UC Merced

Proceedings of the Annual Meeting of the Cognitive Science Society

Title

How do children learn new words via reading emotional narratives?

Permalink

https://escholarship.org/uc/item/5z74x0m0

Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 47(0)

Authors

Dong, Yuzhen
Mak, Matthew HC
Hepach, Robert
et al.

Publication Date

2025

Copyright Information

This work is made available under the terms of a Creative Commons Attribution License, available at https://creativecommons.org/licenses/by/4.0/

Peer reviewed

eScholarship.org Powered by the California Digital Library
University of California

How do children learn new words via reading emotional narratives?

Yuzhen Dong (yuzhen.dong@psy.ox.ac.uk)
Department of Experimental Psychology, University of Oxford, United Kingdom

Matthew Mak (matthew.mak@warwick.ac.uk)
Department of Psychology, University of Warwick, United Kingdom

Robert Hepach (robert.hepach@psy.ox.ac.uk)
Department of Experimental Psychology, University of Oxford, United Kingdom

Kate Nation (kate.nation@psy.ox.ac.uk)
Department of Experimental Psychology, University of Oxford, United Kingdom

Abstract

Context valence has been shown to predict word learning in adult experiments. Little is known about whether this extends to children. To address this gap, we conducted a pre-registered word learning experiment to investigate how emotional narrative context shapes children's learning of novel adjectives during naturalistic reading. 120 children aged 7 to 11 years from UK primary schools read 15 novel words (such as "garive") embedded in 30 short narratives of either neutral, negative, or positive valence. Three immediate post-tests assessed learning. We found that children were able to learn novel adjectives from reading short narratives, and older children outperformed younger children. Novel adjectives read in more emotional (positive or negative) contexts were recognized more accurately than those read in neutral narratives. The findings extend previous research conducted using noun concepts and with adults, providing further evidence for affective embodiment in supporting the learning of abstract concepts.

Keywords: Language; Emotion; Development; Reading; Children

Introduction

In language, emotional valence refers to the pleasantness of a word (Warriner et al., 2013). Large-scale studies have established valence norms by asking adult participants to rate on a scale how they feel while reading a word in isolation. Rated valence is associated with language processing, where positive and negative words are responded to more quickly in lexical decision tasks than neutral words (e.g., Kousta et al., 2009). Children also show this effect and more generally, valence predicts age-of-acquisition ratings (e.g., Ponari et al., 2018). But how do children learn the valence of a new word? One possibility is via the language context it appears in. Emotional context influences word learning in adults (e.g., Dong et al., 2024; Lana & Kuperman, 2023; Snefjella et al., 2020) and complementing this evidence, Snefjella and Kuperman (2016) found that the valence of an individual word correlated with the valence of the contexts in which it occurs across a large corpus analysis of adult language. Given these findings, it is plausible that as children experience a new word, they can acquire its valence from the valence of the language contexts in which it occurs. However, no existing work has considered language contexts experienced by children via reading. We tested in a word-learning experiment whether and how the emotional valence of the narrative context influence children's learning of new words.

Emotionally valenced words, whether positive or negative, tend to be acquired earlier than neutral words, especially abstract ones such as great and sad (Kousta et al., 2011; Ponari et al., 2018). This earlier acquisition may be facilitated by emotional valence acting as a bootstrapping mechanism, where children use existing knowledge and experiences to help them understand and learn new abstract concepts (as described in the affective embodiment account, Vigliocco et al., 2014). Ponari et al. (2020) taught children new abstract words that were either valenced (negative or positive, e.g., *tyranny*, *insight*) or neutral (e.g., *trend*), according to the word valence norms by Warriner et al. (2013). Ponari et al. (2020) found that 7- to 9-year-olds showed better learning of the valenced words compared to the neutral words, consistent with the affective embodiment account that emotional experience grounds the learning of abstract words and concepts. These findings align with auditory lexical decision data showing that children responded more accurately to emotionally valenced abstract words (Ponari et al., 2018).

There is some evidence that this emotionality advantage might interact with the age of the children. Ponari et al. (2018) tested three age groups: children aged 6 to 7, 8 to 9, and 10 to 11 years, with 20 children in each group. The processing advantage of emotionally valenced abstract words was most pronounced in the 8- to 9-year-olds. In contrast, in another auditory lexical decision experiment, Lund et al. (2019) tested children aged 5 to 7 years and found a faciliatory effect of valence only in 6- to 7-year-olds. It is difficult to draw conclusions across these studies due to methodological differences. For example, Lund et al. (2019) included words that were less abstract than those used by Ponari et al. (2018). Other studies have shown diminished effects of valence in words that are less abstract, and for older children (Reggin et al., 2021; Vigliocco et al., 2018). Vigliocco et al. (2018) suggested that the changing emotionality effect with age might indicate a shift from an affective embodied model to a more language-based one for children's abstract word

In D. Barner, N.R. Bramley, A. Ruggeri and C.M. Walker (Eds.), *Proceedings of the 47th Annual Conference of the Cognitive Science Society* ©2025 the author(s). This work is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

acquisition. On this view, as children's language becomes more sophisticated, familiarity with the distributional properties might play an increasingly important role in complementing affective embodiment to support the learning of abstract words and concepts. Furthermore, linguistic development and social development might also support word acquisition at different developmental stages (e.g., Borghi et al., 2017; Kousta et al., 2011).

While there is an emotionality advantage, the empirical results regarding whether positive or negative valence is more effective in facilitating the acquisition of abstracts words have been mixed (Kauschke et al., 2019). Some studies (e.g., Ponari et al., 2018) reported a positivity effect, which can be explained by the Pollyanna Hypothesis (Boucher & Osgood, 1969), also known as the linguistic positivity bias where people tend to use more positive language and remember positive things better (Dodds et al., 2015). Yet, Silk et al. (2009) found that children and adolescents show no clear advantage for positive or negative words, and some studies even reported a negativity effect, where children demonstrate better recall for negative words (Kim et al., 2020). This negativity effect could be due to the greater attention people allocated to negative concepts, which might serve to enhance memory retention (Vaish et al., 2008). This mixed evidence highlights the complexity of emotional word processing in children and how it might also be influenced by factors such as developmental stage, emotional context, and task demands.

In adult language, there is a positive correlation between the valence of individual words and the emotional tone of the contexts in which they appear (Snefjella & Kuperman 2016). Kuhlmann et al. (2017) suggested that valence may function as a "semantic super-feature" that is represented in the patterns of association in semantic networks. These findings may have implications for children's language development. As children grow older, increased exposure to written language through independent reading offers abundant opportunities to encounter new words. In natural reading, texts do not usually provide explicit definitions of new words. Instead, the meaning (and valence) of new words needs to be inferred from context.

There is consistent evidence to indicate that adults can infer valence for new words based on the context in which they are embedded (e.g., Dong et al., 2024; Driver, 2021; Frances et al., 2020; Lana & Kuperman, 2023; Snefjella et al., 2020). For example, Snefjella et al. (2020) asked native speakers of English to learn nine novel nouns (e.g., *plurk*), each embedded in five short passages that were designed to be neutral, negative, or positive. In the subsequent post-tests, participants showed clear evidence of word learning, with the positive condition resulting in the best learning outcomes. Importantly, all the novel words acquired emotional connotations corresponding to the contexts in which they appeared. Lana and Kuperman (2023) extended the paradigm and found that the inference of valence based on context was only evident for concrete, but not abstract nouns. Since adjectives tend to be more abstract and their meanings more context-dependent (Davies et al., 2020; Dawson et al., 2021), Dong et al. (2024) adopted a similar paradigm but with adjectives and again found that participants were able to infer the valence of the novel words based on their context, and that words experienced in emotionally valenced contexts were better learned than those experienced in neutral contexts. While an emotionality advantage holds across studies, note that there is some inconsistency as to whether there is a difference between positive and negative contexts. Differences across studies might reflect differences in experimental design, and whether the learning is incidental or via explicit teaching.

A study by Ponari et al. (2020), introduced earlier, investigated similar themes in children. They taught 7- to 10-year-olds new abstract words that were neutral, negative or positive. One group of children were taught the new words in a condition that emphasized emotional information, while the other group via more encyclopedic, non-emotional information. Abstract words with emotional valence were better learned, consistent with the idea that emotional valence serves as a bootstrapping mechanism for acquiring abstract concepts. While they found no overall difference in learning for the two types of teaching approach, context was operationalized very differently to the method used in the adult word learning studies reviewed above, and even their "non-emotional" condition included many valenced words, thereby creating a valenced context from which children could potentially learn, regardless of the teaching strategy. In addition, Ponari et al. (2020) focused on direct teaching, repeated in multiple sessions across a week. This is quite different to the incidental learning targeted in the adult word learning experiments, and more importantly, it differs from how children experience new words in narrative contexts when reading independently.

To understand if and how the emotional valence provided by the narrative context influence children's word learning, we conducted a word-learning experiment testing whether children learn the emotional properties of new words when reading narrative. We chose 7- to 11-year-olds as they passed the initial stages of reading acquisition and are reading independently. The onset of literacy and exposure to written language provide unique opportunities for children to encounter complex language and vocabulary (Nagy et al., 1985, 1987; Nation et al., 2022). This age range also coincides with an increase in emotion vocabulary (Baron-Cohen et al., 2010; Dong & Nation, 2024) and sensitivity to word valence in lexical decision (Ponari et al., 2018). We chose to focus on adjectives, for which the effect of context valence might be more important. Following the paradigm developed by Dong et al. (2024), we used a naturalistic reading procedure to investigate the effect of context valence on adjective learning in children. We compared word learning after reading novel adjectives embedded in narratives that provided neutral, negative, or positive contexts. We aimed to test the hypothesis that context valence facilitates children's novel word learning, and our predictions were as follows:

1. Children would learn novel words from reading short narratives,
   a. and older children would learn better than younger children.
2. Words experienced in more emotional (positive and negative) contexts would be learned better than words experienced in neutral contexts.
3. Children would infer a valence for the novel words from the linguistic context in which the words appeared.

Method

Design

The experiment was based on a scenario of an alien learning and practicing English who occasionally included some "alien" words in its diary. These served as the novel words in the experiment. In the reading phase, children read 15 novel words embedded in 30 short narratives. The short narratives were of either neutral, negative, or positive valence. In the test phase, children completed several tasks to assess their learning of the novel words. There was one categorical independent variable, context valence, with three levels: neutral, negative, and positive. This was manipulated within-participant. Age (treated as a continuous variable) served as a covariate. Responses to each post-test served as the outcome measure. The study was pre-registered ahead of data collection (https://doi.org/10.17605/OSF.IO/MVZS4). Data and analysis scripts are available on OSF (https://osf.io/wspux/?view_only=9b3bfea6e8054952b56d774b7e9ea81b).

Participants

In total, 120 children (59 girls, 61 boys) were recruited from Year 3-6 classrooms in primary schools in the UK. Their ages ranged from 7 to 11 years old (M_{age} = 9.70, SD_{age} = 1.12). All children were enrolled in primary schools with English as the language of instruction. Fifty-five children (45.8%) had at least one family member who spoke to them in a language additional to English. Informed opt-in or opt-out consent (based on the preference of each participating school) was obtained from parents or guardians, and children provided verbal assent before starting the experiment. Following our pre-registered exclusion criterion, two children were excluded on the basis of poor reading (defined as 1.5 SD or more below the mean of the standardized sample on the Test of Word Reading Efficiency Second Edition (TOWRE–2; Torgesen et al., 2012)). The final sample comprised 118 children (57 girls, 62 boys; M_{age} = 9.71, SD_{age} = 1.12). There were 30 children from Year 3, 34 from Year 4, 27 from Year 5, and 27 from Year 6.

Materials

We created 30 short narratives ($M_{word\ count}$ = 18.00, $SD_{word\ count}$ = 2.58) of either neutral, negative, or positive valence (10 narratives in each condition). These were adapted from a pool of 70 narratives devised by Dong et al. (2024). The sentiment of each narrative was estimated using a Bidirectional Encoder Representations from Transformers (BERT) model, a transformer-based machine learning technique for natural language processing (Devlin et al., 2019). BERT considers the entire context of words in a sentence, rather than one word at a time, allowing it to capture emotional nuances in the narratives. The pool of 70 narratives were also rated by 19 native English adult speakers. Both approaches showed that context valence differed significantly across the three valence conditions, with narratives in the positive condition showing the most positive valence, followed by neutral, and then by negative. Narratives were matched across conditions for total word count and mean length of utterance. To ensure that the 30 narratives were age-appropriate, they were checked by four native English speakers (including one parent and one speech language therapist) with extensive experience working with children. A sample set of narratives is shown in Table 1).

Table 1: Example narratives in each condition

Context Valence	Examples
Neutral	I went to the roific library today. To get there, I turned left at the roific house.
Negative	I had a lenful argument with my classmate today. Their lenful words hurt my feelings.
Positive	I won a merous prize in writing today. I love the feeling of writing merous stories.

There were 30 novel words, 15 of which served as target novel words and the others as foils in the post-tests. Each of the 15 target novel words was embedded twice in two narratives in the same valence condition (see Table 1). The novel words were all 6 letters long and did not have a base meaning. They were created to have a nonword stem plus an adjective suffix, for example, the nonword stem roif- and the adjective suffix -ic led to the novel word roific. We chose five adjective suffixes from a list of suffixes with high diagnosticity values for adjectives, as calculated by Ulicheva et al. (2020). The novel words had no replacement orthographic neighbors, according to NWatch (Davis, 2005). Assignment of novel words to the context valence condition was counterbalanced such that a novel word appearing in the positive context for one child appeared in the neutral or negative context for other children. The post-test foils were the same across children.

Procedures

Consent forms were distributed by schools, and children who had parental consent (or absence of opt-out consent) were invited to take part. The experiment was conducted in a one-to-one setting in a quiet room, adjacent to the main classroom. The experiment was programmed and hosted on Gorilla (www.gorilla.sc). It was completed in a single session taking approximately 30 minutes. Study-themed stickers were used to keep children's attention and engagement.

After providing verbal assent, the child was introduced to the background of the study, which was structured around the premise of an alien attempting to learn English who, when writing their diary, occasionally replaced English words with words from its own language. Before they read the diary, they completed the word reading efficiency component of the TOWRE in which they read as many words from a card as they could in 45 seconds, based on the manual instructions.

Next, they read the alien's diary on the experimenter's laptop via Gorilla. They saw novel words in neutral, negative, or positive narratives, presented in a random order. Each child experienced 15 novel words embedded in 30 short narratives, evenly split into two blocks of 15 narratives. Each word appeared with two different contexts of the same valence. They were told to pay attention to these novel words, but no further instruction was provided.

Immediately after reading the narratives, word learning was assessed via three outcome measures, administered in a fixed order: *word recognition*, *valence judgment*, and *meaning generation*. Several practice items were provided before each task began. Following that, items were presented randomly in a single block with no feedback.

For *word recognition*, modelled after lexical decision, children identified whether they had previously seen a presented letter string. Each trial began with a fixation cross displayed for 250 ms, followed by the letter strings, during which the children pressed marked buttons on the keyboard to make a judgment. Accuracy of the response was recorded. Each child responded to 15 targets and 15 foils.

They then completed a *valence judgment* task in which they made a categorical judgment to indicate whether the meaning of each of the 15 novel word was neutral, negative, or positive. Each word was first displayed for 300 ms before the three options (emoji with words) appeared. Children made a judgment by clicking on what they thought was the most suitable option. The next trial started as soon as a response was recorded. Accuracy was scored.

The final task was *meaning generation*. In each trial, children were shown one of the 15 newly learnt words along with the diary narrative context in which they appeared. They were invited to say one English word that they considered to correspond with the meaning of the novel word. This was typed into interface by the experimenter. The words produced were cross-referenced with norms of valence for English lemmas (Warriner et al., 2013) to assign a valence score.

At the end of the session, children completed the phonemic decoding subtest of TOWRE, and they reported their basic demographic information, including age and gender.

Statistical Analyses

As set out in the pre-registration, we fitted mixed-effect models with random effects of participants and stimuli for each dependent variable, using the *lme4* package (Bates et al., 2015) in R (R Core Team, 2022). For all full models DV ~ ContextValence + Age + (1+ ContextValence | participant) + (1+ ContextValence | item) that failed to converge, we followed Mak et al. (2023) by simplifying the random-effect structure using the R package *buildmer* (Voeten, 2023). A likelihood ratio test was used to compare the full model to the reduced model to assess whether including the fixed factor ContextValence significantly improved model fit.

For the dependent variable sensitivity *d'* in *word recognition*, a one-sample t-test compared the sample mean to the population mean 0, to test for the overall learning effect. For the dependent variable accuracy for valence judgment, a one-sample t-test compared the sample mean to the chance level, which is 0.33, to test for the overall learning effect.

The fixed effect was context valence (neutral, negative, positive). This was dummy-coded, with the neutral condition serving as the reference level. Models were fitted using maximum likelihood estimates.

Results

Descriptive statistics are provided in Table 2.

Table 2: Descriptive statistics (mean and standard deviation) of various tasks.

	Word Recognition	Valence Judgment	Meaning Generation
Variable[1]	Accuracy	Accuracy	Valence score
Neutral	0.67 (0.23)	0.36 (0.20)	5.90 (0.82)
Negative	0.75 (0.22)	0.42 (0.22)	3.27 (0.64)
Positive	0.73 (0.26)	0.34 (0.19)	7.31 (0.50)

For novel word learning assessed via *word recognition*, we first computed sensitivity from raw responses using the *dprime* function in psycho package (Makowski, 2018). A one-sample *t*-test provided clear evidence that children were sensitive to distinguish learned items from foils, $M_{d'} = 1.04$, 95% CI = [0.91, 1.17], $t(117) = 15.87$, $p < .001$. We then compared novel words learned across the different valence conditions (Figure 1). From the likelihood ratio test, context valence was a significant predictor for recognition accuracy, $\chi^2(2) = 12.40$, $p = .002$. As compared to words in the neutral context ($M = 0.67$, $SD = 0.47$), children were more accurate in recognizing words experienced in the negative context ($M = 0.75$, $SD = 0.43$) and the positive context ($M = 0.73$, $SD = 0.44$; negative vs. neutral: $\beta = 0.47$, $SE = 0.14$, $z = 3.41$, $p < .001$; positive vs. neutral: $\beta = 0.33$, $SE = 0.13$, $z = 2.46$, $p = .01$). Age was also a significant predictor for recognition accuracy, $\chi^2(1) = 26.38$, $p < .001$, with older children performing better than younger children, $\beta = 0.40$, $SE = 0.07$, $z = 5.36$, $p < .001$.

Novel word valence learning was first assessed via *valence judgment*. A one-sample *t*-test provided evidence that

[1] Accuracy is a probability from 0-1; Valence score is a continuous value between 1-9, with 9 being very positive, and 1 being very negative.

children performed above chance, $M_{accuracy}$ = 0.37, 95% CI = [0.35, 0.39], $t(117) = 4.48$, $p < .001$. We then compared novel words learned across the different valence conditions (Figure 2). Context valence was a significant predictor of valence judgment accuracy, $\chi^2(2) = 7.67$, $p = .02$. As compared to novel words learned in the neutral contexts ($M = 0.36$, $SD = 0.20$), there was no significant difference in the performance for novel words learned in the negative condition ($M = 0.42$, $SD = 0.22$), or the positive condition ($M = 0.34$, $SD = 0.29$; negative vs. neutral: $\beta = 0.22$, $SE = 0.12$, $z = 1.85$, $p = .06$; positive vs. neutral: $\beta = -0.10$, $SE = 0.12$, $z = -0.85$, $p = .39$). Age was a significant predictor for valence judgment accuracy, $\chi^2(1) = 4.03$, $p = .02$, with older children performing better on the task than younger children, $\beta = 0.09$, $SE = 0.04$, $z = 2.01$, $p = .04$.

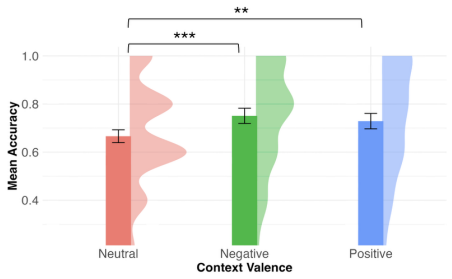


Figure 1: Plot[2] of mean recognition accuracy (proportion correct) of novel words in each condition

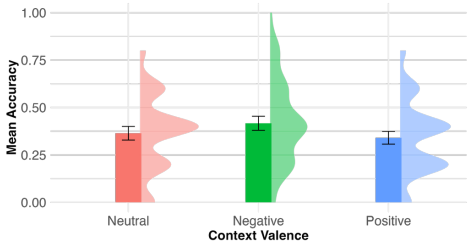


Figure 2: Plot of mean valence judgment accuracy (proportion correct) of novel words in each condition.

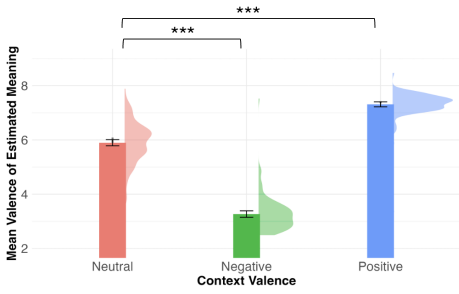


Figure 3: Plot of mean valence scores (from norms) of generated meanings of novel words in each condition.

Novel word valence learning was also assessed via *meaning generation*. 1642 out of 1770 (93%) responses had associated valence scores listed in Warriner et al.'s (2013) norms. Figure 3 shows the mean valence score of generated meaning per participant by context valence. The likelihood ratio test shows that context valence was a significant predictor of estimated valence scores, $\chi^2(2) = 153.22$, $p < .001$. Compared to novel words appearing in the neutral context ($M = 5.90$, $SD = 0.82$), children assigned more negative meanings to novel words experienced in the negative context ($M = 3.27$, $SD = 0.64$), and more positive meanings to novel words experienced in the positive context ($M = 7.31$, $SD = 0.50$; negative vs. neutral: $\beta = -2.69$, $SE = 0.12$, $t = -22.65$, $p < .001$; positive vs. neutral: $\beta = 1.37$, $SE = 0.12$, $t = 11.59$, $p = .003$). Age was also a significant predictor for estimated meaning valence, $\chi^2(1) = 7.06$, $p = .008$. Older children generated word meanings that were less positive than younger children, $\beta = -0.08$, $SE = 0.03$, $z = -2.68$, $p = .009$.

We also explored whether the significant age effect held across different emotional contexts. Using a median split on age, we compared the confidence intervals of each age group, mindful that our sample size might be underpowered to test for an interaction. We found that older children recognized novel words read in neutral and positive contexts better than younger children, and they were more accurate in judging a word read in the negative context as negative.

Discussion

This pre-registered word learning experiment investigated the influence of emotional narrative context on children's learning of novel adjectives. We found that children can learn novel words from reading short narratives, as seen in the above chance performance in *word recognition*. Words read in more emotional (positive or negative) contexts were recognized more accurately than those read in neutral narratives. Older children learned better than younger children. Children were also able to infer word valence from context, as seen in the above chance performance in *valence judgment,* as well as in *meaning generation* where the valence of generated meanings reflected the respective emotional valence of the associated context.

That children can learn novel valenced words through reading short narratives corroborates and extends previous research conducted with adults (e.g., Dong et al., 2024). This makes sense, given that more generally, reading is a crucial avenue for vocabulary acquisition (Nagy et al., 1985, 1987). Previous corpus research shows that compared to aged-matched spoken language, book language is more emotionally arousing, and books use a greater diversity of emotion words (Dawson et al., 2021; Dong & Nation, 2024). Our results also revealed an emotion advantage in *word recognition*. Words that were embedded in more emotional contexts – both positive and negative – were recognized more

[2] The density plots represent the distribution of the mean accuracy. Error bars represent 95% within-participant Confidence Intervals. $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.

accurately than words presented in neutral contexts. This supports the affective embodiment account, which posits that emotional content enhances cognitive processing and memory retention. Additionally, we observed an age effect in *word recognition*, with older children outperforming younger children. This age effect could be attributed to a combination of factors, including increased proficiency in language and cognitive skills. Older children are more likely to have better language and reading, which in turn can support new word learning.

Children were also able to infer word valence from context. In *valence judgment*, performance was above chance, though it is worth noting that performance was relatively low, and the interpretation should take into consideration of the overall low performance. The task was challenging as it did not provide any narrative context during the test. This categorical judgment to either neutral, negative, or positive may be particularly complex for children, who might not have a fully developed understanding of these valence terms or may interpret them differently compared to adults. Complementary evidence was provided by performance on *meaning generation*. Here, children were asked to provide an English word that they thought best represented the meaning of each novel word in context. As the novel words did not have exact translations, we did not measure the accuracy of their responses in terms of the precision. Instead, we focused on the valence of the English words they produced. There was a close correspondence between the emotional valence of the generated meanings and the relative emotional valence of the context in which the novel words appeared.

Many studies have explored the influence of context on word learning (e.g., Bolger et al., 2008; Hulme et al., 2023; Mak et al., 2021; Rosa et al., 2022), but relatively few have examined the affective aspects of word learning in adults (e.g., Snefjella et al., 2020), and none have focused on children. Our findings suggest that children as young as 7 years old can infer the emotional valence and meaning of novel words through reading in context, even without explicit definitions or scaffolding by adults. This highlights that word learning occurs incidentally and incrementally during reading. In our study, although we asked children to pay attention to the novel words, they were not informed about any upcoming tests. While we acknowledge that our approach might not fully resemble natural reading, where children are not typically instructed to focus on unfamiliar words, our approach is a step closer to incidental learning. Future research could eliminate this instruction entirely to assess whether children can infer valence spontaneously. Moreover, in line with our aim to simulate incidental learning, we chose not to provide predefined meanings for the made-up words. This allowed children to engage with the novel words more naturally. Consequently, we did not control for sentence structures between contexts, and whether the novel adjectives were used in prenominal (before nouns) or postnominal (predicative) positions. Yet, real words sometimes have positional constraints (e.g., Davies et al., 2020); for example, "afraid" can only be used predicatively. Future studies should consider controlling for adjective position and explore the syntactic, semantic, and pragmatic dimensions of adjectives to provide a more comprehensive understanding of children's acquisition of adjectives via reading.

Our results support the affective embodiment account that emotional valence facilitates the acquisition of abstract words, but the account does not specify whether positive or negative valence is more effective in supporting word learning and processing. Interestingly, however, when looking at children's own language production, children's generated meaning showed a linguistic positivity bias, where the overall valence of all generated words is 5.49 out of 9, which is also above the midpoint of 5. Specifically, the estimated valence rating for words in the neutral context (5.90) is also slightly more positive than neutral. This is in line with the Pollyanna hypothesis that human language demonstrates a universal tendency to use more positive terms (Boucher & Osgood, 1969; Dodds et al., 2015). Similar findings were also reported with adult participants in Dong et al. (2024) and Snefjella and Kuperman's (2016) analysis on adult language. These provide additional evidence for the Pollyanna hypothesis and the universal linguistic positivity. While both positive and negative contexts support learning, when it comes to language usage, both adults and children tend to use more positive language.

Additionally, while the better performance in emotional contexts is in line with the affective embodiment account, it does not preclude alternative explanations. Broader language learning mechanisms, such as statistical learning and distributional semantics may also contribute to children's learning of emotion language (Lenci et al., 2018; Seidenberg & MacDonald, 2018). To rule out other possible explanations such as word association in accounting for word learning, future studies should more strictly control for stimulus attributes, including arousal and dominance. Additionally, future studies should incorporate tasks that assess children's understanding of novel word meanings beyond valence, such as testing their ability to use the novel words correctly in new, unrelated contexts. These approaches would help determine whether emotional contexts facilitate deeper semantic learning rather than merely forming simple associative links.

In conclusion, we tested through an experiment that children can indeed infer the emotional valence of novel words from reading them in context, and that words read in emotional contexts were learned better than those experienced in more neutral contexts. As the first study of its kind with children, questions remain for future research to address. For example, assessing word knowledge after a delay would reveal whether the learning effects seen in our experiment maintain over time, and introducing a frequency manipulation could test how learning unfolds through multiple exposures. We focused on valence, and it would be interesting to consider other emotion attributes such as arousal. Together, this will deepen our understanding of the interplay between words and the contexts in which they appear, and how affective associations of both influence word learning.

References

Baron-Cohen, S., Golan, O., Wheelwright, S., & Granader, Y. (2010). Emotion Word Comprehension from 4 to 16 Years Old: A Developmental Survey. *Frontiers in Evolutionary Neuroscience*, *2*. https://www.frontiersin.org/articles/10.3389/fnevo.2010.00109

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software*, *67*, 1–48. https://doi.org/10.18637/jss.v067.i01

Batini, F., Luperini, V., Cei, E., Izzo, D., & Toti, G. (2021). The Association Between Reading and Emotional Development: A Systematic Review. *Journal of Education and Training Studies*, *9*(1), Article 1. https://doi.org/10.11114/jets.v9i1.5053

Bolger, D. J., Balass, M., Landen, E., & Perfetti, C. A. (2008). Context variation and definitions in learning the meanings of words: An instance-based learning approach. *Discourse Processes*, *45*(2), 122–159. https://doi.org/10.1080/01638530701792826

Boucher, J., & Osgood, C. E. (1969). The Pollyanna hypothesis. *Journal of Verbal Learning & Verbal Behavior*, *8*, 1–8. https://doi.org/10.1016/S0022-5371(69)80002-2

Brysbaert, M., Warriner, A. B., & Kuperman, V. (2014). Concreteness ratings for 40 thousand generally known English word lemmas. *Behavior Research Methods*, *46*(3), 904–911. https://doi.org/10.3758/s13428-013-0403-5

Davies, C., Lingwood, J., & Arunachalam, S. (2020). Adjective forms and functions in British English child-directed speech. *Journal of Child Language*, *47*(1), 159–185. https://doi.org/10.1017/S0305000919000242

Davis, C. J. (2005). N-Watch: A program for deriving neighborhood size and other psycholinguistic statistics. *Behavior Research Methods*, *37*(1), 65–70. https://doi.org/10.3758/BF03206399

Dawson, N., Hsiao, Y., Tan, A. W. M., Banerji, N., & Nation, K. (2021). Features of lexical richness in children's books: Comparisons with child-directed speech. *Language Development Research*, *1*(1), Article 1. https://doi.org/10.34842/5we1-yk94

Devlin, J., Chang, M.-W., Lee, K., & Toutanova, K. (2019). *BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding* (arXiv:1810.04805). arXiv. https://doi.org/10.48550/arXiv.1810.04805

Dodds, P. S., Clark, E. M., Desu, S., Frank, M. R., Reagan, A. J., Williams, J. R., Mitchell, L., Harris, K. D., Kloumann, I. M., Bagrow, J. P., Megerdoomian, K., McMahon, M. T., Tivnan, B. F., & Danforth, C. M. (2015). Human language reveals a universal positivity bias. *Proceedings of the National Academy of Sciences*, *112*(8), 2389–2394. https://doi.org/10.1073/pnas.1411678112

Dong, Y., Mak, M. H., Hepach, R., & Nation, K. (2024). Learning New Words via Reading: The Influence of Emotional Narrative Context on Learning Novel Adjectives. *Quarterly Journal of Experimental Psychology*, *0*(0). https://doi.org/10.1177/17470218241308221

Dong, Y., & Nation, K. (2024). *Charting the frequency and diversity of emotion words in children's language: Written language matters*. OSF. https://doi.org/10.31219/osf.io/zj5k7

Doost, H. T. N., Moradi, A. R., Taghavi, M. R., Yule, W., & Dalgleish, T. (1999). The development of a corpus of emotional words produced by children and adolescents. *Personality and Individual Differences*, *27*, 433–451. https://doi.org/10.1016/S0191-8869(98)00253-0

Driver, M. (2021). EMOTION-LADEN TEXTS AND WORDS: THE INFLUENCE OF EMOTION ON VOCABULARY LEARNING FOR HERITAGE AND FOREIGN LANGUAGE LEARNERS. *Studies in Second Language Acquisition*, 1–24. https://doi.org/10.1017/S0272263121000851

Frances, C., Bruin, A. de, & Duñabeitia, J. A. (2020). The effects of language and emotionality of stimuli on vocabulary learning. *PLOS ONE*, *15*(10), e0240252. https://doi.org/10.1371/journal.pone.0240252

Honnibal, M., & Montani, I. (2017). *spaCy 2: Natural language understanding with Bloom embeddings, convolutional neural networks and incremental parsing*.

Hulme, R. C., Begum, A., Nation, K., & Rodd, J. M. (2023). Diversity of narrative context disrupts the early stage of learning the meanings of novel words. *Psychonomic Bulletin & Review*, *30*(6), 2338–2350. https://doi.org/10.3758/s13423-023-02316-z

Kauschke, C., Bahn, D., Vesker, M., & Schwarzer, G. (2019). The Role of Emotional Valence for the Processing of Facial and Verbal Stimuli—Positivity or Negativity Bias? *Frontiers in Psychology*, *10*. https://www.frontiersin.org/articles/10.3389/fpsyg.2019.01654

Kim, J. M., Sidhu, D. M., & Pexman, P. M. (2020). Effects of Emotional Valence and Concreteness on Children's Recognition Memory. *Frontiers in Psychology*, *11*, 615041. https://doi.org/10.3389/fpsyg.2020.615041

Kousta, S.-T., Vigliocco, G., Vinson, D. P., Andrews, M., & Del Campo, E. (2011). The representation of abstract words: Why emotion matters. *Journal of Experimental Psychology: General*, *140*(1), 14–34. https://doi.org/10.1037/a0021446

Kousta, S.-T., Vinson, D. P., & Vigliocco, G. (2009). Emotion words, regardless of polarity, have a processing advantage over neutral words. *Cognition*, *112*(3), 473–481. https://doi.org/10.1016/j.cognition.2009.06.007

Kuhlmann, M., Hofmann, M. J., & Jacobs, A. M. (2017). If You Don't Have Valence, Ask Your Neighbor: Evaluation of Neutral Words as a Function of Affective Semantic Associates. *Frontiers in Psychology*, *8*. https://www.frontiersin.org/articles/10.3389/fpsyg.2017.00343

Lana, N., & Kuperman, V. (2023). Learning concrete and abstract novel words in emotional contexts: Evidence from incidental vocabulary learning. *Language Learning and*

Development, *20*(2), 158-173. https://doi.org/10.1080/15475441.2023.2246438

Lenci, A., Lebani, G. E., & Passaro, L. C. (2018). The Emotions of Abstract Words: A Distributional Semantic Analysis. *Topics in Cognitive Science*, *10*(3), 550–572. https://doi.org/10.1111/tops.12335

Lund, T. C., Sidhu, D. M., & Pexman, P. M. (2019). Sensitivity to emotion information in children's lexical processing. *Cognition*, *190*, 61–71. https://doi.org/10.1016/j.cognition.2019.04.017

Mak, M. H. C., Curtis, A. J., Rodd, J. M., & Gaskell, M. G. (2023). Episodic memory and sleep are involved in the maintenance of context-specific lexical information. *Journal of Experimental Psychology. General*, *152*(11), 3087–3115. https://doi.org/10.1037/xge0001435

Mak, M. H. C., Hsiao, Y., & Nation, K. (2021). Anchoring and contextual variation in the early stages of incidental word learning during reading. *Journal of Memory and Language*, *118*, 104203. https://doi.org/10.1016/j.jml.2020.104203

Makowski, D. (2018). The psycho Package: An Efficient and Publishing-Oriented Workflow for Psychological Science. *Journal of Open Source Software*, *3*(22), 470. https://doi.org/10.21105/joss.00470

Nagy, W. E., Anderson, R. C., & Herman, P. A. (1987). Learning Word Meanings From Context During Normal Reading. *American Educational Research Journal*, *24*(2), 237–270. https://doi.org/10.3102/00028312024002237

Nagy, W. E., Herman, P. A., & Anderson, R. C. (1985). Learning Words from Context. *Reading Research Quarterly*, *20*(2), 233–253. https://doi.org/10.2307/747758

Nation, K., Dawson, N. J., & Hsiao, Y. (2022). Book Language and Its Implications for Children's Language, Literacy, and Development. *Current Directions in Psychological Science*, *31*(4), 375–380. https://doi.org/10.1177/09637214221103264

Nencheva, M. L., Tamir, D. I., & Lew-Williams, C. (2023). Caregiver speech predicts the emergence of children's emotion vocabulary. *Child Development*. https://doi.org/10.1111/cdev.13897

Ponari, M., Norbury, C. F., & Vigliocco, G. (2018). Acquisition of abstract concepts is influenced by emotional valence. *Developmental Science*, *21*(2), e12549. https://doi.org/10.1111/desc.12549

Ponari, M., Norbury, C. F., & Vigliocco, G. (2020). The role of emotional valence in learning novel abstract concepts. *Developmental Psychology*, *56*(10), 1855–1865. https://doi.org/10.1037/dev0001091

R Core Team. (2022). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. https://www.r-project.org/

Reggin, L. D., Muraki, E. J., & Pexman, P. M. (2021). Development of Abstract Word Knowledge. *Frontiers in Psychology*, *12*, 686478. https://doi.org/10.3389/fpsyg.2021.686478

Rosa, E., Salom, R., & Perea, M. (2022). Contextual diversity favors the learning of new words in children regardless of their comprehension skills. *Journal of Experimental Child Psychology*, *214*, 105312. https://doi.org/10.1016/j.jecp.2021.105312

Seidenberg, M. S., & MacDonald, M. C. (2018). The Impact of Language Experience on Language and Reading: A Statistical Learning Approach. *Topics in Language Disorders*, *38*(1), 66. https://doi.org/10.1097/TLD.0000000000000144

Silk, J. S., Siegle, G. J., Whalen, D. J., Ostapenko, L. J., Ladouceur, C. D., & Dahl, R. E. (2009). Pubertal Changes in Emotional Information Processing: Pupillary, Behavioral, and Subjective Evidence during Emotional Word Identification. *Development and Psychopathology*, *21*(1), 7–26. https://doi.org/10.1017/S0954579409000029

Snefjella, B., & Kuperman, V. (2016). It's all in the delivery: Effects of context valence, arousal, and concreteness on visual word processing. *Cognition*, *156*, 135–146. https://doi.org/10.1016/j.cognition.2016.07.010

Snefjella, B., Lana, N., & Kuperman, V. (2020). How emotion is learned: Semantic learning of novel words in emotional contexts. *Journal of Memory and Language*, *115*, 104171. https://doi.org/10.1016/j.jml.2020.104171

Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (2012). *TOWRE-2 Test of Word Reading Efficiency*. New York: Pearson.

Ulicheva, A., Harvey, H., Aronoff, M., & Rastle, K. (2020). Skilled readers' sensitivity to meaningful regularities in English writing. *Cognition*, *195*, 103810. https://doi.org/10.1016/j.cognition.2018.09.013

Vaish, A., Grossmann, T., & Woodward, A. (2008). Not all emotions are created equal: The negativity bias in social-emotional development. *Psychological Bulletin*, *134*(3), 383–403. https://doi.org/10.1037/0033-2909.134.3.383

Vigliocco, G., Kousta, S.-T., Della Rosa, P. A., Vinson, D. P., Tettamanti, M., Devlin, J. T., & Cappa, S. F. (2014). The neural representation of abstract words: The role of emotion. *Cerebral Cortex*, *24*(7), 1767–1777. https://doi.org/10.1093/cercor/bht025

Vigliocco, G., Ponari, M., & Norbury, C. (2018). Learning and Processing Abstract Words and Concepts: Insights From Typical and Atypical Development. *Topics in Cognitive Science*, *10*(3), 533–549. https://doi.org/10.1111/tops.12347

Voeten, C. C. (2023). *Using 'buildmer' to automatically find & compare maximal (mixed) models*. https://cran.r-project.org/web/packages/buildmer/vignettes/buildmer.html

Warriner, A. B., & Kuperman, V. (2015). Affective biases in English are bi-dimensional. *Cognition and Emotion*, *29*(7), 1147–1167. https://doi.org/10.1080/02699931.2014.968098

Warriner, A. B., Kuperman, V., & Brysbaert, M. (2013). Norms of valence, arousal, and dominance for 13,915 English lemmas. *Behavior Research Methods*, *45*(4), 1191–1207. https://doi.org/10.3758/s13428-012-0314-x