



Visual processing of pictures and letters in alphabet books and the implications for letter learning



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ABSTRACT

Alphabet books as studied in this research typically highlight one letter per page combined with a depiction of a word that begins with the letter (e.g., a bear illustrates B). This study tests whether children's letter knowledge improves as a result of alphabet book sharing and how the visual processing of pictures and letters affects learning from repeated alphabet book readings. The study is designed as a randomized control trial in which participants were assigned to one of two experimental groups ($N = 30$) or a control group ($N = 15$). Half of the experimental group received version A in which the letters A–L were illustrated with anthropomorphic figures and the letters M–Z with objects. Half received version B in which the letters A–L were illustrated with objects and the letters M–Z with anthropomorphic figures. Mean age of the children was 57.6 months ($SD = 3.6$). While sharing the alphabet book we registered children's eye movements in the first and fourth (last) reading session. Alphabet book reading stimulated letter knowledge although the make-up of the alphabet book moderated the effects. Relatively more visual attention to pictures of anthropomorphic figures interfered with learning letters from alphabet book sharing. Visual attention to letters also predicted letter knowledge and learning. Only a small part of each letter attracted children's attention and the briefer their fixations on this distinctive area, the more letters they knew at the pretest and were able to learn from alphabet book sharing.

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1. Introduction

Alphabet books are a popular genre of children's literature (Brabham, Murray, & Bowden, 2006; Evans and Shaw, 2008; Greenwald & Kulig, 1995; Murray, Stahl, & Ivey, 1996). They are designed to attract young children's attention to letters and may thus contribute to the development of alphabetic knowledge that is of vital importance for learning to read (e.g., Hatcher et al., 2006; Lonigan, Purpura, Shauna, Walker, & Clancy-Menchetti, 2013). Conventional alphabet books present the letters of the alphabet in a sequence from A to Z. As the target book in this study, they typically highlight one letter per page combined with a depiction of a word that begins with the letter (e.g., a bear illustrates B). Adults use alliteration with letters by giving voice to the illustration with a phrase such as "B is for . . . [bear]". This predictable text invites the child's participation and the illustration, if easily named, acts as a rebus to complete the sentence.

As alphabet books draw the child's attention to the individual letters by highlighting one letter per page in an enlarged bold font they might be more successful in attracting attention to letters than storybooks. In earlier studies, it was found that letters in alphabet books indeed attract more attention than letters in storybooks (e.g., Evans, Saint-Aubin, & Landry, 2009). Moreover, parents are more inclined to focus attention on letters in alphabet books compared to storybooks, in particular when children have higher levels of alphabetic knowledge (e.g., Bus & van Ijzendoorn, 1988). There is evidence showing that conventional alphabet books may be a route to learning how letters sound in words (Murray et al., 1996) but not that repeated readings of alphabet books may support learning letter-sound associations.

1.1. Illustrations in alphabet books

The prominence of the letter on the page along with an accompanying depiction of a word beginning with that letter's sound is expected to help the child learn letter-sound correspondence (Evans, Sulima, Nowak, & Wiloughby, 2013). This design may be efficacious unless children for some reason fail to pay attention to the sound of a letter that may impede them from

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associating the sound with the printed letter form. It is, for instance, imaginable that illustrations have qualities that keep children from paying attention to the first sound of the word. Probably not all but many pictures of anthropomorphic figures may distract attention from the first sound of the word because these figures may elicit interest in story-like elements such as their actions and motives. The literature offers a spate of articles showing that even small and unpretentious illustrations of anthropomorphic figures attract more visual attention than illustrations of objects as part of pictures or picture storybooks (e.g., van der Geest, Kemner, Camfferman, Verbaten, & van Engeland, 2002; Verhallen & Bus, 2011). In the same vein, we expect that illustrations of anthropomorphic figures in alphabet books may attract more visual attention than illustrations of objects, due to children's interest in story-like elements. As a consequence of focusing on the actions and motives of the depicted humans or animals, children may not focus on the first sound of the word and fail to associate this sound with the printed letter form on the same page. Characteristics of illustrations in alphabet books may thus moderate the alphabet book's efficacy as incentive for learning letters.

1.2. Familiarity with forms of letters as moderator of letter learning

As forms of letters differ in subtle ways, it seems a plausible assumption that familiarity with the letter forms is basic to learning letters. Parents comment on letter forms from early on, thereby helping their children to discriminate letters from pictures. When referring to letters, parents tend to focus on descriptive or objective features (e.g., size, color or shape) and not on aesthetic features (Robins, Treiman, Rosales, & Otake, 2012). Later, during preschool years, parents focus their child's attention on letter form and name as a fixed couple saying: "Which one on the cereal box is the letter M who has two humps?" (Robins et al., 2012). It is not yet known whether children, just as experts, merely process a small part of letter forms (Dunn-Rankin, 1990; Fiset et al., 2008, 2009) and whether the way in which children process letter forms predicts the ease of learning letters.

A whole lot of practice may be needed before the critical dimensions of letter forms are engraved in children's memory and children immediately recognize a letter form by focusing on critical dimensions of the form. Failure to focus on distinctive parts when shapes are largely similar (e.g., f and t) may explain confusion between letter names, well into the stage that children are able to name most letters correctly (Treiman, Kessler, & Pollo, 2006; Treiman, Levin, & Kessler, 2012). Since the 1960s, only a few reading researchers have studied how beginning readers process the letter forms. In a unique experiment with 4- to 8-year-old children, Gibson and colleagues (Gibson, Gibson, Pick, & Osser, 1962) studied children's knowledge of letter forms by asking them to decide whether letter-like forms were similar after a small transformation in one of four form dimensions (rotation or reversal, line to curve, different perspective, and so-called topological transformations like closes between lines or breaks within lines). They contrasted transformations that are irrelevant with transformations that discriminate real letters. Gibson et al. demonstrated that many transformations were permissible without destroying the letter's identity but certain features – referred to as "distinctive features" – appeared to be critical for perceiving the difference between letters. Four-to-eight-year-old children neglected perspective transformations, that is, letter-like forms slanted 45° left or tilted 45° right. By contrast they denoted letter-like forms as different when straight line segments were transformed into curves, as between U and V, or the transformed letter-like form included closures in lines, as between F and P.

1.2.1. Distinctive features of letter forms

Gibson's (Gibson et al., 1962) findings make plausible that emergent readers are aware of features that are relevant to discriminate between letter forms. Additionally, there is evidence from research among adults that expert readers recognize letters by fixating only on small areas of the letter (Dunn-Rankin, 1990; Fiset et al., 2008). Fiset et al. (2008) used the so-called *bubbles*, a classification image technique, to study which areas of letters contribute most to the identification of lower- and upper-case Arial letters. This was done by masking a part of each of the letters with bubbles that made it possible to test which features are critical for letter identification. They concluded that, in particular, line terminations are the most important features for letter identification, that is, "the inferior termination of the uppercase C clearly allows the discrimination of this letter form from the uppercase letters G, Q and O, and is in fact sufficient for the correct identification of 'C'" (p. 1166). Using eye movement registrations, Dunn-Rankin (1990) pinpointed, per lower-case letter, areas that 18 adults utilized to recognize the letter. He described these areas as distinctive features, similar to Gibson et al. (1962). The lower quarter of most letters attracted few fixations, especially when letters include ascending verticals like h and k. Angular intersection appeared to be a distinctive feature for the letters x, v, and w. For 'C', fixations were located close to the opening at the right side, and included therefore more of the background of the letter than the letter itself. When letters have several distinctive features, such as an angular intersection as well as an ascending vertical in the letter 'k', both areas may attract eye fixations.

There have not yet been any studies into whether emergent readers recognize letters by fixating on distinctive features. Furthermore, there is no knowledge about whether the way in which children process letter forms predicts the rate of learning letters. Yet, a plausible assumption seems to be that familiarization with letter forms starts at an early age since children growing up in a literate society are continuously exposed to print. Children's visual processing of letters may change and speed up as a result of being exposed to letter forms. However, there may be variations in how many letters are seen prior to formal reading instruction due to the amount of parent-child book sharing (Mol & Bus, 2011). If familiarization with distinctive parts of letter forms is part of learning letters, this may explain why well-read-to children score higher on letter knowledge (Mol, Bus, & de Jong, 2009). Likewise, we may expect that, as letter knowledge increases, letter forms may be processed differently. They may exclusively fixate on distinctive features and a brief fixation on a small area in the various letters may suffice as children become more familiar with letter forms. However, no studies have been conducted into whether the way in which children fixate letters varies with their letter knowledge, which area of letters emergent readers fixate, and whether the duration of the fixation on a distinctive area predicts the ease of learning new letters.

1.3. This study

Evans et al. (2009) concluded that children who knew more letter-sound associations were quicker to look at print on a page in an alphabet book and spent more time fixating the featured letter. Our study goes one step beyond Evans' study (2009) and aims to test how visual processing of various parts of a book page moderates letter learning from an alphabet book. In general this study tested: (1) whether repeated readings of an alphabet book promote letter learning. (2) More specifically we tested whether more absorbing pictures of anthropomorphic figures may interfere with letter learning. Appealing illustrations may take away children's attention from how the word sounds and thus hinder children in forming associations between the first sound of the word and the letter

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