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Touch-and-feel features in “first words” picture books hinder infants’ word learning

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ABSTRACT

Little is known about the role of book features in infant word learning from picture books. We conducted a preregistered study to assess the role of touch-and-feel features in infants’ ability to learn new words from picture books. A total of 48 infants ($M_{\text{age}} = 16.75$ months, $SD = 1.85$) were assigned to a touch-and-feel picture-book condition or a standard picture-book condition (no touch-and-feel features) and were taught a novel label for an unfamiliar animal by the researcher during a book-reading session. Infants were then tested on their ability to recognize the label (i.e., choose the target from a choice of two pictures on hearing it named) and to generalize this knowledge to other types of pictures and real-world objects (scale model animals and stuffed animals). Infants in the no touch-and-feel condition performed above chance when choosing the target picture, whereas infants in the touch-and-feel condition did not. Infants in both conditions failed to generalize this knowledge to other pictures and objects. This study extends our knowledge about the role of tactile features in infant word learning from picture books. Although manipulative features like touch-and-feel patches might be engaging for infants, they may detract from learning. Depending on the purpose of the activity, parents and practitioners might find it useful to consider such book features when selecting books to read with their infants.

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Introduction

Early shared reading predicts later vocabulary (DeBaryshe, 1993; Karrass & Braungart-Rieker, 2005), but less is known about how and when such reading practices result in word learning. One mechanism might be that shared reading provides repeated encounters with pictures and their labels, fostering word learning over time (Heller & Rohlfing, 2017). However, in addition to learning the association between a label and its referent, infants must also transfer this knowledge from the book to the real world. This symbolic insight involves *dual representation*; infants must mentally represent both the concrete symbol (e.g., as it appears in the book) and the abstract thing it symbolizes (DeLoache, 1995; DeLoache et al., 2003).

Several studies suggest that infants *can* learn new words and other novel information from picture books and transfer this knowledge to real life. For example, Ganea et al. (2008) found that 15- and 18-month-olds extended newly learned words from picture books to objects when asked to choose between the target and a distractor object. However, learning was affected by picture iconicity (how closely the pictures resembled the objects), with better performance from photographs and realistic pictures than from cartoons. Similar results were found with 18- to 30-month-olds taught to imitate a novel action sequence from a picture book: toddlers succeeded at the task, but performance was lower for younger toddlers and when the pictures in the books were less iconic (drawings vs. photographs; Simcock & DeLoache, 2006). Thus, symbolic insight with pictures is still fragile during the second year of life and is hampered when the picture does not closely resemble the real-life object or scene.

In addition to picture iconicity, infants' learning of new words during shared reading is also affected by manipulative features of books such as pop-up, pull-the-tab, and lift-the-flap features. For example, when 20-month-olds were taught animal names from a commercial book with flaps and tabs that caused the animals to pop up or move, they failed to learn the names or generalize them to other types of pictures and scale model objects compared with above-chance performance with books without manipulative features (Tare et al., 2010). However, iconicity and manipulative features were confounded in that study (the manipulative book condition contained only drawings, whereas the two non-manipulative book conditions varied whether the pictures were drawings or photographs). More recently, Shinsky (2020) found that 2-year-olds who saw a commercial lift-the-flap book with photos chose the target significantly less often than those who saw the same book with no flaps, and only those who saw the no-flap book performed above chance. Findings from these two studies indicate that manipulative features may hinder infants' word learning either because they bias infants to treat the book as a toy or object, thereby impeding their symbolic insight, or because they capture attention, distracting infants from the word-learning task.

One type of picture-book feature that has not yet been studied in infant word learning is "touch-and-feel" (texture). These books contain areas that are a different texture to the rest of the page, such as a soft or rough material, often representing an attribute of the referent depicted on the page (e.g., soft fur, hard beak). These highly popular infant books are marketed as being educational and may be perceived by caregivers as beneficial for learning words and concepts through increased interest and engagement. But it is not clear whether such books benefit or hinder infant word learning. Touch-and-feel features might facilitate word learning through physical interaction by drawing infants' attention to the referent (e.g., a bear with a soft fur touch-and-feel feature). However, given previous evidence from studies with other tactile features (Shinsky, 2020; Tare et al., 2010), it seems more likely that such features might hinder word learning by biasing infants to treat the book as a toy or an object or by increasing attentional demands.

Our goal was to investigate the role of touch-and-feel features in infants' word learning from a commercially available "first words" picture book. We were especially interested in whether infants could be taught new words from these books given that touch-and-feel books are routinely targeted at infants, and learning and generalization from pictures without tactile features has previously been demonstrated in 15- to 18-month-olds (Ganea et al., 2008). We taught 14- to 20-month-olds a non-word for an unfamiliar animal during a single book-reading session in the lab. Infants were randomly assigned to a touch-and-feel picture-book condition or a standard picture-book condition (no touch-

and-feel). Infants were read to and then tested immediately after book reading to assess whether they (a) had learned the nonword from the book and (b) could transfer this knowledge to real-world objects and other types of pictures. Infant interest during book reading was rated from videos to provide insight into engagement with the two book types. Importantly, we controlled for the potential confound of picture realism by using books with photographs. We hypothesized that infants would demonstrate less learning of the novel label from the touch-and-feel book than from the standard book because tactile features would distract infants from the word-learning task and/or hinder their symbolic insight by increasing the bias to regard books as toys.

This study was preregistered on the Open Science Framework (<https://osf.io/jd4mp>).

Method

Participants

Participants comprised 48 monolingual, typically developing infants ($M_{\text{age}} = 16.75$ months, $SD = 1.85$, range = 13.87–20.55), 24 in each condition (touch-and-feel vs. standard). Infants were recruited from the southeastern United Kingdom via a marketing database and community centers. Infants were White (67%), Mixed race (25%), and Asian (8%). Maternal education was high school level (2%), pre-college (19%), undergraduate degree (38%), and postgraduate degree (42%). Infants knew on average 49.73 words ($SD = 22.49$), as indicated by the UK-Child Development Inventories (UK-CDI; Alcock et al., 2017). An additional 7 infants were excluded for fussiness (2 did not complete the book reading, 2 did not complete the trials, and 3 did not complete either). Infant age, vocabulary scores, and sex did not differ significantly between conditions ($ps = .27-.83$).

Materials

Infant vocabulary

Vocabulary was assessed by parent report using the short form of the UK-CDI (Words and Gestures) for 8- to 18-month-olds (Alcock et al., 2017), comprising a list of 91 words. We incorporated the study animal names into the checklist to assess whether infants knew them before participating. Only infants who did not know the names of the target animals were eligible.

Picture books

A commercially available picture book marketed for infants and toddlers was selected: *Touch and Feel: Jungle Animals* (Dorling Kindersley, 2012). Only infants who were reported as unfamiliar with the study book participated. The book had 10 pages of photographs of five different animals with five touch-and-feel features (short fur, long fur, hard smooth material, rough material, and sticky texture). This last feature (sticky frog's feet) was omitted by gluing pages together because repeated touching would decrease its stickiness. To create the standard book, pages were covered by identical images with no touch-and-feel features. The final two books each contained eight pages with four animals (jaguar, orangutan, snake, and toucan) and were identical except that one book had four touch-and-feel features and the other had none. Infants learned a label for either *toucan* or *jaguar*, which were unlikely to be known (estimated age of acquisition ≥ 6 years; Kuperman et al., 2012). We counterbalanced animals across participants such that half had the toucan as their labeled target and the jaguar as an unlabeled distractor to which they were equally exposed (see "Procedure" section), and half had the reverse. The *orangutan* and *snake* were unlabeled fillers.

Nonword selection

A nonword ("mip") was used as a label to rule out any prior knowledge of the to-be-learned word-referent association. Similar nonwords were used in previous infant word-learning studies (e.g., Gurteen et al., 2011). All parents confirmed that the nonword was novel to infants.

Testing stimuli (pictures and objects)

At test, infants saw pictures and objects. Pictures were exact copies from the books and realistic color drawings (created through the photo editing app Photo Lab). Objects were realistic scale model animals ($\sim 5 \times 5 \times 4$ cm) and stuffed animals ($\sim 30 \times 20 \times 25$ cm) that closely resembled the target and distractor animals in the books.

Masking

The experimenter wore a face mask throughout the procedure, in line with the lab's COVID-19 risk assessment. To succeed at the current task, infants only needed to identify the referent that was labeled during the book reading (from a target and distractor choice). They did not need to discriminate between sounds or produce the word. Therefore, we expected that infants would be able to do the task despite masking.

Procedure

Book reading/training phase

Infants were seated in a highchair or on their parent's lap. The experimenter sat alongside infants and "read" the book, pointing to and labeling the target animal six times during each reading (e.g., "This is a mip!"; "Look at the mip!"). An equal amount of time was spent commenting on the distractor animal (e.g., "Look at that. Can you see it? Yeah, look at that."). The experimenter pointed to and briefly commented on the two filler animals in the book without labeling them (e.g., "Wow, look at that!"). After the first reading, the experimenter read the book for a second time in the same manner. The researcher followed the identical procedure for both book conditions except that in the touch-and-feel condition she encouraged infants to touch the touch-and-feel features (e.g., "Oh, can you feel it?") during both readings, as is conventional with such books. Crucially, the experimenter engaged with each book type as would be expected naturalistically.

Testing

The testing procedure is based on existing infant word-learning studies (Ganea et al., 2008). The recognition test was presented first because it was necessary to establish first whether infants had learned the nonword for the animal as pictured in the book. Transfer of knowledge from the book to the scale model objects was of primary interest, and so this trial was presented second. The picture generalization trials were presented next, followed by the stuffed animals (to maximize infant attention).

In each trial, the experimenter presented infants with a different pair of stimuli (target and distractor) and asked them to choose the target (see Fig. 1). The session began with two practice trials (with familiar pictures and objects) to familiarize infants with the testing procedure. Target position (left/right) was counterbalanced across trials. Once infants had made their choice, the experimenter provided neutral feedback ("Thank you"). In trials involving objects, infants were allowed to play with their selected object for 20 s (as in Shinsky, 2020). When infant choice was unclear (e.g., no response, reaching for both), the trial was repeated once with stimuli presented on opposite sides.

Scoring

We scored infant choice from the video-recordings (target = 1; distractor, both, neither, or choice unclear = 0). The first author coded all videos; a research assistant blind to the study's hypotheses additionally coded 20 videos (42%). Agreement and reliability for scores and categorical coding were excellent at 97.6% ($\kappa = .95$) and 94.0% ($\kappa = .91$), respectively.



Fig. 1. From left to right: Standard version of the book (displaying toucan page); touch-and-feel version of the book (displaying jaguar page); colored drawing version of toucan; colored drawing version of jaguar; stuffed toy toucan; stuffed toy jaguar. Bottom row: The experimenter drew the infant's attention to the target and distractor stimuli by saying "Look at these" and then pointed at the target and distractor, saying "See this?" and "See this?" The experimenter then met the infant's gaze before asking the infant to identify the target animal (e.g., "There's a mip here. ... Where's the mip?"). Scale model objects were approximately $5 \times 5 \times 4$ cm. Stuffed animals were approximately $30 \times 20 \times 25$ cm.

Infant interest during book reading

We rated infant behavior from video-recordings using an interval rating scale (Deckner et al., 2006) for *availability* (e.g., attending), *affect* (e.g., smiling), and *active participation* (e.g., vocalizations, touching the book). Ratings (1–5, low to high) were obtained for each book reading and then averaged. A

research assistant rated 25% of the videos for reliability. Reliability was excellent for affect and active participation (κ s = 1.00 and .78, respectively) but was low for availability (κ = .31).¹ Cronbach's alpha was low (.40) and was not improved by removing any subscale. Thus, subsequent analyses were conducted with individual subscales rather than combined as one scale.

Results

Reading durations

Reading durations were longer in the touch-and-feel condition ($M = 200.96$ s, $SD = 33.37$) than in the standard condition ($M = 170.00$ s, $SD = 29.36$), $t = -3.41$, $p = .002$.

Performance by condition and trial type

Fig. 2 shows the percentage of correct responses by infants in each condition across the five tests. Infants performed significantly above chance on picture recognition in the standard condition (17 of 24 chose the target, $p = .03$), but not in the touch-and-feel condition (11 of 24 chose the target, $p = .73$). Performance on generalization trials did not differ from chance in either condition ($ps > .40$). In the scale model object trial (Test 2), 10 of 24 chose the target in the standard condition compared with 12 of 24 in the touch-and-feel condition. In the other book-type picture generalization trial (Test 3), 13 of 24 chose the target in the standard condition compared with 11 of 24 in the touch-and-feel condition. In the drawing generalization trial (Test 4) 10 of 24 chose the target in the standard condition compared with 11 of 24 in the touch-and-feel condition. Finally, in the stuffed toy trial (Test 5), 9 of 24 chose the target in the standard condition compared with 11 of 24 in the touch-and-feel condition.

Preliminary analyses showed no effect of infant age, sex, vocabulary skills, reading duration, interest during reading (any of the subscales), or target type (toucan/jaguar) on performance. Therefore, these variables were not included in subsequent analyses. We ran mixed-effects logistic regressions to assess whether infants' performance was significantly different by condition or by trial and whether there was an interaction between condition and trial. Models were fit with condition (touch-and-feel or standard) and trial (picture recognition, generalization to model object, generalization to other picture types, or generalization to stuffed animals) as fixed factors and a random intercept for participant (accounting for repeated measurements across trials). Models were run in R (Version 4.2.1) using the "lme4" package. Likelihood ratio tests to estimate effects of overall terms were conducted using the "afex" package. There was no significant effect of condition, $\chi^2 = 0.12$, $p = .73$; or trial, $\chi^2 = 3.57$, $p = .47$. A model that included condition and trial as an interaction term revealed no significant interaction, $\chi^2 = 4.36$, $p = .36$, suggesting that infant performance in any given trial did not differ significantly by condition.

As a final conservative test of word learning, we report on infants' individual performance in learning for each condition across tests. Only one infant chose the correct target on all five tests in the standard condition compared with none in the touch-and-feel condition. Of those infants who correctly identified the target in the picture recognition trial ($n = 28$), 6 infants in the standard condition (25%) correctly identified the target in three or more of the four generalization trials compared with 4 infants in the touch-and-feel condition (17%).

Infant interest by book condition

Active participation was marginally higher in the touch-and-feel condition ($Mdn = 5.0$, range = 4–5) than in the standard condition ($Mdn = 5.0$, range = 1–5), $U = 192.0$, $p = .09$. Availability ($Mdn = 4.5$,

¹ Low reliability for availability was likely because all infants displayed high or very high levels of availability (those who were fussing/crying throughout the book reading or did not complete the book reading due to fussiness were excluded), and Cohen's kappa is a poor index of reliability when variability is low (Bakeman et al., 1997).

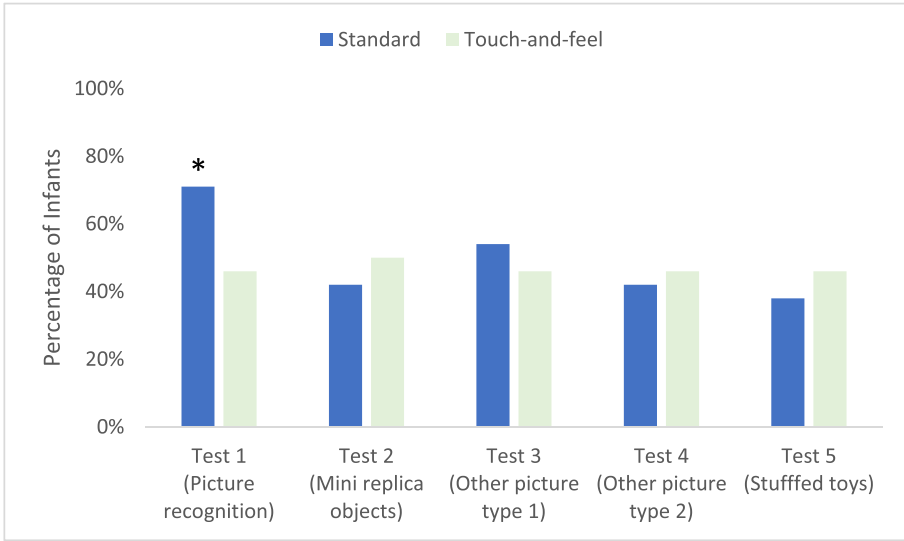


Fig. 2. Percentage of correct responses by infants in each condition across the five tests. * $p < .05$.

range = 3–5) and affect ($Mdn = 3$, range = 2–5) did not differ between conditions, $U = 268.5$, $p = .72$ and $U = 244.5$, $p = .85$, respectively.

Discussion

This preregistered study investigated the role of touch-and-feel features in infants' word learning from a "first words" picture book. We tested whether infants could learn a novel label for a new animal from a picture book (touch-and-feel vs. control), and then transfer this knowledge to other types of pictures and real-world objects. We expected that infants would demonstrate better learning of the novel label from the standard book than from the touch-and-feel book, given previous research suggesting that word learning is hindered from picture books with other types of tactile features (Shinskey, 2020; Tare et al., 2010). Indeed, results showed that infants who saw the standard book at least learned the association between the picture and the newly taught nonword, whereas infants who saw the touch-and-feel book did not. However, infants in neither condition showed evidence of generalizing this knowledge beyond the book to other types of pictures and real-world objects.

In line with previous research, these findings indicate that tactile features hinder infants' word learning. Only infants in the standard book condition learned the association between the word and the picture. Thus, we conclude that different kinds of tactile features (not only lift-the-flap and other more intricate manipulative features but also touch-and-feel) may not benefit infant word learning. Nonetheless, we expected infants in the standard book condition not only to learn the word but also to generalize it beyond the book to at least some other pictures and objects, given that previous research suggests that infants as young as 15 months can extend newly learned words from picture books with realistic photographs to objects (Ganea et al., 2008). However, our study used a commercially available book that contained more imagery than the experimentally designed books in Ganea et al. (2008). This could explain why the 14- to 20-month-olds in our study learned to recognize the target as pictured in the book but were unable to generalize beyond that. Slightly older infants (18–22 months) in Tare et al. (2010) showed evidence of learning and generalization from commercially available books, but their books differed from ours in that the referent was very large and there was no pictorial scene or other detail in the background.

Why would tactile features hinder infants' word learning? We suggest that this may occur through increasing their bias to treat the book as a toy or an object, which impedes their ability to dually represent the concrete and abstract aspects of the symbol (Tare et al., 2010). Alternatively, it may be that tactile features simply distract infants from the word-learning task (Tare et al., 2010). Future research is needed to uncover the mechanism.

A novel finding of our study is that even when the tactile feature draws attention to the pictured referent and conveys additional information about a property of the real-life referent (e.g., soft fur on an animal), word learning is impeded. Thus, it seems that any benefit of the tactile features for word learning is offset by the additional challenges they introduce for infants' symbolic insight or attentional capacities. Interestingly, Chiong and DeLoache (2013) found that older children's (30–36 months) learning of alphabet letters from plain and tactile books did not differ when the tactile features were placed on the letters, thereby drawing attention to the referent. Thus it may be that tactile features, when drawing attention to or providing additional information about the referent, are more useful for learning (or at least do not hinder it) once infants are older.

Future studies could investigate the role of tactile features in word learning over time (both repeated readings and across development). This may shed light on whether the impeding effects of tactile features can be overcome during repeated readings of the same book in infants of this age, and at what age infants' symbolic insight and/or attentional abilities are sufficiently robust that they learn words equally well from books with and without touch-and-feel features. Future research could also consider the role of touch-and-feel features on different parts of the page (e.g., on the referent as in our books, on another aspect of the picture), and the role of touch-and-feel patches in the learning of corresponding adjectives (e.g., soft, rough, hard) as opposed to nouns.

We found borderline evidence that one measure of infants' interest during book reading was higher with the touch-and-feel book: active participation, which includes vocalizing and touching the book, was marginally significantly greater with the touch-and-feel book. This suggests that touch-and-feel books may encourage more active participation than standard books with no touch-and-feel. However, there was no evidence that the other two measures of infants' interest (availability and affect) differed between conditions. More research is needed to examine infants' interest in book reading during naturalistic parent–infant interaction.

Another novel contribution of this study is that it also tested infant generalization to stuffed animals, a type of object commonly encountered by young children. Although infants did not generalize their knowledge learned from books to the stuffed animals (or indeed to the model objects or other picture types), we suggest that future research also include stuffed animals. This will allow researchers to understand how easily infants recognize what these commonly encountered toys represent (as opposed to seeing them as unique referents or as having a primarily sensory or comforting function).

The study has some practical implications. Touch-and-feel books are a popular genre and are often featured in bestseller lists for infants and toddlers. Although such books are designed to be engaging (e.g., encouraging play and shared attention between infants and caregivers), they may be less optimal when it comes to infants' ability to learn new words. This knowledge will be useful for those concerned with infant word learning. When working with infants and toddlers with delayed language skills, practitioners may wish to use fun and engaging picture books that do *not* have touch-and-feel features, given that infants are more likely to be able to learn new words from these than those with touch-and-feel. However, it is important to note that our findings are based on a single lab session. We do not know what the role of tactile features would be in infants' novel word learning over time (e.g., repeated readings over several days or weeks). It could be that greater infant engagement when being read books with tactile features translates to enhanced learning over time when compared with books without tactile features. Furthermore, touch-and-feel books may be a good choice for those infants who might not have yet developed an interest in picture books or established a reading routine, given that these books promoted more physical interaction and half-a-minute longer reading durations on average.

In conclusion, this study showed that after a brief book-reading session, infants demonstrated greater word learning from a commercially available picture book that did not have touch-and-feel features compared with one with touch-and-feel. Even though infants did not generalize their acquired word knowledge to real-life objects or other types of pictures, they were able to learn the

association between the word and the picture they had seen labeled in the book with no touch-and-feel features. Thus, this study extends our understanding about the role of tactile features in infants' word learning to the touch-and-feel book genre. The study also showed that books with touch-and-feel features facilitated longer reading sessions and marginally more active participation from infants. This knowledge will be useful for parents and practitioners alike.

CRedit authorship contribution statement

Amber Muhinyi: Conceptualization, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Jessie Ricketts:** Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing. **Jeanne Shinskey:** Conceptualization, Data curation, Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing – review & editing.

Data availability

Data will be made available on request.

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