test phase. Children were presented with 3 naming instances of novel objects during the training phase, one object during the distractor phase, and an array of 4 objects (new exemplar of the target, distractor, familiar object, and an unfamiliar object) at test. The condition manipulation was the pattern of cloths upon which each individual object (or group of objects at test) were presented. Vlach and Sandhofer (2011) found that 2.5-year-olds were affected by context variability, while 4- to 5-year-olds were not. Younger participants learned words best when the training instances, distractor, and test trials all occurred on the same patterned cloth, and their performance was worst when the cloth patterns differed for each training instance, distractor, and test. In addition, even infants seem to show context dependencies in word learning (e.g., Perry et al., 2014) as well as word comprehension (e.g., Meints, Plunkett, Harris, & Dimmock, 2004).

There are conflicting accounts of whether background context affects word learning and, if it does have effect, whether variability facilitates or interferes with memory for labels. It is not clear why some manipulations result in context dependencies in word learning and some do not. In addition, there is little work exploring how context variability may affect fact learning in young children despite the focus on these effects in adults (e.g., Godden & Baddeley, 1975; Herz, 1997; Smith, 1982; 1985; Smith & Vela, 2001).

It is somewhat surprising that word learning would be affected by context variability at all due to the social and conventional nature of language. First, word meanings are "facts" only through use by competent speakers in social interactions (Wittgenstein, 1953). Essentially, words only provide information about the world through use in everyday interactions between speakers. Additionally, the link between words and their referents is conventional across speakers of a language; functional language is based upon agreements between speakers about how to use words and other features of language (e.g., Clark, 1993; 2007). Finally, in contrast to learning new facts, word learning requires individuals to abstract a label across multiple learning episodes involving different exemplars and to generalize a label to newly encountered category members (Vlach & Sandhofer, 2011). In short, fully developed label knowledge is not contextually bound because this information is assumed to be shared across speakers and situations.

Importantly, research has demonstrated that children are aware of language conventionality (e.g., Diesendruck, 2005) and are capable of correctly generalizing labels (e.g., Golinkoff, Mervis, & Hirsh-Pasek, 1994; Waxman & Gelman, 1986). The same is not true of facts: Children do not expect facts to be shared across individuals (e.g., Diesendruck & Markson, 2001) nor do they extend a fact about one object to other category members (e.g., Behrend, Scofield, & Kleinknecht, 2001; Waxman & Booth, 2000). Essentially, successful word learning relies on an ability to decontextualize information, while successful fact learning does not. These findings provide support for the claim that fact learning might be subject to context effects, while word learning may not be.

The purpose of the present study was to explore the effect of context variability on word and fact learning in 2-year-olds, the group that has shown consistent context dependent word learning in the literature (e.g., Goldenberg & Sandhofer, 2013a; Vlach & Sandhofer, 2011). We attempted to induce context dependencies in word and fact learning using a variant of the procedure described in Vlach & Sandhofer (2011) but included half as many total trials to reduce task load. We predicted that children would be able to process labels more deeply and suppress irrelevant context features due to decreased task load. We predicted that this, in turn, would lead to robust word learning despite context variability, since context suppression and target encoding are factors that contribute to the strength of context effects (e.g., Smith & Vela, 2001). However, because facts about objects are not conventional in the same way words are (e.g., Diesendruck & Markson, 2001) and generalization is narrower for facts than words (e.g., Behrend et al., 2001; Waxman & Booth, 2000), we hypothesized that children's memories for facts would be sensitive to context variability. Additionally, we included a delayed test phase, to explore how context variability may affect retention of object/label and object/fact associations. To our knowledge, this is the first attempt to explore context dependencies in children's word and fact learning using the same paradigm.

Method

Participants

Forty-eight 2.5-year-olds participated. Six additional children were recruited, but their data were excluded due to inattentiveness (n = 1) or failure to complete the delay phase of the experiment (n = 5). Caregivers reported children heard primarily English at home and school. Participants received a small toy or book as compensation for taking part in the experiment. Participants were recruited from a database using public birth records from a large city in the southeastern United States.

Materials

Novel objects were constructed from supplies purchased at hardware stores (see Figure 1 for examples). For each target object, three training exemplars differed from one another based on color (see Figure 1). Distractor objects were identical during training and at test. Distractor and target objects were placed in yoked pairs. Novel labels and facts were randomly assigned to one item in each yoked pair. Which object served as the distractor or target in each yoked pair was counterbalanced across participants. Caregivers were shown images of novel objects and asked if their child would know a word for any of them. They confirmed that the objects would be novel for their child.

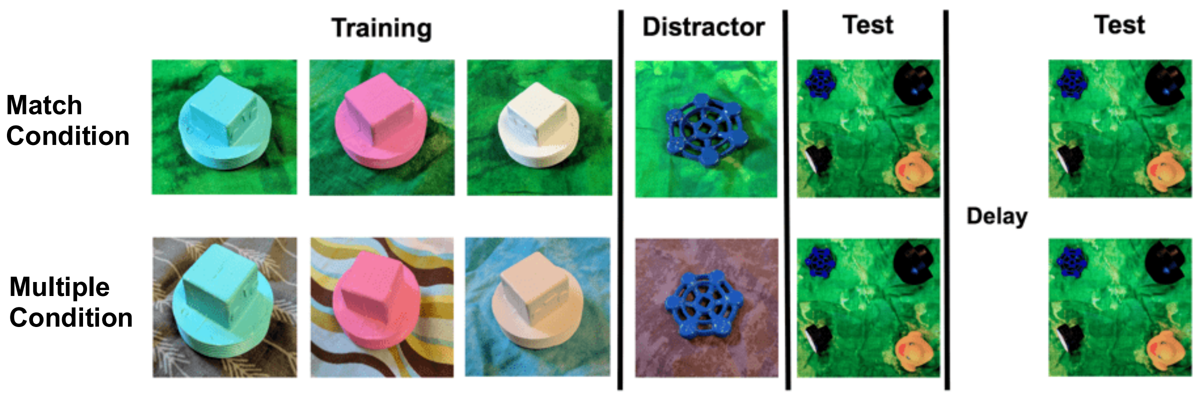

Figure 1. Example objects and contexts for both conditions. One row represents a set of trials for one object pair. This is one potential combination. The delay phases took place following the fourth immediate test phase, but the procedure was simplified for this figure.

Objects were wrapped in a cloth. In the match condition, learning phases occurred on the same patterned cloth as test phases (e.g., learning on a polka dot cloth followed by testing on a polka dot cloth). In the multiple condition, each learning phase and test phase occurred on a different patterned cloth (e.g., learning on polka dot, striped, and plain cloths followed by testing on a camouflage cloth). Figure 1 depicts an example of the match and multiple conditions. The cloth was turned inside out and held together with a piece of twine to give the appearance of a bag. To present the objects, the twine was untied and removed before the cloth was unwrapped. This resulted in objects sitting on top of the cloth, which created a background context. Cloth pieces were purchased at a craft store and were large enough (18 × 21 inches) to fully conceal objects.

Design

The design is a modified version of Vlach and Sandhofer (2011) with fewer trials and the addition of a delay test phase. Context was defined as the pattern of cloth upon which objects were presented. Participants were assigned to one of two information types: word (*M* = 2 years, 5 months, 21 days, 12 female) or fact (*M* = 2 years, 5 months, 21 days, 11 female). Data for children assigned to the word group was collected first. Within each information type, children were pseudo-randomly assigned to one of two conditions: match and multiple. Thus, there were four experimental groups: word match context (*M* = 2 years, 5 months, 21 days, 5 female); word multiple context (*M* = 2 years, 5 months, 15 days, 7 female); fact match context (*M* = 2 years, 5 months, 12 days, 5 female); and fact multiple context (*M* = 2 years, 6 months, 1 day, 6 female). Mean ages were not significantly different between these groups, $F(1, 44) = .44$, $p = .51$.

Procedure

Caregivers were instructed not to provide any feedback during the session. Children were told they were going to play a game with new toys they had never seen before. In each of the four conditions, participants completed four trials. Each trial consisted of training, distractor, test, and delayed test phases.

During training, participants were presented with three instances of a novel object in succession. At the beginning of each training exposure, the object was initially hidden from view. Then, the object was brought out concealed in a bundle of cloth. Objects were labeled twice (e.g., "This is a *fep*. Do you see the *fep*?"), or facts were provided twice (e.g., "The cat stepped on one like this! This looks like the one the cat stepped on!"). The child was invited to play with the object for approximately 10 seconds. Then, the object was wrapped back up and placed out of view. This sequence was repeated three times for each set of objects (i.e., for all three exemplars of the target object in a yoked pair).

Next, distractor objects were presented for approximately 30 seconds on a cloth, the pattern of which was determined by condition. The distractor object was not labeled, but the experimenter did draw the participant's attention to it using two utterances of enthusiastic speech (e.g., "Look at this one! Do you see it?"). At the end of the distractor phase, the object was wrapped up and hidden from view. For half of the participants, the distractor phases preceded training phases, and for the other half distractor phases began immediately after training phases.

At test, participants were presented with a set of four objects, the distractor, a novel member of the target category, a familiar object, and an unfamiliar novel object (see Figure 1). The experimenter asked the child to give him the target object using the novel label (e.g., "Can you hand me the *fep*?") or fact ("Which one did the cat step on?"). Requests were repeated until the child selected an object. If the child selected multiple objects, the experimenter requested she select only one (e.g., "Remember, just give me one!"). Test phases concluded once the participant pointed to or grabbed an object or handed an object to the experimenter.

After the last of the four objects was presented, the experimenter and child read books or played with puzzles for 10 minutes in the same room. Then, the set of test objects were presented to the child one at a time in the same order as she had first seen them, and she was asked to select the target using the novel label (e.g., "Can you show me the *fep*?") or fact (e.g., "Which one of these did the cat step on?"). Delay test phases took place on the same patterned cloth as the immediate test phases (see Figure 1). If a child did not make a selection, the request was repeated. If a child selected multiple objects, the experiment requested she select only one (e.g., "Remember, just give me one!"). Delay test phases concluded once the child pointed to or grabbed an object or handed one to the experimenter.

Coding

Participants' responses to requests at test were recorded in real time by the experimenter. For each immediate or delay test phase, children were given a score of 1 if they pointed to, grabbed, or handed the experimenter the target object and a 0 if they selected any other object. The maximum score for both test phases was 4. Coders naïve to the hypotheses of the experiment coded videotaped sessions offline. Interrater reliability was 100% for the 92% (44 of 48) of available videotaped sessions.

Results

The key result was target selection across Information Type, Condition, and Test Phase Type, which is depicted in Figure 2. First, we conducted a 2 (Information Type: Word vs. Fact) × 2 (Condition: Match vs. Multiple) × 2 (Test Phase Type: Immediate vs. Delay) mixed-design ANOVA with Information Type and Condition as between-subjects factors and Test Phase Type as a within-subjects factor. There was a main effect of Information Type, $F(1, 44) = 4.18$, $p = .047$, $\eta_p^2 = .09$. Children selected targets more when they were presented with words ($M = 2.60$, $SD = 1.38$) than when they were presented with facts ($M = 1.88$, $SD = 1.32$). There was also a significant three-way interaction between Information Type, Condition, and Test Phase Type, $F(1, 44) = 4.44$, $p = .04$, $\eta_p^2 = .09$. There were no other significant main effects or interactions.

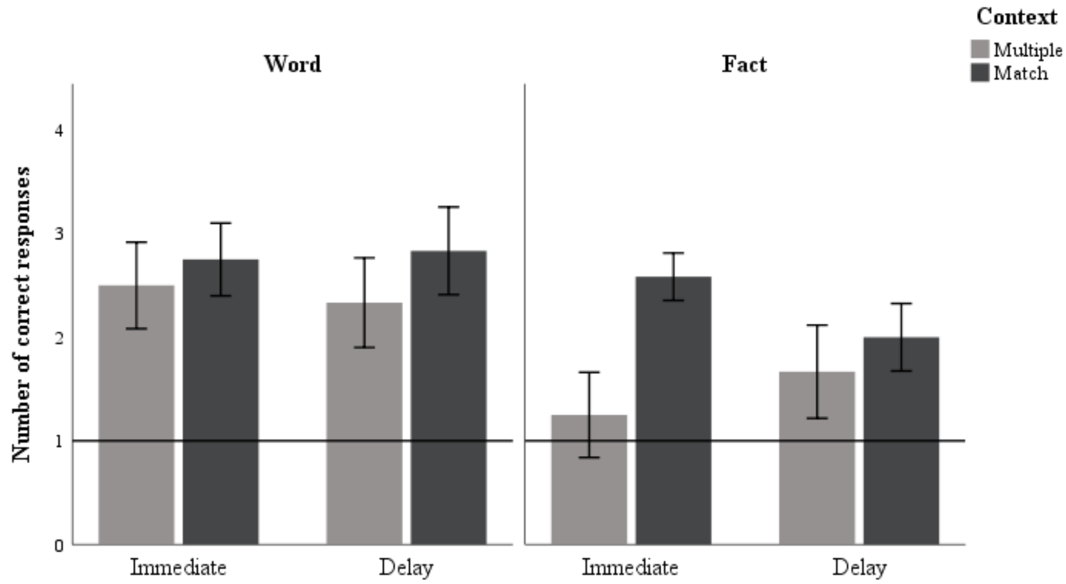

Figure 2. Mean number of correct responses (maximum = 4) immediately and after a delay by information type and condition. Error bars represent standard error, and the horizontal line indicates chance performance.

To resolve the significant three-way interaction, we conducted two separate 2 (Condition) × 2 (Test Phase Type) mixed-design ANOVAs by Information Type. The Condition × Test Phase Type interaction was not significant for words, $F(1, 22) = 0.57$, $p = .46$, $\eta_p^2 = .03$. For facts, there was a marginally significant interaction between Condition and Test Phase Type, $F(1, 22) = 4.15$, $p = .054$, $\eta_p^2 = .16$. This effect was the result of a significant difference in target selection between match and multiple conditions immediately, $F(1, 22) = 8.05$, $p = .01$, $\eta_p^2 = .27$. There was no difference between conditions for the delay test phase.

We also tested whether there were order effects across immediate and delay test phases. We conducted separate 2 (Test Phase Type) × 4 (Trial: 1-4) repeated measures ANOVAs by condition for facts and words. For words, there were no order effects immediately ($F(1, 22) = 0.50$, $p = .49$, $\eta_p^2 = .02$) or after a delay ($F(1, 22) = 1.16$, $p = .29$, $\eta_p^2 = .05$). For facts, there were no order effects immediately ($F(1, 22) = 2.62$, $p = .12$, $\eta_p^2 = .11$) or after a delay ($F(1, 22) = 1.64$, $p = .21$, $\eta_p^2 = .07$).

Finally, we compared performance across Information Type, Condition and Test Phase Type to chance (chance = 1) using one-sample t-tests. When children were presented with words for novel objects, they selected targets above chance on immediate test phases in the match condition ($M = 2.75$, $SD = 1.22$, $t(11) = 4.99$, $p < .001$) as well as the multiple condition ($M = 2.5$, $SD = 1.45$, $t(11) = 3.59$, $p = .004$). When presented with facts, children showed above chance target selection on immediate test phases in the match condition ($M = 2.58$, $SD = 0.79$, $t(11) = 6.90$, $p < .0001$) but not in the multiple condition ($M = 1.25$, $SD = 1.42$, $t(11) = 0.61$, $p = .55$). For delay test phases, children presented with words selected targets above chance in both the match condition ($M = 2.83$, $SD = 1.47$, $t(11) = 4.32$, $p = .001$) and in the multiple condition ($M = 2.33$, $SD = 1.5$, $t(11) = 3.08$, $p = .01$). Children presented with facts, on the other hand, selected targets above chance on delay test phases in the match condition ($M = 2.00$, $SD = 1.13$, $t(11) = 3.07$, $p = .01$) but not in the multiple condition ($M = 1.67$, $SD = 1.56$, $t(11) = 1.49$, $p = .16$).

General Discussion

Context variability did not affect 2.5-year-olds' learning of label information, but it did affect fact learning. For words, children's performance was equivalent regardless of whether test contexts matched or differed from original learning contexts. This differs from previous findings related to context effects in word learning (e.g., Goldenberg & Sandhofer, 2013a; Vlach & Sandhofer, 2011). These results contribute to an emerging body of literature that offers conflicting evidence for the effect of context variability on early word learning

(Akhtar, 2005; Axelsson & Horst, 2014; Goldenberg & Johnson, 2015; Goldenberg & Sandhofer, 2013a; 2013b; Perry et al., 2014; Twomey et al., 2017; Vlach & Sandhofer, 2011). Children's immediate fact learning, on the other hand, was better when training and test contexts matched. This result converges with work in early memory, which tends to show consistent context effects (e.g., Hartshorn et al., 1998) and that redundant cues facilitate performance (e.g., Thiessen & Saffran, 2013; Yoshida & Smith, 2005).

One explanation for our pattern of results is that instances where context affects word learning may result from an inability to suppress irrelevant context features (e.g., Smith & Vela, 2001) or shallower processing of relevant word/object inputs (e.g., Smith, 1988; 1994; Smith & Vela, 1986; 2001). It is possible that previous work demonstrating context dependent word learning (e.g., Goldenberg & Sandhofer, 2013a; Vlach & Sandhofer, 2011)[1] used tasks that taxed cognitive resources in a way that promoted context dependencies, because children were unable to suppress ambient information or unable to attend fully to the word learning task. Because our task included half as many trials as previous work, our task may have been less cognitively demanding for young children, which may have allowed them to suppress irrelevant cues (context changes) and focus on relevant information (word-object pairings). This opens up the possibility that individual differences in executive function could help explain conflicting results in this literature. Perhaps children with better inhibitory control can suppress irrelevant contextual information and fully attend to the word learning task.

Interestingly, context dependent memory for facts did emerge despite reduced task

[1] It is unlikely that our results were due to insufficient power. A power analysis using the large effect reported in Vlach and Sandhofer (2011; $\eta_p^2 = .78$) revealed that, with 12 participants in each condition, we have over 80% power to detect an effect of context on word learning.

load. Children were better at learning facts in the match condition compared to the multiple condition and only demonstrated learning above chance in the match condition both immediately and after a delay. It is possible that the demands of the input may contribute to this effect. Facts contained more verbal information than labels, which, when paired with variable background contexts, was sufficient to negatively affect children's performance immediately and after a delay. Essentially, there may have been a cumulative effect stimulus and context complexity that disrupted learning.

It is worth noting that only immediate memory for facts differed by condition, which could simply be the result of attention rather than memory. Children may have been distracted by contexts across training phases, which translated to poor performance during immediate test. However, children may not have robustly encoded information about the features of the context, which might explain the lack of condition differences after a delay. Future work may explore this possibility more directly. Regardless, the present result suggests that ambient context variability can have adverse effects on memory for facts but not labels under reduced task load.

Comparing labels and facts may explain our pattern of results across information type. It is likely that context variability may not affect memory for words, because these memories are different than memories for other pieces of information (e.g., Behrend et al., 2001; Waxman & Booth, 2000). These differences could emerge because of biases in attention; young children are more likely to attend to objects if provided with a label versus other types of information (e.g., Baldwin & Markman, 1989). Language seems to trigger closer attention to – and potentially encoding of – associated objects. Facts, on the other hand, do not. If attention to relevant cues is crucial to preventing context dependencies (e.g., Smith & Vela, 2001), differences in attention to object-label and object-fact pairings may explain our result. This attentional bias could result from children's recognition that language is conventional across speakers (e.g., Clark, 1993; 2007). Children may feel motivated to attend to language, because it is shared across members of their linguistic communities. Alternatively, this bias could be specific to language and independent of experience. It is also possible that different types of facts may behave more similarly to words. For example, object functions or individuals' preferences, which should remain constant across situations, may be unaffected by context variability.

Word learning could also be robust to context effects because of its reliance on generalization. Children prefer to generalize words but not facts to new exemplars of a category (e.g., Behrend et al., 2001; Waxman & Booth, 2000). Since generalization inherently requires aggregating information across situations and applying it in new scenarios, it is somewhat unsurprising that children show context dependent memories for facts but not words. They may know that words can – and should – be applied broadly, which may prompt them to decouple information about words from surrounding contexts more efficiently.

Although, it is possible that context may affect label retention (e.g., Twomey et al., 2017), although we did not find evidence to support this. The difference between our results and Twomey et al. (2017) could be due to dependent measures of interest; we focused exclusively on explicit target selection, whereas Twomey et al. (2017) also measured looking times to targets. Regardless, this discrepancy leaves open the question of whether variability is beneficial for longer retention of label information. Perhaps context dependencies emerge in word learning over time, with better retention resulting from distributed learning across multiple contexts.

Finally, it is crucial to note a major difference between contexts in Vlach and

Sandhofer (2011) and the contexts used here. The cloths we used were either plain colors or patterned, but they did not include any nameable objects or entities. Vlach and Sandhofer (2011), on the other hand, used cloths with nameable objects and entities (H. Vlach, personal communication, October 17, 2017). This distinction may be important, especially given our diverging results. Children exhibit difficulty in learning words if referents are presented among variable arrays of known objects (Horst, Scott, & Pollard, 2010) but benefit from repeated presentation of a referent among a consistent set of familiar objects (Axelsson & Horst, 2014). Context dependencies in Vlach and Sandhofer (2011) could be related to these findings rather than the result of context variability per se. However, co-occurring objects are also features of the surrounding context, and including these in a context manipulation may more closely mirror contexts in which children learn words. In addition, context effects might be larger when known objects are included, because the contexts become harder to suppress. Future work may test this possibility.

The present study provides evidence that word learning is unaffected by context variability when task load is decreased, but fact learning is affected by context under the same conditions. We provide an account of context effects that may reconcile disparate findings in the literature (Akhtar, 2005; Axelsson & Horst, 2014; Goldenberg & Johnson, 2015; Goldenberg & Sandhofer, 2013a; 2013b; Henderson et al., 2012; Perry et al., 2014; Twomey et al., 2017; Vlach & Sandhofer, 2011). Namely, task load may prevent children from dedicating resources to suppressing context features or attending to inputs, both of which can contribute to the effect size of context on memory (e.g., Smith, 1988; 1994; Smith & Vela, 1986; 2001). What is not clear is why word learning and fact learning show a different pattern of context effects under the same task demands, though it is possible words bias attention in a way that promotes learning regardless of irrelevant ambient information.

REFERENCES

Akhtar, N. (2005). The robustness of learning through overhearing. *Developmental Science*, *8*(2), 199–209.

Axelsson, E. L., & Horst, J. S. (2014). Contextual repetition facilitates word learning via fast mapping. *Acta Psychologica*, *152*, 95–99.

Baldwin, D. A., & Markman, E. M. (1989). Establishing word-object relations: A first step. *Child Development*, *60*(2), 381–398.

Behrend, D. A., Scofield, J., & Kleinknecht, E. E. (2001). Beyond Fast Mapping: Young Children's Extensions of Novel Words and Novel Facts. *Developmental Psychology*, 37(5), 698–705.

Clark, E. (1993). The lexicon in acquisition. Cambridge: Cambridge University Press.

Clark, E. V. (2007). Conventionality and contrast in language and language acquisition. *New Directions for Child and Adolescent Development*, *2007*(115), 11–23.

Diesendruck, G. (2005). The principles of conventionality and contrast in word learning: An empirical examination. *Developmental Psychology*, *41*(3), 451–463.

Diesendruck, G., & Markson, L. (2001). Children's avoidance of lexical overlap: a pragmatic account. *Developmental Psychology*, *37*(5), 630–641.

Goldenberg, E. R., & Johnson, S. P. (2015). Category generalization in a new context: The role of visual attention. *Infant Behavior and Development*, *38*, 49–56.

REFERENCES

Goldenberg, E. R., & Sandhofer, C. M. (2013a). Same, varied, or both? Contextual support aids young children in generalizing category labels. *Journal of Experimental Child Psychology*, *115*(1), 150–162.

Goldenberg, E. R., & Sandhofer, C. M. (2013b). Who is she? Changes in the person context affect categorization. *Frontiers in Psychology*, *4*(October), 745.

Golinkoff, R. M., Mervis, C. B., & Hirsh-Pasek, K. (1994). Early Object Labels: The Case for a Developmental Lexical Principles Framework. *Journal of Child Language*, *21*(1), 125–155.

Godden, D. R., & Baddeley, A. D. (1975). Context-dependent memory in two natural environments: on land and underwater. *British Journal of Psychology*, *3*(3), 325–331.

Hartshorn, K., Rovee-Collier, C., Gerhardstein, P., Bhatt, R. S., Klein, P. J., Aaron, F., … Wurtzel, N. (1998). Developmental changes in the specificity of memory over the first year of life. *Developmental Psychobiology*, *33*(1), 61–78.

Herz, R. S. (1997). The effects of cue distinctiveness on odor-based context-dependent memory. *Memory and Cognition*, *25*(3), 375–380.

Horst, J. S., Scott, E. J., & Pollard, J. A. (2010). The role of competition in word learning via referent selection. *Developmental Science*, *13*(5), 706–713.

Meints, K., Plunkett, K., Harris, P. L., & Dimmock, D. (2004). The cow on the high street: Effects of background context on early naming. *Cognitive Development*, *19*(3), 275–290.

REFERENCES

Perry, L. K., Samuelson, L. K., & Burdinie, J. B. (2013). Highchair philosophers: The impact of seating context-dependent exploration on children's naming biases. *Developmental Science*, *5*, 757–765.

Smith, S. M. (1982). Enhancement of recall using multiple environ- mental contexts during learning. *Memory & Cognition*, *10*, 405-412.

Smith, S. M. (1985). Background music and context-dependent memory. *The American Journal of Psychology*, *98*(4), 591–603.

Smith, S. M. (1988). Environmental context-dependent memory. In D.M. Thomson & G. M. Davies (Eds.), *Memory in context: Context in memory* (pp. 13-34). New York: Wiley.

Smith, S. M. (1994). Theoretical principles of context-dependent memory. In P. Morris & M. Gruneberg (Eds.), *Theoretical aspects of memory* (Aspects of Memory, 2nd ed., Vol. 2, pp. 168-195). New York: Routledge.

Smith, S. M., & Vela, E. (1986). Outshining: The relative effectiveness of cues. Paper presented at the 27th Annual Meeting of the Psychonomic Society, New Orleans.

Smith, S. M., & Vela, E. (2001). Environmental context-dependent memory: A review and meta-analysis. *Psychonomic Bulletin & Review*, *8*(2), 203–220.

Thiessen, E. D., & Saffran, J. R. (2003). When Cues Collide: Use of Stress and Statistical Cues to Word Boundaries by 7- to 9-Month-Old Infants. *Developmental Psychology*, *39*(4), 706–716.

REFERENCES

Twomey, K. E., Ma, L., & Westermann, G. (2017). All the Right Noises: Background Variability Helps Early Word Learning. *Cognitive Science*, 1–26.

Vlach, H. A., & Sandhofer, C. M. (2011). Developmental differences in children's context-dependent word learning. *Journal of Experimental Child Psychology*, *108*(2), 394–401.

Waxman, S. R., & Booth, A. E. (2000). Principles that are invoked in the acquisition of words, but not facts. *Cognition*, *77*(2).

Waxman, S., & Gelman, R. (1986). Preschoolers' use of superordinate relations in classification and language. *Cognitive Development*, *1*(2), 139–156.

Wittgenstein, L. (1953). *Philosophical Investigations*. *Oxford Blackwell* (Vol. 1999/1967).

Yoshida, H., & Smith, L. B. (2005). Linguistic cues enhance the learning of perceptual cues. *Psychological Science*, *16*(2), 90-95.