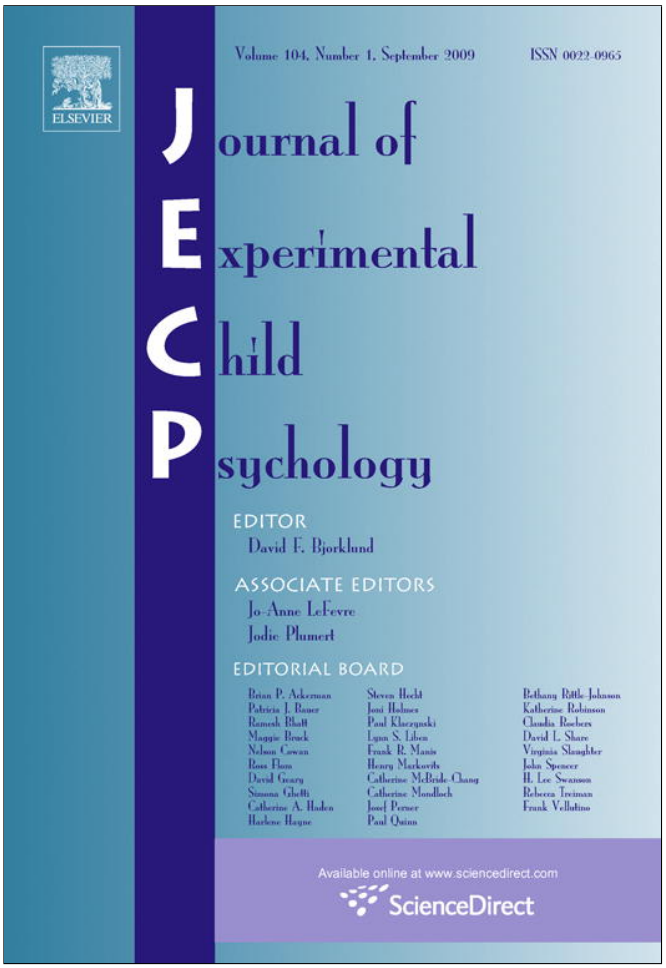

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Picture book exposure elicits positive visual preferences in toddlers

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ABSTRACT

Although the relationship between "mere exposure" and attitude enhancement is well established in the adult domain, there has been little similar work with children. This article examines whether toddlers' visual attention toward pictures of foods can be enhanced by repeated visual exposure to pictures of foods in a parent-administered picture book. We describe three studies that explored the number and nature of exposures required to elicit positive visual preferences for stimuli and the extent to which induced preferences generalize to other similar items. Results show that positive preferences for stimuli are easily and reliably induced in children and, importantly, that this effect of exposure is not restricted to the exposed stimulus per se but also applies to new representations of the exposed item.

Introduction

Zajonc (1968) proposed a positive causal relationship between the frequency with which we encounter stimuli and the attitudes we hold toward them. He demonstrated the short-term effects of "mere exposure" in a series of experimental studies; for example, he reported that participants who had been given 5, 10, or 25 presentations of photographs of faces subsequently rated the faces as significantly more attractive than did participants who had seen the photographs 0, 1, or 2 times. However, Zajonc's proposal was that the effects of exposure are both long term and pervasive. Drawing on correlational evidence linking word frequency with participants' ratings of the pleasantness of

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words' meanings, Zajonc suggested that experiences over one's lifetime might determine one's attitudes toward everyday stimuli.

A considerable body of experimental work on adult preference formation and decision making has confirmed that the effects of exposure are widespread and robust. Participants' ratings of their liking of (or preference for) stimuli are enhanced by exposure in a range of modalities—auditory, visual, olfactory, and gustatory—and for a wide variety of stimulus types, including nonsense words (Johnson, Thomson, & Frincke, 1960), Chinese characters (Monahan, Murphy, & Zajonc, 2000), paintings (Cutting, 2003; Maslow, 1937), classical music (Moore & Gilliland, 1924; Mull, 1957), everyday objects (Maslow, 1937), and food varieties (Pliner, 1982). Exposure effects have been reported to result from both everyday encounters (Cutting, 2003) and controlled experimental presentations (Saegert, Swap, & Zajonc, 1973) as well as across a wide range of time frames, from repeated exposure within a single session (Monahan et al., 2000) to intermittent exposure over a period of weeks or months (Moore & Gilliland, 1924). Effects are especially pronounced when novel stimuli are used; repeated exposure to familiar stimuli might have no effect or even lead to dislike (Pliner, Polivy, Herman, & Zakalusny, 1980; Porcherot & Issanchou, 1998; Zajonc, 1968).

The process by which exposure leads to positive affect has been the topic of some debate. According to Bornstein and D'Agostino (1994), repeated exposure increases the ease and speed with which a stimulus is processed and recognized ("perceptual fluency"), which participants interpret as an indication of their positive affect toward the stimulus. An alternative, but not mutually exclusive, explanation of the mere exposure effect was offered by Zajonc (2001), who argued that exposure removes our natural fear of new stimuli through a process of conditioning; the lack of any aversive consequence serves to positively reinforce interaction with the stimulus, leading to a greater willingness to interact with the stimulus in the future. It is worth noting that neither account requires the stimulus to be consciously processed. This is important because even when exposure is subliminal, participants report greater liking for stimuli that have been presented more frequently (Murphy, Monahan, & Zajonc, 1995; Zajonc, 1980, 2001).

Although the perceptual fluency model has received considerable empirical support (see Butler & Berry, 2004, for a review), the benefits of such a basic means of enhancing affect as Zajonc (2001) proposed are also evident. A mechanism that allows individuals to infer the safety of aspects of the environment that have been consciously or unconsciously perceived without aversive consequence would allow them to direct their attention toward new, and therefore potentially more threatening, stimuli. One can also imagine that a process of "familiarity breeding liking" might facilitate early social development by encouraging young children to form selective attachments with friends rather than strangers. In support of this view, Cairns (1966) reported that the number of encounters experienced between nonhuman mammals and their conspecifics precisely determined the affiliative behaviors they displayed and the social attachments they formed.

Therefore, it is possible that young children's attitudes toward the objects and people who make up their world are at least partly shaped by the extent of their exposure to them. Yet developmental research has largely failed to examine whether the positive effects of exposure that have been reported in the adult literature might be replicated in children. One exception to this dearth of evidence is the literature on group processes, which has shown that intergroup contact can reduce negative attitudes toward out-group members in a school-age population (Brown, Eller, Leeds, & Stace, 2004; Maras & Brown, 1996). A second body of research that has reported positive exposure effects in children is the literature on the development of food preferences. As for adults, preschoolers' liking of the taste and texture of foods has been shown to be strongly predicted by the frequency of exposure, whether this is provided in a controlled experimental setting (Birch & Marlin, 1982; Birch, McPhee, Shoba, Pirok, & Steinberg, 1987; Sullivan & Birch, 1990) or in the home or school environment (Blossfeld, Collins, Kiely, & Delahunty, 2007; Wardle et al., 2003a; Wardle, Herrera, Cooke, & Gibson, 2003b).

However, very little research has examined whether exposure affects children's preference formation in other domains. One very early study by Bühler, Hetzer, and Mabel (1928) suggested that infants' responses to auditory stimuli might become more positive with exposure. Bühler and colleagues observed infants in their first year of life to react with fear on hearing a new sound, but with repeated exposure the infants paid more attention until they finally "showed interest." The majority of more recent work with infants of a similar age has, in contrast, has found that they quickly

become habituated to repeatedly exposed auditory or visual stimuli and that their boredom leads them to prefer new or unfamiliar stimuli (e.g., Eimas, Siqueland, Jusczyk, & Vigorito, 1971; Fantz, 1964), the opposite pattern to that described above for adults. Infants may display a preference for the familiar stimulus over a new stimulus during the very early stages of familiarization (Hunter & Ames, 1988; Roder, Bushnell, & Sasseville, 2000; Rose, Gottfried, Melloy-Carminar, & Bridger, 1982; Wagner & Sakovits, 1986) or when exposed stimuli are highly complex (Fiser & Aslin, 2002), but this is generally interpreted in terms of incomplete encoding of the stimulus (Courage & Howe, 1998). Once an adequate representation of the stimulus has been constructed, infants are free to process new information and will direct their attention elsewhere, reflected in their preference for novelty. Thus, repeated exposure leads to a robust disinterest in the "old", in preference for the "new." Any subsequent return to a preference for the more familiar stimulus in these paradigms, which may occur after a delay, is seen as evidence of loss of the earlier memory trace (Bahrick & Pickens, 1995; Courage & Howe, 1998; Spence, 1996).

This complex picture of how infants' attention toward a stimulus is affected by experience, alongside the scarcity of evidence of repeated exposure leading to an enduring interest in stimuli, is at odds with the adult literature on mere exposure, where a rather more straightforward relationship between exposure and liking is seen. This is perhaps not surprising given that explanations of the two phenomena are strikingly different. In contrast to the infant literature, which sees infants' exploratory behavior toward novel and familiar stimuli as determined by conscious cognitive processes (e.g., Hunter & Ames, 1988; Rose, Feldman, Futterweit, & Jankowski, 1997; Rubenstein, Kalakanis, & Langlois, 1999), mere exposure effects are argued by Zajonc (2001) and Bornstein and D'Agostino (1994) to tap unconscious, automatic, affective processes. Indeed, when researchers have investigated infants' spontaneous preferences, which may be more likely to reflect affective processing, infants perform similarly to adults. For example, infants prefer their mother's face (Bushnell, Sai, & Mullin, 1989; Pascalis, de Schonen, Morton, Deruelle, & Fabre-Grenet, 1995), smell (Cernoch & Porter, 1985), and voice (DeCasper & Fifer, 1980), all of which are highly familiar, to those of strangers. Infants also display a preference for faces of the same racial group and gender as their primary caregiver (Kelly et al., 2005; Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002) and for speech produced in their caregiver's native language (Moon, Panneton Cooper, & Fifer, 1993). Although such preferences may rest on the unique social importance of the caregiver, they may also be driven by repeated exposure to the caregiver during the first months of life. Thus, repeated, naturalistic exposure to stimuli in the home environment may lead to the formation of positive affect in children as it does in adults.

By this account, laboratory studies may fail to elicit enduring positive preferences for stimuli because they differ from the child's home environment in terms of the experiences they provide. For example, the typical use of stimuli with no meaning in laboratory studies (e.g., Colombo, Mitchell, & Horowitz, 1988) might preclude the detection of familiarity preferences that would be elicited by stimuli in the child's natural environment (but note that mere exposure studies with adults also typically use meaningless stimuli [e.g., Willems & Van der Linden, 2006] and that some infant studies familiarize infants with more meaningful stimuli such as everyday objects [e.g., Roder et al., 2000]). The familiarization procedure employed by researchers also maps poorly onto children's usual interactions with the world, which involve repeated experiences of stimuli over an extended period interspersed with a variety of other experiences. It follows that, by examining how preferences for meaningless stimuli change on a micro time scale, we may be missing how children's interest in more meaningful stimuli is motivated by their everyday experiences.

An alternative explanation of the discrepancy between the adult and infant literatures is that the effects of exposure might change with age. Studies that show exposure to lead to novelty preferences have largely been carried out with infants in their first year of life, whereas those that report the opposite pattern have involved 2- to 5-year-olds (Birch & Marlin, 1982; Birch et al., 1987; Sullivan & Birch, 1990) or older children (Brown et al., 2004; Maras & Brown, 1996). The impact of exposure, therefore, might depend on children's cognitive level, which undergoes considerable changes during the second year of life (e.g., Gopnik & Meltzoff, 1987). However, there are alternative accounts of why age-related changes might be seen in the effects of exposure. For example, the learned safety that results from experience of a stimulus may only begin to determine children's preferences during the second year

of life, when children are more mobile and, therefore, have greater choice over the objects with which they interact.

In sum, previous research has failed to explore whether everyday experiences determine young children's developing preferences for the people and objects they encounter. The current studies ask whether repeated exposure to pictorial stimuli in toddlers' home environment leads to (a) an enhanced interest in the exposed stimuli, as might be predicted by adult mere exposure effects, or (b) a preference for novel stimuli, as is typically demonstrated when infants have been familiarized with stimuli in the laboratory environment. At the same time, we set out to establish a simple but effective means of inducing positive preferences for stimuli by manipulating children's exposure to them. Numerous potential applications for such a technique are apparent, from enhancing children's interest in healthy foods and leisure activities to manipulating their attitudes toward other social groups.

As a first step in this direction, we explored whether naturalistic visual exposure to images of fruits and vegetables in picture books could be used to enhance toddlers' visual preferences for foods. We describe three experiments, all of which used the same exposure and test paradigm. Exposure was provided by a daily reading of a picture book by children's parents, and the children's interest in the exposed stimuli was assessed in a laboratory-based visual preference procedure where their gaze duration toward pairs of pictures of exposed and nonexposed items was recorded. Visual preference is an established method for assessing preferences in both infants (Burnham & Dodd, 1999; Fantz, 1964) and adults (Shimojo, Simion, Shimojo, & Scheier, 2003; Simion & Shimojo, 2007) and is employed in the majority of research into infants' preferences for familiar versus novel stimuli. In each study we report, children were exposed to one of two sets of stimuli and saw pairs of pictures in the visual preference test that included one item from each set. Note that in this design, each item serves as both an exposed food and as a nonexposed food for different children, controlling for any preferences for specific items that children may have had.

The first study we report explored whether preferences for stimuli can be elicited by visual exposure and, if so, the number of exposures required, whereas the second study examined the role played by the nature of the exposure provided. The third study sought to clarify the specificity of exposure effects in toddlers. We explored whether enhanced preferences generalize beyond the specific stimulus to which children are exposed, either to new representations of the exposed item or to other items in the same food category.

Experiment 1

We first explored whether exposure to pictures of a food in a naturalistic, book-reading scenario with parents leads children to display a greater interest in these pictures in terms of their looking times toward exposed versus nonexposed pictures in a visual preference procedure. We also examined the effects of different amounts of exposure by asking parents to read the book with their child every day for 1, 2, or 3 weeks. We hypothesized that children would display greater attention toward pictures of exposed foods than toward pictures of nonexposed foods and that the strength of this effect would be related to the number of exposures provided.

Method

Participants

A total of 30 toddlers approaching the end of their second year of life were recruited from the University of Reading's Child Development Group database of parents who had expressed an interest in taking part in research with their child. Among this sample, 5 parents opted out of the study before the preference test due to illness and/or family commitments; these were distributed roughly equally across conditions (1 week: $n = 1$; 2 weeks: $n = 2$; 3 weeks: $n = 2$). The final sample consisted of 25 toddlers (15 boys and 10 girls) with a mean age of 1 year 9.9 months (range = 1 year 8 months to 1 year 11 months). All children were reported to have normal hearing and vision. Participants were rewarded with a certificate, and travel expenses were reimbursed.

Materials

Two different books were created: *All About Asparagus* and *All About Aubergine*. These two foods were selected on the basis of pilot work in which parents of 33 children, aged 1 year 6 months to 1 year 7 months, completed a Food Familiarity Questionnaire. This is a list of 83 commonly available fruits and vegetables that parents are asked to rate in terms of how often their children come into contact with the foods on a 3-point scale: *rarely or never* (less than once per month), *sometimes* (less than once per week but more than once per month), or *often* (at least once per week). Asparagus and aubergine were reported to be among the least familiar vegetables for children in this age group.

Each book consisted of a cover page and seven further pages about the food, with each page displaying a single full-color photograph of the food with an accompanying sentence describing the picture. A variety of pictures were included to show how the vegetable grows, what it looks like inside, what the prepared food might look like, and so on. Pictures were matched across the two books so that, for example, both books included a picture of the food chopped up. Books were produced in a colorful, child-friendly, A5 format and were laminated and bound. A tick sheet for recording each reading of the book was pasted inside the front cover.

The laboratory task took place in a visual preference booth, a three-sided, gray-painted cubicle with a large back projection screen (measuring 1.5 × 0.6 m) on the rear wall and a chair facing the screen. Pairs of the same photographs used in the exposure books were presented side by side on the screen, with each image measuring 24 × 16 cm and the two images separated by 24 cm. A central "attention-getting" picture of a colorful pattern was used to encourage children to look at the screen between trials. Three infrared cameras above the screen recorded children's looking direction, and audio speakers above and below the screen presented the auditory instruction to "Look!"

Procedure

On recruitment, children were randomly assigned to one of three exposure durations: 1 week (n = 9), 2 weeks (n = 8), or 3 weeks (n = 8). Children were also assigned to one of the two books: asparagus (n = 12) or aubergine (n = 13). Parents were sent the relevant book by mail and were asked to read the book with their child every day for 5 min for the required number of weeks. Parents were asked to record each occasion they read the book with their child by marking the tick sheet in the book.

The day after the exposure period ended, parents (in all cases mothers) and toddlers visited the University of Reading to take part in the visual preference test. Mothers sat in the testing booth facing the back projection screen with their child on their lap. Children were at a distance of 1 m from the screen and were able to inspect both displayed images without making a head movement. Mothers listened to classical music over headphones and were asked to keep their eyes closed for the duration of the experiment so that they could not influence their child's looking behavior. Children's attention was directed to the screen by the word "Look!" and the attention-getting image, which was displayed in the center of the screen.

Children saw a series of 14 trials, on each of which a pair of pictures were displayed side by side on the screen for 5 s. Each pair consisted of a picture from each book matched for type; for example, a picture of asparagus growing was presented alongside a picture of an aubergine growing. The target picture on each trial, therefore, varied across participants depending on the book to which the child had been exposed. The seven pairs of pictures were presented twice, once with the asparagus on the left side of the screen and once with the aubergine on the left side of the screen, in a different random order for each child. The instruction to "Look!" was heard 100 ms after the onset of each trial.

Coding

The three camera feeds were merged with a digital display of the start and end times of each trial to create a digital recording of each participant's looking behavior. These were scored off-line frame by frame using Observer 5.0 software (http://www.noldus.com/human-behavior-research/products/the-observer-xt). Coders designated each frame as a look to the left image, to the right image, between images, or away from the screen. Coders were blind to the side of the target image on each trial and to the condition in which each child participated. Two coders each coded half of participants, and to assess reliability a third blind coder recoded a random sample of 20% participants (5 children). The mean Cohen's kappa for the concordance between scorers' ratings was .90 (range = .86–.92).

Results and discussion

Children's mean looking times toward target (exposed) and nontarget (nonexposed) images can be seen in Table 1. Direct comparison of looking times toward target and nontarget images is inappropriate in the context of parametric analysis because the two measures are not orthogonal; a child cannot look at both the target and the nontarget at the same time, so high levels of looking at the target are associated with low levels of looking at the nontarget and vice versa. Therefore, we calculated two measures of children's preference for the target image: *total looking time difference,* the mean difference in the time children fixated the exposed picture versus the nonexposed picture on each trial, and *longest look difference,* the mean difference in the lengths of children's single longest looks toward the exposed picture versus the nonexposed picture on each trial. For each measure, a value greater than zero indicates that children spent longer fixating exposed pictures. Both measures were normally distributed (Shapiro–Wilk, $ps > .40$) with no outliers.

The two measures both supported the prediction that children would prefer to fixate exposed pictures (see Table 1). When data from the three conditions were combined, children spent significantly longer fixating exposed foods than nonexposed foods regardless of whether the measure of visual preference was total looking time difference, $t(24) = 4.33$, $p < .001$, or longest look difference, $t(24) = 4.55$, $p < .001$. Therefore, exposure increased children's attention toward the exposed pictures.

Our second question concerned the number of exposures required to elicit a preference. Table 1 suggests that preference for exposed items was more reliable in the 2-week condition. However, analyses revealed no effect of the number of weeks of exposure: total looking time difference, $F(2, 22) = 0.26$, $p = .77$, partial $\eta^2 = .02$; longest look difference, $F(2, 22) = 0.30$, $p = .74$, partial $\eta^2 = .03$.

Although these findings suggest that the number of exposures was not related to the strength of the exposure effect in this study, it is possible that parents did not follow our instructions about how often they should read the book and that the 1-, 2-, and 3-week conditions are not indicative of the number of exposures children received. Because parents had recorded the occasions on which they read the book, we were able to explore this possibility. We found that the number of book readings provided to children increased with the number of weeks parents had been asked to read the book: 1-week condition, mean number of exposures = 5.8, range = 5–7; 2-week condition, mean = 8.9, range = 5–12; 3-week condition, mean = 11.8, range = 2–18. However, these data also reveal that most

Table 1
Mean total looking times and mean longest look lengths toward exposed versus nonexposed pictures in each condition of Experiments 1–3 and the differences between them.

		Total looking time (ms)			Longest look (ms)		
		Exposed	Nonexposed	Difference	Exposed	Nonexposed	Difference
Experiment 1	1 week ($n = 9$)	2124 (389)	1714 (370)	410 (627)	1493 (253)	1162 (276)	331 (451)
	2 weeks ($n = 8$)	2282 (515)	1659 (251)	623 (524)*	1708 (516)	1200 (87)	507 (478)*
	3 weeks ($n = 8$)	2264 (496)	1701 (348)	563 (719)	1643 (366)	1196 (271)	448 (514)*
	Overall ($N = 25$)	2219 (453)	1692 (316)	527 (609)***	1610 (381)	1185 (222)	425 (466)***
	2–5 readings ($n = 6$)	2051 (466)	1590 (220)	461 (610)	1532 (320)	1116 (160)	415 (420)
	6–8 readings ($n = 9$)	2237 (419)	1757 (354)	481 (619)*	1631 (405)	1201 (267)	430 (527)*
	10–18 readings ($n = 10$)	2304 (493)	1695 (341)	609 (655)*	1637 (424)	1212 (223)	425 (484)*
Experiment 2	Perceptual exposure ($n = 18$)	2096 (335)	1958 (287)	138 (517)	1458 (226)	1387 (209)	71 (318)
	Enriched exposure ($n = 15$)	2118 (249)	1934 (200)	184 (380)	1477 (273)	1321 (186)	157 (213)**
	Overall ($N = 33$)	2106 (295)	1947 (247)	159 (454)*	1467 (245)	1357 (199)	110 (275)*
Experiment 3	Exposed foods ($n = 36$)	2277 (358)	2004 (287)	273 (512)**	1545 (370)	1376 (252)	169 (416)*
	Superordinate category ($n = 36$)	2102 (430)	2108 (423)	−6 (708)	1479 (434)	1476 (369)	3 (611)

Note. Standard deviations are in parentheses.
* $p \leqslant .05$.
** $p \leqslant .01$.
*** $p < .001$.

parents did not complete the full set of readings asked of them and that the variability in the number of readings provided increased greatly with the number of weeks assigned.

Therefore, we recategorized children into three approximately equal groups on the basis of the number of readings parents reported providing (2–5, 6–8, or 10–18 readings); for example, a child in the 3-week condition who received only 2 readings was classified in the 2–5 readings group. We recalculated each preference measure for these new groups (see Table 1). Analyses again found no effect of the number of exposures on the total looking time difference measure, $F(2, 22) = 0.14$, $p = .87$, partial $\eta^2 = .01$, or on the longest look difference measure, $F(2, 22) = 0.002$, $p = .998$, partial $\eta^2 = .00$. Dividing children into two groups using a median split on number of book readings produced a parallel set of findings. Finally, there was no significant correlation between the number of exposures provided, according to parents' reports, and the extent of children's preference for the exposed picture on either the total looking time difference measure, $r(25) = .22$, $p = .28$, or the longest look difference measure, $r(25) = .12$, $p = .57$.

Therefore, children demonstrated a preference for the pictures to which they had been regularly exposed over several days regardless of the precise number of exposures received. Note that this effect cannot be explained in terms of children's spontaneous preferences for the items shown given that the status of each item as exposed or nonexposed was counterbalanced across participants. This study, therefore, demonstrates that children's visual preferences can be enhanced through repeated visual exposure to stimuli by parents in a naturalistic picture book setting.

Experiment 2

The second experiment explored whether the type of exposure provided influences the strength of the exposure effect. During the exposure phase of Experiment 1, children were given more than mere exposure to the pictures that were subsequently used to assess preferences. Parents were encouraged to talk to their children about the food in each book and were provided with a sentence to describe each picture. Therefore, it is not clear whether the positive effects seen in Experiment 1 were mere exposure effects, resulting from perceptual experience of the test stimuli during the exposure phase (Bornstein & D'Agostino, 1994), or were the consequence of children having built a rich internal representation of each food item.

Experiment 2 was designed to tease apart these possibilities. Children received one of two types of book: "enriched exposure" books (like those used in Experiment 1), which provided a variety of pictures and information about each food, or "perceptual exposure" books, which provided multiple repetitions of the same image used to assess children's preferences at test. If the positive effect of exposure seen in Experiment 1 was a result of children's prior perceptual experience of test stimuli, children in the perceptual exposure condition of the current study, who saw many more examples of each test stimulus during the exposure period, might be expected to show the larger exposure effect. In addition, to explore whether a single book could manipulate children's preferences for more than one item, the current study exposed children to one of two sets of six different fruits. As in Experiment 1, each fruit served as an exposed stimulus and as a nonexposed stimulus for different participants, ensuring that any spontaneous preferences for the more colorful or familiar item in each pair were not confounded with the fruit's status as exposed or nonexposed.

Method

Participants

A total of 36 toddlers who had just passed their second birthday were recruited as in Experiment 1. None participated in the other studies reported in this article. Among the sample, 3 children were excluded from the final sample, with 1 child's date of birth falling outside of the target age range and 2 children being excluded as outliers, to satisfy normality criteria (see Results). The final sample of 33 children consisted of 21 boys and 12 girls with a mean age of 2 years 1.3 months (range = 2 years 0 months to 2 years 3 months). Participants were rewarded with a certificate, and their travel expenses were reimbursed.

Materials

Two types of book were created: enriched exposure books and perceptual exposure books. Two versions of each book were created, with each including six fruits (Set A: apple, kiwi, melon, peach, pear, and pineapple; Set B: strawberry, watermelon, plum, banana, orange, and mango). Fruits were selected on the basis of their dissimilar appearances to ensure that children would not be confused about which food was being shown in the visual preference task. Thus, exposed stimuli differed in several ways from those of Experiment 1, namely that they were fruits rather than vegetables, they were not selected to be unfamiliar to children, and children were exposed to six foods rather than one food.

Enriched exposure books were similar to those used in Experiment 1. Two pages were devoted to each fruit. The left-hand page of each pair showed a single large picture of a whole fruit, such as a strawberry, accompanied by the sentence, "This is a strawberry." On the facing page, four different pictures showed how the fruit grows, what it looks like inside, how it is prepared, and so on, with a sentence describing each picture. Perceptual exposure books also included two pages about each fruit, with the left-hand page identical to that of the enriched exposure book. On each facing page, multiple smaller but identical pictures of the whole fruit were shown in groups, increasing in size from one to four fruits, with a sentence under each group stating, for example, "This is one strawberry" or "Here are two strawberries." Instructions to count each set of foods encouraged parents to spend a similar amount of time reading the books to those in the enriched exposure condition. Books were produced in a colorful, child-friendly, A4 format and were laminated and bound.

The laboratory setup for the visual preference task was as in Experiment 1. The stimuli used in the preference task were the large whole-fruit images from the exposure books. Note that children in the enriched exposure condition had seen these stimuli only once during each reading, whereas those in the perceptual exposure condition had seen them 11 times (1 large picture and 10 small pictures).

Procedure

On recruitment, children were randomly assigned to receive either enriched exposure ($n = 15$) or perceptual exposure ($n = 18$) and either Set A foods ($n = 15$) or Set B foods ($n = 18$) foods. Parents were sent the appropriate book with instructions to read the book with their child for 5 min every day for 2 weeks. The 2-week exposure period was selected because exposure effects were slightly more reliable at this duration in Experiment 1 (see Table 1).

The day after the exposure period ended, parents and toddlers took part in the visual preference procedure. Children saw a series of 12 trials, on each of which a pair of pictures was displayed side by side on the screen for 5 s. Each pair consisted of one picture from Set A and one picture from Set B, such that each child saw one of four random sets of pairings of the Set A and Set B foods. The six pairs of pictures were presented twice, once with the exposed picture on the left side of the screen and once with the exposed picture on the right side of the screen, in a different random order for each child. The instruction to "Look!" was heard 100 ms after the onset of each trial. Looking times toward exposed and nonexposed images were recorded and scored off-line as in Experiment 1.

Coding

Coding was conducted as in Experiment 1. Two coders each coded half of the participants, and to assess reliability a third blind coder recoded a random sample of 20% participants (7 children). The mean Cohen's kappa for the concordance between scorers' ratings was .90 (range = .85–.91).

Results and discussion

The same measures of visual preference were calculated as in Experiment 1. The longest look difference measure was significantly kurtotic (Shapiro–Wilk's $W(35) = 0.92$, $p = .018$), but after two outliers were excluded (1 positive and 1 negative) both measures satisfied normality criteria ($ps > .20$).

Both measures revealed a small overall preference for pictures of exposed foods over pictures of nonexposed foods (see Table 1). Analyses revealed that children spent significantly longer fixating exposed foods than would be expected by chance: total looking time difference, $t(32) = 2.01$, $p = .05$; longest look difference, $t(32) = 2.29$, $p = .03$. As in Experiment 1, therefore, exposure to the books had enhanced children's overall interest in the pictures of the foods they contained.

Our second question concerned the role played by the type of exposure provided. If the positive effect of exposure seen in Experiment 1 was driven by perceptual familiarity with the exposed stimuli, a stronger exposure effect might be expected from participants in the perceptual exposure condition of the current study given that they saw many more tokens of the test stimuli in their books. However, there were no differences between conditions on either measure: total looking time difference, $t(31) = 0.29$, $p = .78$; longest look difference, $t(31) = 0.89$, $p = .38$. Indeed, it is worth noting that the effects of exposure were more reliable in the group who received enriched exposure (see Table 1). Despite the smaller number of participants in this condition, this group demonstrated a preference for exposed foods that approached significance on the total looking time difference measure, $t(14) = 1.87$, $p = .08$, and reached significance on the longest look difference measure, $t(14) = 2.85$, $p = .01$. In contrast, the larger group of children in the perceptual exposure condition failed to show a significant preference on either measure: total looking time difference, $t(17) = 1.13$, $p = .27$; longest look difference, $t(17) = 0.94$, $p = .36$.

Although one cannot conclude from these findings that children's preferences are driven by experiences that allow them to furnish an elaborate representation of the exposed item, the data are not consistent with the claim that positive effects of exposure are driven purely by the perceptual familiarity of the exposed stimulus. The next study further explored the role played by perceptual experience by examining whether children's enhanced preferences are restricted to the perceptual stimuli to which they have been exposed or are also demonstrated toward new representations of exposed items. If the latter is the case, it is feasible that exposure might work by enhancing interest in the exposed items per se, which would considerably augment the range of potential applications for this type of visual exposure paradigm.

We also explored whether the effects of exposure generalize to nonexposed items within the exposed category (fruit or vegetable) to establish the limits of any generalization that may occur. Whether children in their second year of life are aware of the categorical distinction between fruits and vegetables is unknown, although research has shown that preschoolers struggle to learn superordinate category labels such as "fruit" and "vegetable" (Markman, 1989). Nevertheless, differences in the manner of provision of these two food groups alongside children's natural preference for sweet tastes (Birch, 1999) might allow children to discover the distinction between fruits and vegetables some time before they know the appropriate labels for these categories. Therefore, we explored whether exposure to several exemplars of either the fruit or vegetable category would lead children to show visual preferences for nonexposed items from the same category.

Experiment 3

In the third study, toddlers were exposed to pictures of either eight unfamiliar fruits or eight unfamiliar vegetables for 2 weeks before they took part in a visual preference procedure to test whether they displayed enhanced attention toward (a) new nonexposed pictures of exposed foods and (b) nonexposed foods from the same category (fruit or vegetable). If children fail to show preferences for exposed foods in the current study, then we can conclude that our visual exposure effects are limited to the exposed stimuli themselves and, thus, are likely to be perceptually driven. If, on the other hand, children's preference for exposed items generalizes to new pictures of exposed foods, it remains a possibility that exposure might serve to enhance interest in the exposed items per se. In addition, trials presenting nonexposed fruit and vegetable pairs allowed us to establish whether children's preference for exposed foods generalizes to other items in the same superordinate category.

Method

Participants

A total of 36 toddlers in their second year of life were recruited as in Experiments 1 and 2. None had participated in another study reported in this article. The sample consisted of 23 boys and 13 girls, with a mean age of 1 year 6.15 months (range = 1 year 5 months to 1 year 8 months). All children

had normal hearing and vision. Participants were rewarded with a certificate, and travel expenses were reimbursed.

Materials

Parents were sent a Food Familiarity Questionnaire (described in Experiment 1) and were asked to rate how often their child came into contact with each food. The eight least familiar fruits (starfruit, persimmon, lychee, redcurrants, watermelon, mango, blackberry, and pomegranate) and the eight least familiar vegetables (marrow, asparagus, watercress, aubergine, mange tout, pumpkin, Brussels sprout, and butternut squash) were selected as exposure stimuli. Unfamiliar foods were selected as exposure stimuli in this study because stronger effects of exposure were seen in Experiment 1 (when unfamiliar vegetables were used) than in Experiment 2 (when familiar fruits were used). The eight most familiar fruits (cherry, kiwi, pineapple, nectarine, strawberry, apple, banana, and grape) and the eight most familiar vegetables (beetroot, parsnip, mushroom, cauliflower, peas, sweet corn, broccoli, and carrot) were used to test the generalization of preferences to foods in the same superordinate category. Familiar foods were used as generalization stimuli to increase the likelihood that children would be aware of their membership in the fruit or vegetable category.

Two books were created: a "fruit book" about the eight unfamiliar fruits and a "vegetable book" about the eight unfamiliar vegetables. Each book consisted of a cover page and a further page about each food. This displayed a large photograph of the whole food and several smaller photographs showing how the vegetable grows, what it looks like inside, what the prepared food might look like, and so on, with accompanying sentences. Books were produced in a colorful, child-friendly, A4 format and were laminated and bound.

The laboratory task took place in the same visual preference booth as Experiments 1 and 2. A new set of photographs of each of the exposure foods and superordinate category foods was created for the laboratory task; pictures of exposure foods showed foods from a different angle to corresponding pictures in the exposure books. All pictures showed a whole fruit or vegetable full color against a white background and measured 24 $\times$ 16 cm on the screen.

Procedure

On recruitment, children were randomly assigned to receive either the fruit book (n = 19) or the vegetable book (n = 17). Parents were sent the appropriate book with instructions to read the book with their child for 5 min every day for 2 weeks.

The day after the exposure period ended, children took part in the visual preference procedure. They saw a series of 18 trials, on each of which a pair of pictures was displayed side by side on the screen for 5 s, and the instruction to "Look!" was heard 100 ms after the onset of each trial. The first two trials were attention-getting trials, presenting pairs of pictures of familiar objects. These were followed by 16 test trials, on each of which children saw one fruit and one vegetable side by side, with the side on which each food type was presented being counterbalanced.

Test trials consisted of eight exposed food trials and eight superordinate category trials presented in random order. On exposed food trials, children saw new pictures of two exposed foods, one from each book, so that the target picture depended on the book to which the child had been exposed. Each food was presented once, and the pairing of fruits and vegetables was randomized. On superordinate category trials, children saw a familiar fruit and vegetable that had not been included in either book. Again, foods were randomly paired and the target picture depended on the category of foods in the child's exposure book. Note that any spontaneous preferences children might have exhibited do not present a confound in this design because each food served equally often as the target and nontarget image across participants.

Coding

Coding was conducted as in Experiments 1 and 2. Two coders each coded half of the participants, and to assess reliability a third blind coder recoded a random sample of 20% participants (7 children). The mean Cohen's kappa for the concordance between scorers' ratings was .86 (range = .72–.91).

Results and discussion

The same two measures of visual preference were calculated as in Experiments 1 and 2; both were normally distributed with no outliers (Shapiro–Wilk, *ps* > .20).

Both measures confirmed that children preferred to fixate new pictures of exposed foods over pictures of nonexposed foods (see Table 1). Children spent significantly longer fixating exposed foods on exposure trials regardless of whether the measure of preference was total looking time difference, $t(35) = 3.21$, $p = .003$, or longest look difference, $t(35) = 2.44$, $p = .02$. Therefore, exposure had enhanced children's interest in new pictures of the exposed foods. Our second question concerned whether children's preference for exposed foods would generalize to other foods from the same category, that is, to other fruits or vegetables. As can be seen in Table 1, there was no generalization of preferences to foods in the same superordinate category as the exposed foods. Children spent equally long looking at pictures of foods from the exposed and nonexposed categories: total looking time difference measure, $t(35) = 0.05$, $p = .96$; longest look difference measure, $t(35) = 0.03$, $p = .98$. Thus, exposure does not merely enhance children's fixation of the specific visual stimulus to which they have been exposed, nor does it enhance the positivity of the whole category of items to which exposure has been given. Rather, effects extend to new pictures of exposed items, suggesting that exposure might lead to greater interest in the exposed items themselves.

General discussion

The three studies reported in this article clearly demonstrate that visual exposure leads young children to show visual preferences for exposed stimuli. In all three experiments, toddlers between 18 and 27 months of age preferred to look at pictures of foods to which they had been repeatedly exposed over pictures of foods to which they had not been exposed. In addition, Experiment 3 demonstrated that children's interest was enhanced not only for the exposed pictures but also for new pictures of exposed stimuli. Thus, as seen in mere exposure studies in the adult literature (Monahan et al., 2000; Zajonc, 1968), visual exposure increases toddlers' interest in stimuli. In this discussion, we consider some of the factors that may have contributed to the success of the visual exposure manipulation before turning to the theoretical implications of our findings for the locus of the exposure effect and, finally, to potential applications of the exposure paradigm.

What factors determine the success of picture book exposure?

The lack of any significant effects of the number or type of exposures provided in our studies suggests that the power of exposure to bring about changes in preference is robust and, to some extent, immune from such manipulations. In Experiment 1, for example, 1, 2, and 3 weeks of exposure enhanced children's interest in the exposed stimuli to a similar degree. Although effects were more reliable in the 2-week condition, prompting us to select 2 weeks as the exposure duration in the experiments that followed, future research might reduce the period of exposure to less than 1 week to establish how few picture book encounters are required for a preference to be established. Experiment 2 similarly found no effect of the type of exposure provided. When books containing multiple images of the same picture were compared with books containing a variety of pictures and information about each food, children's interest in the pictures contained did not differ. However, it is interesting that the larger amount of exposure experienced by children in the perceptual exposure condition of this study failed to facilitate learning; indeed, analysis of the behavior of children in each condition suggested that enriched exposure books were better able to elicit preferences. However, the differences between the two types of book were many, meaning that further work is needed before conclusions can be drawn regarding the means of presenting stimuli with the greatest effect on children's preferences.

However, as a starting point toward identifying an optimal exposure strategy, one might take into consideration the different strengths of the exposure effects across our studies. Although there were many dissimilarities between studies, there were also similarities, allowing us to draw some tentative

conclusions about the factors that might be important for eliciting a positive effect. For example, it is notable in Table 1 that children's mean preference for exposed foods was considerably larger in Experiment 1 than in Experiment 2. What factors might account for the stronger effect in Experiment 1? One difference was that in Experiment 1 children were exposed to a single food rather than a set of foods; if the exposure effect is diluted by larger numbers of exposed stimuli, one might wish to place limits on the number of stimuli that are exposed at any one time. Another difference between studies was the use of unfamiliar vegetables as stimuli in Experiment 1 compared with familiar fruits in Experiment 2; future work might wish to explore whether exposure effects are stronger for vegetables or, more likely, for stimuli that are initially unfamiliar. Alternatively, the weaker effect of Experiment 2 might be due to the older age of participants in this study; in Experiment 1 participants were still in their second year of life, whereas in Experiment 2 children had passed their second birthday.

However, it is important to note that, regardless of participants' ages, all three studies found exposure to exert a positive effect. As such, the findings of our studies fill an important developmental gap in the literature in terms of the period between infancy and the later preschool years. Tightly controlled laboratory studies with infants in their first year of life have demonstrated that repeated familiarization with a stimulus leads to a robust preference for a new stimulus over the old stimulus (Fantz, 1964; Hunter & Ames, 1988; Rose et al., 1982; Wagner & Sakovits, 1986). In a very different domain, repeated exposure to the taste of a new food has been shown to lead 2- to 5-year-olds to give more positive ratings of how much they like the exposed food (Birch & Marlin, 1982; Birch et al., 1987; Sullivan & Birch, 1990; Wardle et al., 2003a, 2003b). As discussed in the Introduction, adults' ratings of the extent to which they like or prefer stimuli are also enhanced by exposure (e.g., Monahan et al., 2000; Pliner, 1982; Zajonc, 1968). Our data, therefore, suggest that toddlers in their second year of life react to repeated visual familiarization more similarly to older children and adults.

Therefore, it is possible that an age-related change occurs between the first and second years of life in terms of children's response to repeated exposure. As discussed in the Introduction, the learned safety of familiar objects might only become important during the second year of life, when children have more control over the objects with which they interact. However, it is equally plausible that the discrepancy in the behavior of younger infants and toddlers lies in the different methodologies employed in the two types of studies. Although our use of visual preference as an assessment tool is in line with the methods employed by researchers working with younger infants, there are gross differences in the means by which familiarization was provided. Studies that provide familiarization in laboratory settings typically present the same visual stimulus repeatedly alongside a second stimulus that changes on every trial (e.g., Roder et al., 2000). The point at which infants begin to sustain a preference for the new item is used as an indication that processing of the unchanging stimulus is complete. In our studies, children were familiarized with, rather than habituated to, pictures in a manner that is likely to be more akin to their everyday experiences of items. Whether this type of more naturalistic exposure enhances interest in stimuli regardless of the age of the child remains a question for further research.

One component of the naturalistic exposure we provided that has not been considered so far is the role played by the parents who interacted with their children during the book-reading process. The children in our studies did not undergo a mere exposure experience of passively encountering pictures of stimuli, as would have been the case if pictures had been fixed to their bedroom walls. Rather, exposure was provided in the context of shared attention with the children's primary caregivers. Given that parents were willing participants in our studies, we might assume that children's experiences with the books were positive and that parents pointed out the pictures they contained in an animated, interested manner. The social referencing literature has shown that children's behavior toward a stimulus can be influenced by other people's expressions of positive or negative affect toward it. Some authors have found negative expressions of emotion to exert a particularly strong influence on children's attitudes. For example, Mumme and colleagues showed that 12-month-olds avoided interacting with objects toward which their mothers had expressed a fearful tone of voice (Mumme, Fernald, & Herrera, 1996) or toward which an actress on television had shown negative affect (Mumme & Fernald, 2003). However, other work has shown that positive expressions of emotion toward a stimulus or an environment are also able to induce exploratory behavior by children. In studies using the visual cliff paradigm, for example, 12-month-olds were found to be more likely to cross the deep side of the cliff

when their mothers bore a positive facial expression than when their mothers bore a fearful or angry expression (Sorce, Emde, Campos, & Klinnert, 1985), and the addition of positive vocal cues by their mothers encouraged infants to cross the cliff even faster (Vaish & Striano, 2004).

In our studies, parents are likely to have provided positive vocal emotion, and perhaps also positive facial expressions, while reading the book. Therefore, it is possible that children's enhanced preferences for exposed stimuli in our studies are based on their parents' apparent liking for the stimuli rather than on the visual exposure itself. If parents' approach toward and manner of reading the book differed between experiments, or even between conditions within an experiment, the social referencing account might explain some of the differences we observed in the strength of the exposure effect. For example, the weaker effect of the perceptual exposure condition of Experiment 2 might be attributed to parents' boredom with the repetitive counting task provided to them. A social referencing explanation might also account for the discrepancy between our positive exposure effects and the novelty preferences induced by standard familiarization paradigms. The emotional component required for social referencing to occur is not present in the exposure experiences that give rise to novelty preferences in laboratory studies. Further work is clearly needed to establish the precise conditions under which home-based everyday exposure to stimuli elicits positive preferences in toddlers.

What is the locus of the visual exposure effect?

We find in our data several sources of evidence to suggest that visual exposure effects are not tied to the exposed pictures themselves but rather reflect children's enhanced interest in the stimuli depicted in these pictures. The first is the failure to find any benefit of repeated perceptual exposure in Experiment 2. If the positive impact of visual exposure results from increased perceptual fluency (Bornstein & D'Agostino, 1994), as has been demonstrated in mere exposure studies, we might expect those children who had seen 11 tokens of the test stimuli on each reading of their picture book to show a larger exposure effect than children in the enriched exposure condition, who saw each test stimulus only once. Yet they did not. Similarly, the quantity of exposure provided in Experiment 1 bore no relation to the size of children's visual preferences for exposed stimuli regardless of whether quantity is framed in terms of the number of weeks parents were asked to read the book or in terms of the actual number of readings they reported providing. Third, children had received no previous exposure to the test images used in Experiment 3, yet the size of children's preference for exposed foods in this study was comparable to that seen in Experiment 2. Thus, quantity of exposure to the images that served as test stimuli played no part in determining the strength of the exposure effect in our studies.

These are theoretically important findings because if the effects of the exposure manipulation are not tied to the exposed pictures, they are less likely to be purely perceptually driven. Experiment 3 served to clarify the object of children's preferences by demonstrating that their interest is also enhanced for new pictures of exposed stimuli. That is, toddlers showed strong preferences for previously unseen pictures of the foods to which they had been exposed in their picture book. This suggests to us that the changes we observed in children's interest in stimuli may be associated with their representations of the exposed items rather than with the exposed percepts per se. That is, children's behavior suggests that they learned about and subsequently recognized foods rather than pictures.

At the same time, exposure did not create a general preference for the superordinate category of the exposed items; exposure to a book about fruit did not lead children to prefer fruits in general, only the fruits contained in the book. Whether this finding would apply equally to other types of stimuli remains to be seen. In the food preference literature, exposure-induced enhancements in children's liking of the taste of one food have been shown to generalize to other similar foods (Birch, Gunder, Grimm-Thomas, & Laing, 1998). However, such generalization may depend on children's knowledge that the two foods belong to the same superordinate category (Birch, 1981). Fruits and vegetables might not be easily separable categories for toddlers; indeed, adults struggle to place tomatoes and rhubarb in their appropriate botanical groups. Thus, children's failure to generalize their interest from one set of fruits to another, or from one set of vegetables to another, may reflect their failure to distinguish the two food groups rather than their failure to generalize preferences. Research should explore whether our findings extrapolate to stimuli that are more readily categorized by young children.

Potential applications of the exposure paradigm

The finding that exposure to pictures of stimuli enhances children's interest in new pictures of the same stimuli is of practical importance, as well as theoretical interest, because it implies that naturalistic picture book exposure might be used to enhance children's interest in the stimuli shown in the pictures; that is, children might display more positive attitudes toward the objects, events, or people they have been exposed to in books. There is evidence in the social psychological literature that children of school age develop more favorable attitudes toward disabled and refugee children as a result of reading stories about these groups (Brown et al., 2004; Cameron, Rutland, & Brown, 2007; Maras & Brown, 1996). Although there is some controversy over whether children as young as our participants would understand the symbolic nature of the relationship between the two-dimensional pictures and the three-dimensional referents they depict (DeLoache, 1991; DeLoache, Pierroutsakos, Uttal, Rosengren, & Gottlieb, 1998; Hochberg & Brooks, 1962), there is good evidence that very young infants recognize the similarities between the two (DeLoache, Strauss, & Maynard, 1979; Dirks & Gibson, 1977). If this ability is sufficient to support extrapolation of preferences for exposed pictures to the exposed items themselves, visual exposure of the type employed in these studies might prove to be effective as a tool for creating socially desirable attitudes and lifestyle choices in young children.

An obvious first avenue to explore in this regard is whether visual exposure might increase young children's willingness to taste healthy foods in the same way that it increases their willingness to look at healthy foods. If this were the case, visual exposure might be recommended as a means of facilitating parents' attempts to introduce more fruits and vegetables into their young children's diets, a topic of considerable current concern. Although a substantial body of research has demonstrated the positive effects of taste exposure on liking of fruits and vegetables (e.g., Birch et al., 1987; Blossfeld et al., 2007; Pliner, 1982; Wardle et al., 2003a, 2003b), the value of visual exposure in promoting healthy eating has been little explored. Birch and colleagues (1987) examined the relative benefits of taste exposures and visual exposures for children's ratings of the appearance and taste of foods and found no cross-modal facilitation by visual exposure. However, the finding that visual exposure does not enhance children's liking of the taste of a food does not rule out the possibility that increasing children's interest in the food might also increase their willingness to taste it, a necessary first step toward consumption.

In conclusion, although mere exposure effects on participants' liking of stimuli have been discussed in the adult literature for several decades (Zajonc, 1968), little similar work has explored the role played by exposure in preference formation during early development. Our data demonstrate that repeated exposure to stimuli in picture books leads young children to preferentially attend to exposed items over nonexposed items. Importantly, this effect is not limited to the perceptual stimuli seen during the exposure phase; rather, it generalizes to new depictions of exposed items. Therefore, we propose that visual exposure to stimuli in picture books may be an effective means of positively manipulating young children's preferences.

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