Establishing and explaining the impact of characters on young children’s healthy food choices

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Chapter 4

Enhancing Children's Vegetable Consumption using Vegetable-Promoting Picture Books: The Impact of Interactive Shared Reading and Character-Product Congruence

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Abstract

The present study investigated whether and how a picture book promoting a vegetable enhanced young children's consumption of that vegetable. One hundred and four children (aged 4-6 years) participated in shared reading sessions using the book on five consecutive days. The children were assigned randomly to one of four experimental conditions. In a 2 x 2 between-subjects design we manipulated: type of shared reading (passive vs. interactive) and type of character in the book (congruent vs. incongruent with the promoted vegetable). Compared to a baseline group of 56 children (aged 4-6 years) who were not exposed to the picture book, only children in the interactive shared reading condition consumed more of the promoted vegetable, which was the result of a combined cognitive and affective processing route.
Research from around the world suggests that children do not eat enough fruit and vegetables (e.g., Geller & Dzewaltowski, 2009; Ocké et al., 2008). However, it is crucial that young children meet the recommended daily intake for two reasons. First, fruit and vegetable consumption has been linked to a healthier weight in childhood (Lin & Morrison, 2002; Tohill, 2005), which is one of the most important predictors of a healthy weight in adulthood (De Kroon, Renders, Van Wouwe, Van Buuren, & Hirasing, 2010). Second, (taste) experience with fruit and vegetables is particularly important during the preschool years when children develop food attitudes that persist into adulthood (Rasmussen et al., 2006; Zeinstra, Koolen, Kok, & De Graaf, 2007). An engaging way to stimulate young children’s fruit and vegetable consumption is via shared book reading. A number of child nutrition programs worldwide such as the American Alliance for a Healthier Generation (2011), and the Family Nutrition Education Programs (2012), use picture books modeling healthy food behaviors. However, whether and how such picture books actually stimulate children’s consumption of healthy foods is currently unknown.

Therefore, the present study investigates whether and how picture books can stimulate young children’s vegetable consumption. Its first aim is to investigate whether exposure to a picture book promoting carrots can influence children’s consumption of carrots and other (non-promoted) healthy and unhealthy food products. In an experimental study, we compare the consumption results of exposed children with a group of non-exposed children. The second aim is to investigate whether the impact of the picture book on children’s carrot consumption can be enhanced by interactive shared reading, meaning that children are asked questions about the book during the reading session. Finally, we investigate whether the impact of the picture book can be enhanced by character-product congruence, meaning that a character is used that fits well with the vegetable in the book.

The Impact of Picture Books on Children’s Food Consumption

Influencing children’s consumption of healthy foods via picture books is more generally referred to in the literature as Entertainment Education (EE). EE has two defining characteristics (Moyer-Gusé, 2008). First, EE-productions contain an educational message, for example that eating carrots makes you feel fit and strong. Second, the educational message is incorporated into an entertaining narrative, such as a story about a rabbit. A growing body of research indicates that EE-productions can successfully influence the attitudes and behaviors of a number of different target groups (e.g., Moyer-Gusé & Nabi, 2010; Singhal, Cody, Rogers, & Sabido, 2004).

From an information-processing perspective, combining educational and entertaining content to manipulate behavior may be particularly effective among young children. The limited information-processing abilities of children aged 6 and under are likely to inhibit processing of traditional educational health messages (Buijzen, Van Reijmersdal, & Owen, 2010; Siegler, 1998). As we will explain in detail in the following sections, incorporating an educational message into an entertainment framework renders message processing less demanding, because new information is linked to story and character schemas, consequently increasing children’s comprehension of, and positive attitude toward, the message (Buijzen et al., 2010; Fisch, 2000). This suggests that young children may be more receptive to an entertainment-based health message compared to a purely educational health message.

While the positive influence of EE-productions on children’s academic and social skills has been well established (for overviews see: Fisch, 2000; Wilson, 2008), the impact on children’s health behaviors...
has received little scientific attention. Preliminary research via the Healthy Habits for Life project, in which healthy food messages were incorporated into various Sesame Street media outlets, suggests that EE-productions may successfully enhance children's consumption of healthy foods (Ritchie, Whaley, Spector, Gomez, & Crawford, 2010). We thus hypothesize that exposure to the carrot-promoting picture book will increase young children's consumption of carrots (H1a).

In addition to the impact on young children's consumption of the healthy food product promoted in the book, children's consumption of other (non-promoted) food products may also be influenced. First, we may anticipate a spill-over effect for other healthy food products. Research suggests that advertising a specific food product may also increase consumption of unadvertised food products from the same category (Buijzen, Schuurman, & Bomhof, 2008). In other words, promoting one vegetable may also encourage consumption of other vegetables. Second, we may anticipate a displacement-effect for unhealthy food products (i.e., foods high in saturated fats and salt). Child nutrition studies suggest that consuming more vegetables decreases the intake of unhealthy foods, because vegetables are high in fiber and thus reduce cravings for high-calorie snacks (Lin & Morrison, 2002; Tohill, 2005). We therefore expect that exposure to the carrot-promoting picture book will increase young children's consumption of other (non-promoted) healthy food products (H1b), and decrease their consumption of unhealthy food products (H1c).

Enhancing the Impact of Picture Books via a Cognitive and Affective Processing Route

In order to enhance the impact of picture book exposure on young children's consumption of the promoted healthy food, we need to understand how EE-picture books work. In general, narrative persuasion theories suggest that EE-productions lead to the production of fewer counterarguments among recipients, resulting in more story consistent beliefs and attitudes (e.g., Slater & Rouner, 2002; Moyer-Gusé, 2008). However, such theories cannot be applied to very young children, because their limited information processing abilities render them unable to spontaneously produce counterarguments regarding messages embedded in an EE-production (Roedder, 1981).

We thus put forward two alternative perspectives regarding the effectiveness of picture books. These are based on the literature regarding young children's information processing of either the educational or persuasive entertainment component of EE-productions. The first perspective proposes a cognitive route to processing picture book content and is derived from theories accounting for children's processing of educational content (Fisch, 2000; Zeinstra et al., 2007). The second perspective proposes an affective route and is derived from theories explaining children's processing of persuasive entertainment content (Buijzen et al., 2010). Based on these two perspectives, we develop and test a conceptual model of the impact of EE-picture books on young children's healthy food consumption. The two perspectives and their corresponding paths in the model will now be described in detail.

The Cognitive Route to Processing Picture Book Content

The cognitive perspective on the effectiveness of EE-picture books explains how children process the educational content in EE-productions. Fisch's (2000) capacity model predicts that easier processing of the EE-production results in better comprehension of the embedded educational message, because greater cognitive resources are available to more deeply process the message. This is particularly important for food products, because a deeper processed and better comprehended educational message

Enhancing Children's Vegetable Consumption using Vegetable-Promoting Picture Books: The Impact of Interactive Shared Reading and Character-Product Congruence

Our findings are relevant for increasing vegetable consumption among young children and thus contribute to the healthy habits of children in the long run. Further, the research offers an important insight into the role of age in interactive shared reading. Although theValidating the Development of the Children's Vegetable Consumption scale

Our findings provide evidence that the new scale developed for measuring children's vegetable consumption is valid. The scale has adequate internal consistency and is able to reliably measure children's vegetable consumption. Interestingly, preliminary research has shown that the scale is also able to differentiate between children who consume more vegetables and those who consume fewer. This suggests that the scale has good discriminant validity.

In conclusion, the research presented in this chapter suggests that interactive shared reading and vegetable-promoting picture books may be effective in increasing vegetable consumption among young children. The findings have implications for policymakers, educators, and parents, as they provide insights into effective strategies for promoting healthy eating habits among young children. The results also highlight the need for further research to understand the long-term effects of these interventions on children's eating behaviors.
about a food product can lead to a strong belief about that product (Zeinstra et al., 2007), here denoted as the child’s cognitive response. In turn, a strong cognitive response toward a food product is typically a good predictor of the consumption of that product (Oram, 1994).

Cognitive processing of picture book content may be enhanced through interactive shared reading (Barrentine, 1996; Dickinson, 2001; Whitehurst et al., 1988). This type of shared reading demands active participation by the child and is designed to assist young children’s processing and comprehension of picture book content. For example, before, during, and after the reading session, children are asked questions regarding the content of the story and its characters (e.g., “What should the character eat in order to be fit and strong?”), to make predictions regarding the storyline (e.g., “How will the character rescue his friend?”), and to make connections between events in the story and their own lives (e.g., “The character loves to eat carrots. Do you eat carrots?”) (Whitehurst, 1992; McGee & Schickedanz, 2007). Studies have demonstrated that such interactive shared reading sessions are more effective than passive shared reading sessions (in which children often merely listen to the story), resulting in enhanced comprehension of the content and ultimately to the (desired) behavioral change (Barrentine, 1996; Dickinson, 2001; Whitehurst et al., 1988).

We would thus expect interactive shared book reading to increase young children’s processing and comprehension of the picture book content, measured as a strong cognitive response toward the carrots promoted in the book (H2a). In turn, this strong cognitive response toward carrots will enhance children’s carrot consumption (H2b). This hypothesized mediated path from interactive shared book reading to children’s consumption, via their cognitive response, is presented in Figure 4.1.

![Figure 4.1. Conceptual information processing model of the impact of the EE-picture book on young children’s carrot consumption.](image)

**The Affective Route to Processing Picture Book Content**

The affective perspective on the effectiveness of EE-picture books explains how children process the persuasive entertainment content in EE-productions. According to persuasion theories (e.g., Buijzen et al., 2010), the positive feelings evoked when processing entertainment content are easily transferred to the food product promoted in the EE-production, resulting in a more positive affective response toward that product. In turn, positive affective responses toward food products have shown to predict food consumption (Institute of Medicine, 2006).
Affective processing of picture book content may be enhanced using characters. In an EE-picture book, the embedded health message is typically communicated via a character’s behavior. For example, a character is able to rescue his friend after eating carrots to make him fit. Characters evoke strong positive emotions that children typically transfer to everything associated with that character, including the food product it promotes (Acuff & Reiher, 1997; De Droog, Valkenburg, & Buijzen, 2011b; Roberto, Baik, Harris, Brownell, 2010). Within an information processing context, research suggests that characters conceptually congruent with the food product they promote (i.e., a rabbit and a carrot), automatically evoke a pleasant feeling due to ease of processing the familiar character-product concept. This automatic feeling feeds into children’s conscious evaluations, resulting in a more positive elaborate response toward the character and product (De Droog, Buijzen, Opree, & Valkenburg, 2011a; De Droog, Buijzen, & Valkenburg, 2012).

We anticipate that this effect of character-product congruence will also apply to book characters and, thus, that easier processing of the character-product combination in the picture book will result in a more positive affective response toward the carrots promoted in the picture book. Specifically, character-product congruence will induce initially a positive automatic affective response toward carrots (H3a) that will then feed into a more elaborate affective response (H3b). In turn, this positive elaborate affective response toward carrots will enhance young children’s carrot consumption (H3c). This hypothesized mediated path from character-product congruence to children’s consumption, via their automatic and elaborate affective responses, is presented in Figure 4.1.

**Method**

**Sample**

Between October and December of 2011, 160 four- to six-year-old children (51% boys, 49% girls) were recruited from six primary schools situated in both urban and suburban districts of The Netherlands. Only schools without formal fruit and vegetable programs were selected. The sample consisted of various socioeconomic and cultural backgrounds. The majority of children were classified as ‘normal’ weight (81%), with 12% classified as ‘underweight’, 5% as ‘overweight’ and 3% as ‘obese’ (see BMI classifications in the measures section). IRB approval for data collection and parental informed consent were obtained. One child was unable to participate due to a food allergy.

**Design and Procedure**

The study had a 2 (type of shared reading: passive vs. interactive) x 2 (type of character: congruent vs. incongruent) between-subjects design, plus a baseline group. We randomly assigned 104 children to the four experimental groups (n = 26 per condition) and 56 children to the baseline group. Only the children in the experimental groups participated in the shared reading sessions. Children in the baseline group received no exposure to the picture book.

Children were read the picture book in a quiet room near their class on five consecutive days, because previous studies have indicated that around five exposures are needed for an EE-production to be effective (e.g., Anderson et al., 2000; Crawley et al., 1999). Shared reading took place in groups of approximately four children. The composition of each experimental group remained identical for all
five days. A female daycare worker was trained for the shared reading task (storyteller) to ensure that, other than the experimental manipulations, the reading sessions were similar for all children. Children were provided with name badges to enable the storyteller to call them by their names. In the interactive sessions, the storyteller used a reading manual to ask children questions about the story and its characters before, during, and after the session. In the passive sessions, children were not asked any questions and only encouraged to sit quietly and listen to the story. While not blind to the conditions, the storyteller was blind to the hypotheses and not involved in the measurements of the study.

Observations by the storyteller revealed that children in the interactive sessions were more involved and progressively active during the reading sessions than the children in the passive sessions. For example, these children listened attentively to the storyteller, raised their fingers when a question was asked, loudly verbalized the correct answers, sang along enthusiastically with the song incorporated into the story and demonstrated modeling behavior (e.g., the character’s ‘fit and strong’ pose). Two photographs of the interactive sessions are presented in Figure 4.2.

Immediately following the final reading session, the main variables were measured. All children, including the baseline group, participated in this part of the study. Children were interviewed individually in a quiet room by two female experimenters who were unaware of each child’s experimental condition. Initially, children completed a questionnaire on a 12-inch touchscreen notebook suitable for structured questionnaire research with young children (HP Pavilion tx2-1150) (cf. De Droog et al., 2011a, 2012). Children were then invited to eat snacks in a more comfortable seating area. For a maximum of five minutes, children were permitted to eat from four bowls, each containing a different snack food. At the outset, each bowl contained four pieces. The experimenter thus counted the number of pieces of each snack food eaten after five minutes had elapsed. Finally, children were weighed and measured (without shoes) to compute their body mass index (BMI).

*Figure 4.2. Photos of the interactive shared reading sessions, in which children raised their hands to answer questions (left) and modeled the ‘fit and strong’ pose of the main character (right).*
Stimulus Materials
The experimental stimulus was a picture book, created specifically for this study. The healthy food product promoted in the picture book were carrots, because raw carrots are a common snack in the Netherlands that can easily be included into children's lunch boxes. The embedded health message in the picture book was that "eating carrots makes you fit and strong". A professional children's illustrator developed two identical picture books differing only in type of character (see Figure 4.3): One book featured a product-congruent character (a rabbit), and the other featured a product-incongruent character (a turtle). We selected these characters based on a pretest among 40 children in which we tested six different animals drawn by the same illustrator (rabbit, mouse, caterpillar, turtle, rhino, and monkey) for both likability and congruence with a carrot. The rabbit and turtle were selected because these characters were liked equally (measured on a 4-point scale: rabbit $M = 3.43$; turtle $M = 3.31$; $t(39) = .81$, $p = .43$, $d = .13$), yet differed significantly in perceived character-product congruence (measured on a dichotomous scale: rabbit $M = 0.85$; turtle $M = 0.41$; $t(39) = 9.11$, $p < .001$, $d = 1.44$).

The picture book story was written by a professional children's writer and describes a main character rescuing his friend. A key premise of EE-productions aimed at young children is that the educational content (health message) and the entertaining content (story and characters) are intertwined (Fisch, 2000). Therefore, the main character in this story is able to rescue his friend only after eating carrots to make him fit and strong. The books were printed in A4-size, which is typical for classroom reading in small groups. For the interactive reading conditions, transparent sleeves containing a reading manual were placed on the book's back cover. This manual was based on Whitehurst's dialogic reading method (1992; Whitehurst et al., 1994). On each consecutive day of reading, a new manual of increasing difficulty was used. At the beginning of the week, children were asked largely completion-questions (e.g., to finish the song in the book) and wh-questions (e.g., "What does Rabbit give to his friend?"). As the week progressed, the children were increasingly asked recall-questions (e.g., "Can you remember why Rabbit has to eat carrots?") and open-ended questions ("Now it's your turn to tell me about this page"). Children's responses were repeated by the storyteller and evaluated (praised or corrected).

Figure 4.3. Excerpts from the picture book containing the congruent character (left) and the incongruent character (right).
Measures

Cognitive response carrots. To measure the cognitive response toward carrots, the following two items were used: "How strong do you get from eating carrots?" and "How fit do you get from eating carrots?". Children responded on a visual 4-point-scale containing squares of various sizes ranging from very small (1 = *not at all strong / fit*) to very big (4 = *very strong / fit*). These two scale items were averaged to create a single measure of cognitive response (\( r = .49, M = 3.34, SD = .86 \)).

Automatic affective response carrots. To measure the automatic affective response toward carrots, children expressed whether they liked carrots using a dichotomous smiley scale (unhappy face, happy face): 0 = *dislike*, 1 = *like* (\( M = 0.57, SD = .50 \)). To evoke an automatic response, children were asked to tap on the smiley that best showed their liking of carrots as fast as they could (cf. De Droog et al., 2011a, 2012). The average reaction time was 1998 ms.

Elaborate affective response carrots. To measure the elaborate affective response toward carrots, we supplemented the De Droog et al.'s (2011a, 2012) original measure "How much do you like carrots?" with the more consumption-related item "How tasty do you find carrots?". To evoke an elaborate response on both items, children were given sufficient time to think before answering on a 4-point smiley scale (ranging from an unhappy to a happy face): 1 = *don't like at all*, 2 = *like a little bit*, 3 = *like quite a bit*, 4 = *like very much* (cf. De Droog et al., 2011a, 2012). The two scale items were averaged to create a single measure of elaborate affective response (\( r = .61; M = 2.61, SD = 1.17 \)). The average reaction time was 4776 ms, which was significantly slower than their automatic response time: \( t(159) = -11.41, p < .001, d = .90 \).

Product consumption. To measure product consumption, four products were selected for the eating task: The promoted vegetable (carrots), a non-promoted vegetable (cucumber), and two non-promoted unhealthy food products (cheese and salty sticks; high in saturated fats and/or salt according to WHO, 1998). Like carrots, all non-promoted food products selected were common snack foods in Dutch households. Further, because young children tend to prefer sweet tastes (Desor, Maller, & Turner, 1977), we used unhealthy food products with a salty taste in order to create more equal competition with carrots. Children's proportional product consumption was measured by dividing the number of pieces of each food product eaten by the total number of pieces of food products eaten, for example: # carrots eaten / total # products eaten (means and standard deviations are presented in Table 4.1).

Control variables. Children's BMI and hunger levels were measured because these variables may significantly influence children's product consumption (Anschutz, Engels, & Van Strien, 2010). To establish each child's BMI score (weight/height\(^2\)), international standards were used to categorize children into the four BMI groups described above (Cole, Bellizzi, Flegal, & Dietz, 2000). Because BMI did not correlate with product consumption, BMI was not controlled in our analyses. Children's level of hunger was established prior to the eating task by asking them to point to how hungry they were on a visual 4-point smiley scale (ranging from an unhappy to a happy face): 1 = *not hungry*, 2 = *a little bit hungry*, 3 = *quite a bit hungry*, 4 = *very hungry*. Hunger level was significantly correlated with cucumber and cheese consumption (cucumber \( r = .16; \) cheese \( r = .16; \) both \( p < .05 \)), but not with carrot and salty stick consumption (carrots \( r = .10; \) salty sticks \( r = -.10; \) both \( p > .20 \)). Hunger was thus included as a covariate in the analyses regarding cucumber and cheese consumption only.
Table 4.1
Mean Product Consumption Scores for Children Exposed (Experimental Groups) and not Exposed (Baseline Group) to the Picture Book

<table>
<thead>
<tr>
<th></th>
<th>Carrot consumption</th>
<th>Cucumber consumption</th>
<th>Cheese consumption</th>
<th>Salty stick consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental groups</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Interactive + congruent</td>
<td>0.19 ± (0.03)</td>
<td>0.22 ± (0.03)</td>
<td>0.16 ± (0.04)</td>
<td>0.40 ± (0.04)</td>
</tr>
<tr>
<td>Interactive + incongruent</td>
<td>0.15 ± (0.03)</td>
<td>0.17 ± (0.03)</td>
<td>0.26 ± (0.04)</td>
<td>0.41 ± (0.04)</td>
</tr>
<tr>
<td>Passive + congruent</td>
<td>0.11 ± (0.03)</td>
<td>0.23 ± (0.03)</td>
<td>0.29 ± (0.04)</td>
<td>0.39 ± (0.04)</td>
</tr>
<tr>
<td>Passive + incongruent</td>
<td>0.12 ± (0.03)</td>
<td>0.20 ± (0.03)</td>
<td>0.28 ± (0.04)</td>
<td>0.35 ± (0.04)</td>
</tr>
<tr>
<td><strong>Baseline group</strong></td>
<td>0.08 ± (0.02)</td>
<td>0.21 ± (0.02)</td>
<td>0.34 ± (0.03)</td>
<td>0.38 ± (0.03)</td>
</tr>
</tbody>
</table>

Note. Reported means and standard deviations are corrected for the covariate ‘hunger’. *Row differences are significant at least at p < .05.

Results

Impact of Picture Book on Children’s Product Consumption
To investigate whether exposure to the carrot-promoting picture book influenced young children’s consumption of carrots (H1a) and other (non-promoted) healthy (H1b) and unhealthy (H1c) food products, we first compared children exposed to the picture book (the experimental groups) with children not exposed to the book (the baseline group). We performed a multivariate analysis of covariance with study condition (experimental groups vs. baseline group) as the between-subjects factor, consumption of the four products as the dependent variables, and hunger level as a covariate. The analysis yielded a main effect for carrot consumption, F(1,159) = 6.54, p < .05, η² = .04, with children exposed to the picture book consuming a higher proportion of carrots (M = 0.14, SD = .02) than children not exposed to the book (M = 0.08, SD = .02). This effect was not found for the other healthy food product, because children in both conditions consumed an equal proportion of cucumber. Further, the analysis yielded a main effect for cheese consumption, F(1,159) = 11.15, p < .01, η² = .06, with children exposed to the picture book consuming a lower proportion of cheese (M = 0.24, SD = .02) than children not exposed to the book (M = 0.34, SD = .03). This effect was not found for the other unhealthy food product (salty sticks).

These first results suggested that exposure to the carrot-promoting picture book influenced young children’s consumption of carrots and cheese. We explored these results in more detail by performing another multivariate analysis of covariance with all study conditions (i.e., interactive-congruent, interactive-incongruent, passive-congruent, passive-incongruent, and baseline) as the between-subjects factor, consumption of the four products as the dependent variables, and hunger level as a covariate. The results are presented in Table 4.1. Again, the analysis yielded a main effect for carrot consumption, F(4,159) = 2.57, p < .05, η² = .07. However, planned contrasts (that compared each experimental group
with the baseline group) revealed that only children in the interactive shared reading sessions consumed a higher proportion of carrots than children in the baseline group. The analysis also yielded a main effect for cheese consumption, $F(4,159) = 4.47, p < .01$, $\eta^2 = .10$. Planned contrasts revealed that only children in the interactive shared reading sessions and children exposed to a congruent character-product combination consumed a lower proportion of cheese than children in the baseline group.

### The Impact of Interactive Shared Reading and Character-Product Congruence on Carrot Consumption

The second aim of the study was to investigate specifically how exposure to the carrot-promoting picture book led to increased carrot consumption. We tested whether the impact on carrot consumption was enhanced via a cognitive processing route induced by interactive shared reading, and/or an affective processing route induced by character-product congruence (see Figure 4.1). The zero-order correlations presented in Table 4.2 indicate that character-product congruence was not related to any other variable. However, interactive shared reading was related positively to cognitive response, automatic affective response, and consumption, but not to elaborate affective response. Further, cognitive response was related positively to elaborate affective response, but not to automatic affective response or consumption. Finally, the two affective responses were related positively to each other and to consumption.

The paths in Figure 4.1 were investigated using the structural equation modeling program AMOS 17.0. The analysis was based on two independent variables (interactive shared reading and character-product congruence), three mediating variables (cognitive response, automatic affective response and elaborate affective response), and one dependent variable (consumption). To indicate the fit of the model, three model fit indices were used: The $\chi^2$-test, the comparative fit index (CFI), and the root mean square error of approximation index (RMSEA). The model would be supported with a nonsignificant $\chi^2$ value of .95 or more, and a RMSEA value of .05 or less, with $p$-close > .05 (Browne & Cudeck, 1992).

#### Table 4.2

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<td>1. Character-product congruence</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>2. Interactive shared reading</td>
<td>.00</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Cognitive response carrots</td>
<td>.03</td>
<td>.18*</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Automatic affective response carrots</td>
<td>.04</td>
<td>.20*</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Elaborate affective response carrots</td>
<td>.15</td>
<td>.13</td>
<td>.19*</td>
<td>.79**</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6. Carrot consumption</td>
<td>.03</td>
<td>.18*</td>
<td>-.03</td>
<td>.47**</td>
<td>.54**</td>
<td>-</td>
</tr>
</tbody>
</table>

* $p < .05$, ** $p < .01$.

The conceptual model in Figure 4.1 yielded a reasonable fit to the data, $\chi^2(9, N = 104) = 16.40, p = .06$, CFI = .95, RMSEA = .09, with $p$-close = .16. Modification indices indicated that the fit could be improved by including two paths: One leading from interactive shared reading to automatic affective
response, and one leading from cognitive response to elaborate affective response. Because these two relations are theoretically plausible (see Discussion), these paths were added to the model. The adjusted model, presented in Figure 4.4, fit the data very well, $\chi^2(7, N = 104) = 7.88, p = .34$, CFI = .99, RMSEA = .04, with $p$-close = .51. No further meaningful modifications were viable. We thus accepted this adjusted model as our final model. Of the seven paths specified in the model, five were statistically significant. These paths were all positive and represented the relations between: interactive shared reading and cognitive response ($\beta = .18, p < .05$), interactive shared reading and automatic affective response ($\beta = .20, p < .05$), automatic affective response and elaborate affective response ($\beta = .79, p < .001$), cognitive response and elaborate affective response ($\beta = .12, p < .05$), and elaborate affective response and consumption ($\beta = .56, p < .001$). The variables in the final model accounted for 31% of the variance in carrot consumption.

Our hypothesized affective route (via automatic and elaborate affective responses), induced by character-product congruence (see H3a-H3b-H3c in Figure 4.1) was not fully supported. Rather, our final model indicated that the affective route was induced by interactive shared reading. In addition, our hypothesized cognitive route (via cognitive response), induced by interactive shared reading (see H2a-H2b in Figure 4.1) was also not fully supported. Instead, our final model indicated that the cognitive response induced by interactive shared reading influenced carrot consumption only via the elaborate affective response. The final model thus suggested a combined cognitive-affective mediating path.

To formally test the significance of these two new mediating paths, we performed a bootstrap procedure suggested by Preacher and Hayes (2004). This procedure (1,000 samples, N = 104) was used to generate a 95% bias-corrected and accelerated confidence interval (BCA CI) for the indirect effects described above. First, the strength of the direct effect of interactive shared reading on carrot consumption was determined, which was significant ($\beta = .18, p < .05, R^2 = .03$). The new affective route was tested next. When the automatic and elaborate affective responses were included, the direct effect of interactive shared reading on carrot consumption disappeared ($\beta = .11, p = .20$). The analysis yielded a significant indirect effect of interactive shared reading on carrot consumption, via the automatic and elaborate affective responses ($\beta = .08, p < .05, R^2 = .31$, BCA CI = .013 to .159). Thus, the impact of interactive

\[
\begin{align*}
\text{interactive shared reading} & \quad 0.18 \quad \text{cognitive response} \\
\text{character-product congruence} & \quad \ldots \quad \text{automatic affective response} \\
& \quad 0.20 \quad \text{elaborate affective response} \\
\text{consumption} & \quad 0.56
\end{align*}
\]
shared reading on young children's carrot consumption was fully mediated by children's successive automatic and elaborate affective responses toward carrots.

Finally, the new combined cognitive-affective route was tested. Again, the direct effect of interactive shared reading on carrot consumption disappeared ($\beta = .12, p = .19$), while the mediating path leading from interactive shared reading to carrot consumption via the cognitive response and elaborate affective response was significant ($\beta = .02, p < .05, R^2 = .30, BCA CI = .008 to .055$). Thus, the impact of interactive shared reading on young children's carrot consumption was also fully mediated by children's successive cognitive and elaborate affective responses toward carrots.

**Discussion**

The present study investigated whether and how picture books can stimulate young children's vegetable consumption. The study had two specific aims. The first aim was to investigate whether exposure to a carrot-promoting picture book can influence young children's consumption of carrots and other (non-promoted) healthy and unhealthy food products. In line with hypothesis 1a, children exposed to the picture book consumed a higher proportion of carrots than children not exposed to the book. Thus, in addition to improved academic and social skills (Fish, 2000; Wilson, 2008), it appears that picture books can also increase young children's consumption of healthy foods. However, the increased effect on carrot consumption was only found in the group of children who were actively involved in the reading sessions (i.e., interactive shared reading). Thus, in line with adult-mediation studies and social susceptibility theories (Kirkorian, Wartella, & Anderson, 2008; Valkenburg & Peter, in press), the results demonstrate that the success of health communication interventions for children depend largely on how parents and other important caregivers maximize the positive impacts of these interventions.

Inconsistent with hypothesis 1b, the impact of carrot promotion on carrot consumption did not spill over to other vegetables. Perhaps the spill-over effects demonstrated in earlier research (e.g., Buijzen et al., 2008) are limited to branded products, and promotion of a certain carrot brand stimulates solely the consumption of other carrot brands. Nonetheless, consistent with hypothesis 1c, consuming more carrots appears to displace the consumption of certain unhealthy foods. This is in line with child nutrition studies suggesting that the high fiber content of vegetables decreases the appetite for unhealthy foods (Lin & Morrison, 2002; Tohill, 2005). The results thus indicate that picture book exposure stimulated a displacement but not a spill-over effect.

The second aim of the study was to investigate specifically whether the impact of picture book exposure on young children’s carrot consumption was enhanced via a cognitive processing route induced by interactive shared reading, and/or an affective processing route induced by character-product congruence. With regard to the cognitive route, we anticipated that interactive shared reading of the picture book would increase children’s cognitive response toward carrots (H2a) and, in turn, increase children’s carrot consumption (H2b). This hypothesized cognitive processing route was not fully supported. However, in line with hypothesis 2a, interactive shared reading enabled young children to fully process and comprehend the embedded health message (i.e., "eating carrots makes you fit and strong"), as measured in a strong cognitive response toward carrots.
Inconsistent with hypothesis 2b, a stronger cognitive response toward carrots did not enhance directly young children's carrot consumption. Rather, only when children's cognitive response toward carrots increased their liking of carrots (i.e., elaborate affective response), did they also consume more carrots. This supports previous research with young children suggesting that affect is an important mediator of behavioral effects (Acuff & Reiher, 1997; Bahn, 1989; Contento, 1981; Zeinstra et al., 2007). Specifically, due to the limited reasoning capacities of children aged 6 and under, behavior change tends to be motivated largely by affective responses (“I like this”) rather than cognitive responses (“eating this will make me strong”). While young children may learn the educational message that ‘eating carrots makes you fit and strong’, it is not until age 7 that functional attributes are used as a direct motivation to behavior (Acuff & Reiher, 1997; Bahn, 1989).

With regard to the affective route, we anticipated that character-product congruence would induce initially a positive automatic affective response toward carrots (H3a), followed by a positive elaborate affective response (H3b), that, in turn, would enhance young children's carrot consumption (H3c). This hypothesized route was not fully supported, because the affective responses were induced by interactive shared reading only. This new path was incorporated into the model, because children generally enjoy interactive shared reading sessions more than passive shared reading sessions (Justice & Kaderavek, 2002). We observed this in our study, with children in the interactive sessions showing increased enthusiasm as the week progressed. It is plausible that the enjoyment these children experienced was transferred automatically to the carrots promoted in the book, leading to a positive automatic affective response toward carrots.

A reason why hypothesis 3a was not supported may be because the children in our study became familiarized with the incongruent character-product combination as the week progressed. While the pretest clearly indicated that the rabbit was perceived as more congruent with carrots than the turtle, five reading sessions may be sufficient to learn a new character-product concept. Consequently, if children in both the rabbit and the turtle conditions perceived their character to be congruent with carrots, no difference in their automatic affective responses (as a result of easier processing the familiar concept) would be observed. Following this, characters used in EE-productions, such as picture books and television programs, do not necessarily need to be conceptually congruent with the product they promote. EE-productions are usually intended for repeated exposure, making it possible for young children to familiarize with new character-product concepts.

Conclusions and Implications
Research suggests that young children should eat more vegetables in order to maintain a healthy weight (e.g., Lin & Morrison, 2002; Tohill, 2005). Many parents are aware of the importance of healthy eating, but struggle to encourage their children to consume enough vegetables. This study presents an attractive and easy way for parents to enhance their children's vegetable consumption. By rendering shared book reading in the home environment more interactive, we demonstrated that young children may consume more of a vegetable after reading a book about that vegetable. Because between 10 and 15 taste exposures may be required to elicit children's vegetable liking (Birch & Marlin, 1982), offering a taste of the vegetable after each reading session increases the chances of a long-term effect. In addition to shared book reading in the home environment, we recommend the development of a school program in which a new vegetable is introduced each month via interactive shared reading sessions of a picture book promoting that vegetable in class.
Finally, we provide three suggestions for future research. First, the long-term impact of picture book exposure on children's consumption patterns should be tested. Second, the impact of picture book exposure should be measured in the home-environment, to investigate whether children would also eat more carrots at home and, more importantly, whether they would ask their parents for carrots when they are not available directly. Finally, the study should be replicated with other, more bitter tasting vegetables, such as spinach or broccoli, to determine whether a picture book could also increase consumption (or at least willingness to taste) these less popular vegetables.
References


Enhancing Children's Vegetable Consumption using Vegetable-Promoting Picture Books: The Impact of Interactive Shared Reading and Character-Product Congruence


Parental Feedback on the Picture Book Intervention

During the course of the picture book intervention, I received feedback from parents about changes in their child’s behavior. Below are two emails from parents of children from different primary schools. Names have been changed to preserve anonymity.

November 8, 2011

Hello,
Last week my son participated in the vegetable book study at his school. Not aware of the study, I asked my son (coincidentally) what he wanted to eat for dinner that evening. He was not allowed to choose Dutch pancakes or French fries, but vegetables only. He chose carrots because, he said, that would make him feel strong and tough.
Later on I discovered that he had participated in the study, which was about a rabbit and carrots. Therefore, it definitely had an influence. He also abundantly enjoyed eating the carrots.

Kind regards,
Kirsten

Hallo,
Mijn zoon heeft vorige week meegedaan aan het groenteboekonderzoek op zijn school. Toen ik er nog niet vanaf wist, vroeg ik (toevallig) wat mijn zoon wilde eten die avond. Hij mocht geen pannenkoeken en patat kiezen, maar groente.
Hij koos voor worteltjes, want daar werd hij sterk en steor van zei hij. Later kwam ik er echter dat hij meedeed aan het onderzoek en dat het over een konijntje ging en worteltjes.
Dus het heeft wel invloed gehad. Hij heeft ook heerlijk van de worteltjes gesmuld.

Met vriendelijke groet,
Kirsten
Hello,
I wanted to let you know that after the study my daughter made a different choice at McDonald's. Instead of a fruit snack, she chose carrots for dessert.

Kind regards,
Roos

November 14, 2011

Hallo,
Ik vind het leuk om even te laten weten dat mijn dochter na het onderzoek een andere keuze bij McDonalds maakte. In plaats van een knijfpudding koos ze worteltjes als toetje.

Met vriendelijke groet,
Roos