Judgment and Decision Making, Vol. 14, No. 1, January 2019, pp. 72–79

The effect of limited availability on children's consumption, engagement, and choice behavior

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Abstract

Three studies examine the effect of limited availability on the engagement, consumption, and choice behavior of four- to five-year old children. It is shown that children engage longer in an activity when the activity is presented as limited in time and consume more of a particular food when the food is presented as limited in quantity. It is also shown that the consumption ratio of a less preferred food to a more preferred one increases when the less preferred food is presented as limited in quantity. Finally, children are more likely to choose a less preferred option over a more preferred one when the less preferred option becomes less available.

Keywords: children, limited availability, scarcity, choice, consumption, engagement, healthy eating

1 Introduction

Parents often battle to convince their children to eat vegetables or step away from their screen to engage in other activities.[1] One strategy parents use in this battle is to persuade their children that vegetables are good for their development, and so are non-screen activities.[2] Research indicates that children may resist such explicit persuasion attempts (Maimaran & Fishbach, 2014; Wardle & Huon, 2000). Another strategy parents use is to reward the consumption of a particular food or the engagement in a particular activity. While rewards can be effective (Cooke et al. 2011), research shows that this strategy may lead to decreased liking of the rewarded task, which is viewed as the means to get the reward (Birch, Marlin & Kramer, 1982; Birch, Marlin & Rotter, 1984; Newman & Taylor, 1992). A third strategy is to limit the consumption of unhealthy food items such as candies and sweets (e.g., "you can have only one cookie") or screen time (e.g., "you can watch TV for only 30 minutes"). This strategy may backfire because the limited availability of a good may increase its value (Brock, 1968; Cialdini, 2009).[3]

Building on the research suggesting that limited availability increases value, this paper makes modest progress in examining a variation of the third strategy. Rather than limiting the availability of unhealthy food items or screen time, we limit the availability of healthy food items and non-screen activities, and examine whether such limitations may trigger children to view the healthy food items and the non-screen activities as more desirable. Put differently, we study whether limited availability increases the value of objects children may initially view as less desirable.

We conduct three studies to examine this question. In the first study, we limit how much of a healthy food children can consume and how long they can engage in a particular non-screen activity. We find that children consume more of the healthy food when it is positioned as limited in quantity, and engage longer in the non-screen activity when it is positioned as limited in time.

In the second study, we offer children a plate with two snacks, one of which children prefer to the other. We position the less preferred snack as limited in quantity and observe how this positioning changes the consumption ratio of the two snacks. We find that the consumption ratio of the less preferred snack to the more preferred snack increases when the less preferred snack is positioned as limited in quantity.

In the third study, we aim to create limited availability in the context of choice. We offer children a snack from a set with two types of snacks where each snack appears multiple times in the choice set and one snack is preferred to the other.

The authors thank the children of the McGaw YMCA Children's Center, Evanston, IL, for participating in this research, the staff of the Children's Center for their help and support, and Erin Dierker, Sowa Imoisili, Elizabeth Kim, and Kaitlyn Lannan for their help in collecting the data at the Children's Center. This paper extends and substitutes the authors' previous paper "The Effect of Visual Minority on Children's Choice and Consumption" posted in July 2015.

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[1] For evidence on rising childhood overweight and obesity, see e.g., de Onis, Blössner & Borghi, 2010, Lobstein, Baur & Uauy, 2004, and Ogden et al. 2014. For the dramatic increase in children's screen time, see e.g., American Academy of Pediatrics, 2013.

[2] A screen activity is an activity that involves sitting in front of a screen, e.g., watching TV or playing games on an electronic device.

[3] Throughout the paper, we use the term "limited availability" to describe a situation in which an object is offered in limited quantity or an activity is offered for a limited time. An alternative term, often used to describe such limitations is scarcity.

https://doi.org/10.1017/S1930297500002928 Published online by Cambridge University Press

We make the less preferred snack less available by reducing the number of times it appears in the choice set. We find that this manipulation increases the likelihood children choose the less preferred snack.

The three studies share several design features. First, participants in all studies are four-to-five year old preschoolers. We focus on preschoolers in this age group because they already exercise independence in choosing their food and activities, and because it is important to establish healthy eating and playing habits at as young an age as possible. Second, the studies involve tasks children are familiar with. For example, children often choose a single snack from a bowl with several snack types similarly to the setting of study 3. As Peracchio (1990) emphasizes, familiarity with the task is important for the evaluation of research with children, because children process information better when they are familiar with the situation (Chi 1976, 1977). Third, these are real, non-hypothetical, tasks that involve actual consumption and engagement, and consequential choices, thus enhancing the external validity and overall realism of the findings (Morales, Amir & Lee, 2017).

While there is a large literature studying the effect of limited availability, or scarcity, on adults' decision-making (e.g., Lynn, 1992; Verhallen & Robben, 1994; Worchel, Lee & Adewole, 1975), there is only a handful of papers studying the effect of limited availability on children's decision-making. Brehm and Weinraub (1977) found that two-year old children were more attracted to an object when a large barrier was put in front of the object and blocked access to it. In a group setting, Fisher and Birch (1999) restricted preschoolers' access to crackers, and found that once the crackers became available, children in the group wanted to consume more of them. Mittone, Savadori and Rumiati (2005) found that 9- to 10-year old children, choosing a toy from among toys that are identical in every aspect except for color, tend to choose a color that appears less frequently in the choice set. Using abstract shapes, Echelbarger and Gelman (2017) found that children were more likely to show variety seeking than scarcity seeking when choosing among the abstract shapes. Finally, John et al. (2018) found that 6-year old children choosing in a competitive environment between two opaque containers, each of which containing a sticker, one container drawn from a pile with many containers and the other from a pile with just one container, tend to choose the container drawn from the pile with the single container. They did not find similar results in non-competitive settings, when the stickers are visible, or when children are younger.

We contribute to the literature on the effect of limited availability on children's decision making in several ways. First, we establish that limited availability increases the value of less preferred objects relative to more preferred objects. Specifically, positioning a less preferred food as less available increases its consumption ratio relative to a more preferred food (Study 2), and the likelihood it is chosen over a more preferred food (Study 3). Second, we establish that limited availability increases engagement (Study 1), a measure the literature has not studied in this context. Third, we study real, non-hypothetical, and non-competitive settings using objects children are familiar with and using tasks children perform on a daily basis.

In what follows, we describe our three studies. All studies were conducted in a pre-school facility and involved individual sessions in which children interacted with experimenters who were blind to the research hypotheses. In post-study debriefing, the experimenters indicated they did not figure out the research hypotheses. All children in the relevant age group whose parents signed consent forms to participate in the relevant study and consume the food when applicable, and who were present at the preschool when the study was conducted, were invited to participate. All studies were approved by the preschool management including when food was served to ensure there were no allergy or choking concerns.

2 Study 1: Limited availability increases engagement and consumption

This study tests how children's food consumption, taste ratings, and engagement in an activity change in response to limited availability. We offered children to play with Legos, and we manipulated whether they were told they had limited time to play or not. Consistent with prior research (e.g., Maimaran, 2017), the time children played served as our measure of engagement. We then offered children a snack to eat (carrots), and we manipulated whether or not they were told there is a limited amount of carrots. The amount children ate served as our dependent variable. Two experimenters, blind to the research hypotheses, collected the data. No effects involving the experimenters were found.

2.1 Method

Fifty-one children (mean age = 61.98 months, STD = 5.68 months; 53% female) were invited to participate in this study. The study involved two tasks, each with two conditions, and children were randomly assigned to a combination of two conditions across the two tasks.

When the child entered the experiment room, the experimenter greeted the child and offered her to play with Lego blocks in a carpet area similar to the one children in this preschool play on with Legos and other building toys in their classrooms. The experimenter told the child, "Let's play with Legos. When you are done just leave what you built here and come back to this table," and pointed to the table

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FIGURE 1: Lego blocks and base used in Study 1.

where she would sit (henceforth, the experimenter's table). In the limit condition (N = 25), the experimenter added, "I am sorry, but you can only play for 10 minutes." The experimenter did not add this sentence in the control condition. The experimenter then gave the child a green base and a bag with 51 Lego blocks in 12 colors (see Figure 1).

To minimize interaction between the experimenter and the child during play time, the experimenter waited at the experimenter's table located outside the carpet area where the child was playing. In both conditions, the experimenter told children who were still playing with the Legos after 10 minutes, "OK, it is time to finish with the Lego. Just leave everything there and come back to the table." We measured how long the child played, and this served as our dependent variable of engagement.

The experimenter then invited the child to move to a snack table and told her, "Now, we have carrots for you to eat. Please come with me to this table. You can eat as much or as little as you want. When you are done, just let me know." On the snack table, we put a bowl with 42 grams of petite baby carrots (about 12 carrots; see Figure 2). In the limit condition (N = 26), the experimenter added, "I am sorry, but these are all the carrots we have." The experimenter did not add this sentence in the control condition. As before, the experimenter sat at the experimenter's table while the child was eating at the snack table.

When the child finished eating, she moved back to the experimenter's table. The experimenter asked the child to rate how yummy the carrots were, using a 5-point smiley scale (Figure 3). The experimenter explained to the child which face corresponded to yummy, OK, and yucky, and asked the child to point to the face that represented how much she liked the carrots. Children then completed unrelated tasks, including choosing a gift as a token of appreciation for participating in the session, and returned to their classroom. After the child left the room, the experimenter measured the amount (in grams) the child had eaten. This amount served as our dependent variable.

2.2 Results and Discussion

Children played longer when they were told they had limited time to play. On average, children played 494.04 seconds

FIGURE 2: Carrots served in Study 1.

FIGURE 3: Smiley scale used in Study 1. Labels were verbally communicated to children by the experimenter.

(SD = 133.74) in the limit condition in comparison to 389.50 seconds (SD = 194.09) in the control condition (t (49) = 2.23, p = .015, one-tailed, d = .63). We obtain similar results using log of play time (t(49) = 2.43, p = .0095, one-tailed).

This analysis treats children who did not stop playing by the 10 minute mark as children who played for 600 seconds. About 44% of the children in the limit condition and 35% in the control condition hit the 10 minute mark. Because play time is "censored from above" at 600 seconds, we also consider a Tobit regression to account for the censoring and obtain similar results (t = 1.85, p = .035, one-tailed).

Children also ate more carrots when they were told the supply of carrots was limited. On average, children ate 33.76 grams (SD = 12.08) in the limit condition in comparison to 21.84 grams (SD = 16.54) in the control condition (t(48) = 2.91, p = .0025, one-tailed, d = .82).[4] We get similar results using log of grams (t(48) = 2.94, p = .0025, one-tailed).

The percentage of children who ate all 42 grams was also higher in the limit condition with 56% of the children eating all carrots in the limit relative to 36% in the control. As with the Lego task, because consumption is "censored from above" at 42 grams, we also consider a Tobit regression to account for the censoring and obtain similar results (t = 2.45, p = .009, one-tailed).

To confirm that the time-limit manipulation had no effect on carrot consumption, we conduct an ANOVA with the

[4]One child noted she did not want to eat at all prior to receiving the message from the experimenter. This child was not included in the analysis.

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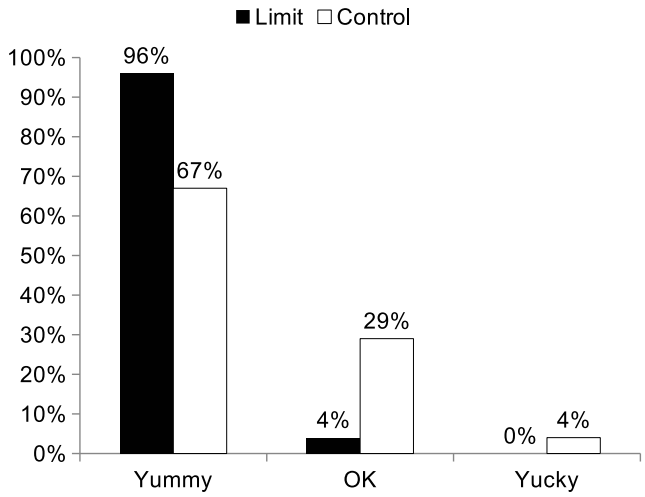

FIGURE 4: Children judge carrots as yummier when carrots are less available.

time-limit indicator (limit vs. control), quantity-limit indicator (limit vs. control), and their interaction as the independent variables and the amount of carrots consumed as the dependent variable. The effect of the quantity-limit manipulation remains significant (F (1, 46) = 8.04, p = .007), but the effect of the time-limit manipulation and the interaction between the two are not (p's > .7).

Children also judged the carrots to be yummier in the limit condition. Figure 4 indicates that about 96% of the children in the limit condition rated the carrots as Yummy and only 4% as OK, relative to 67% who rated the carrots as Yummy, 29% who rated them as OK, and 4% as Yucky in the control condition ($\chi^2(2) = 7.08$, p = .029; one child did not provide ratings). We obtain similar results when analyzing the ratings as a 5-point-interval scale (limit condition: Mean = 4.92, STD = .40; control condition: Mean = 4.25, STD = 1.15; $t(47) = 2.74$, p =.009, d = .78). This result suggests children in the limit condition may have perceived the carrots as tastier, an indication they may be more inclined to eat carrots in the future.

3 Study 2: Limited availability influences consumption ratios

Study 1 established that when an activity is positioned as limited in time, children engage in it longer, and when a single food is positioned as limited in quantity, children consume more of it and rate it as tastier. Study 2 tests whether similar cues influence children's consumption ratios when offered a plate with two food types similarly to real-life settings in which a food plate contains several items. Based on Study 1, we expected that positioning a particular food type as limited in quantity would increase its consumption relative to the other food type. The two food types we used were crackers and carrots, because we wanted to contrast a healthy item (carrots) with an item children prefer to the healthy item (crackers), and test whether positioning the healthy item as less available increases its consumption.

To test whether children indeed prefer crackers to carrots, we conducted a pretest with a separate group of 30 four- to five-year-old children from the same preschool in which the main study was conducted. We offered these children a choice between two snacks to eat: 12 petite baby carrots or 12 crackers. About 70% of the children chose the crackers (p = .02, binomial test against 50%), indicating a preference for crackers. Note that preference for crackers over carrots can also be inferred from the consumption ratios in the control condition of the current study, as shown below.

3.1 Method

Fifty-one children (mean age = 61.27 months, SD = 4.00; 51% female) were invited to participate in this study. The study had two conditions, and children were randomly assigned to one of them.

When the child entered the experiment room, the experimenter greeted the child and played with her at the experimenter's table for a few minutes. The experimenter then invited the child to eat a snack, which was composed of 40 grams of petite baby carrots and 40 grams of crackers put together on a plate (Figure 5), at another table.[5] The experimenter said, "Now, we have a snack for you to eat. You can eat as much or as little as you want." In the control condition (N = 29), the experimenter continued, "We have crackers and we have carrots." In the limit condition, she said instead, "We have crackers and we are almost out of carrots." The experimenter concluded by saying in both conditions "When you are done, just let me know." The experimenter then returned to the experimenter's table in order to minimize the interaction between the experimenter and the child while the child was eating.

When the child finished eating, she returned to the experimenter's table. To test whether children recognized the carrots as limited in quantity in the limit condition but not in the control, the experimenter asked the child, "Do you think we have more carrots?" and "Do you think we have more crackers?" Children then completed several choice tasks, received a gift as a token of appreciation for participating in the session, and returned to their classroom. After the child left the room, the experimenter measured the amount (in grams) the child had eaten of each snack.

[5]Since a single petite baby carrot weighs more than a single cracker, there were fewer carrots than crackers on the plate. This was kept consistent across the limit and control conditions.

https://doi.org/10.1017/S1930297500002928 Published online by Cambridge University Press

FIGURE 5: Food served in Study 2.

3.2 Results and Discussion

Children's responses to the question about whether there are more carrots indicate they perceived carrots as limited in quantity in the limit condition but not in the control. About 68% of the children said they thought there were no more carrots in the limit condition compared to only 28% in the control condition ($\chi^2(1) = 8.33$, $p = .004$). Moreover, the majority of children in both conditions did not perceive the crackers as limited in quantity. Only 28% of the children in the control and 23% in the limit condition said they thought there were no more crackers ($p > .6$).

When analyzing children's consumption, we find that the ratio of carrot consumption to total consumption is larger in the limit condition than in the control condition. Specifically, for each child, we divide carrot consumption in grams by total consumption in grams. The resulting average ratio is larger in the limit condition ($M_{limit} = .52$, SD = .31) than in the control condition ($M_{control} = .35$, SD = .31; $t(49) = 1.99$, $p = .026$, one-tailed, d = .55). Thus, children in the limit condition consumed on average 0.52/(1–0.52) = 1.08 grams of carrots for every gram of crackers, whereas children in the control condition consumed on average only 0.35/(1–0.35) = 0.53 grams of carrots for every gram of crackers.[6] We find no significant difference in total consumption across conditions. On average, children ate a total of 37.05 grams in the limit condition relative to 34.38 in the control ($p > .7$).

There is also a surprising difference in children's consumption behavior across conditions. Children in the limit condition were more likely to begin by eating a carrot than in the control condition. Specifically, about 64% of the children in the limit condition began by eating a carrot in relative to 34% in the control $\chi^2(1) = 4.27$, $p = .019$, one-tailed).

[6]Because two children (one from each condition) did not eat crackers, we cannot compute the ratio of carrot to cracker consumption for each child and then average the ratios.

To summarize, although the manipulation did not affect consumption in absolute terms, it increased the ratio of carrots consumed and the likelihood that children ate a carrot first.

4 Study 3: Limited availability triggers the choice of a less preferred snack

Studies 1 and 2 examined the effect of limited availability on engagement and consumption. Study 3 examines whether limited availability has a similar effect in choice contexts.

To create limited availability in the context of choice, we offered children a choice between containers of grapes and containers of crackers, and we manipulated the frequency of the containers in the choice set. The control condition, in which the choice set included an equal number of grape and cracker containers, enabled us to elicit the intensity of the baseline preferences for grapes versus crackers. The grapes-limited condition, which had fewer grape containers than cracker containers, enabled us to test whether limited availability could override these preferences. Two experimenters, blind to the research hypotheses, collected the data. No effects involving the experimenters were found.

4.1 Method

Fifty-six children (mean age = 56.9 months, SD = 3.99, 48% female) participated in a session that involved several tasks. The first task was to choose a snack to take home. The task had two conditions, and children were randomly assigned to one of them.

When the child entered the experiment room, the experimenter greeted the child and offered her to choose a snack to take home. Two types of snacks were available for choice: a small container with grapes and a small container with crackers. Twenty-seven children were assigned to a control condition, in which the choice set included four containers of grapes and four containers of crackers. This condition aimed to identify children's baseline preferences among crackers and grapes. The rest of the children were assigned to the grapes-limited condition in which the choice set included two containers of grapes and six containers of crackers. This condition aimed to examine whether limiting the availability of grape containers would increase the proportion of children choosing a grape container. In both conditions, the containers were placed in a row on a table (See Figure 6 for an illustration). We used 5.5-ounce clear plastic containers. Given the different density of crackers and grapes, a grape container had about 90 grams of grapes, and a cracker container had about 30 grams of crackers.

https://doi.org/10.1017/S1930297500002928 Published online by Cambridge University Press

Grapes limited

Control

FIGURE 6: Choice Sets Used in Study 3.

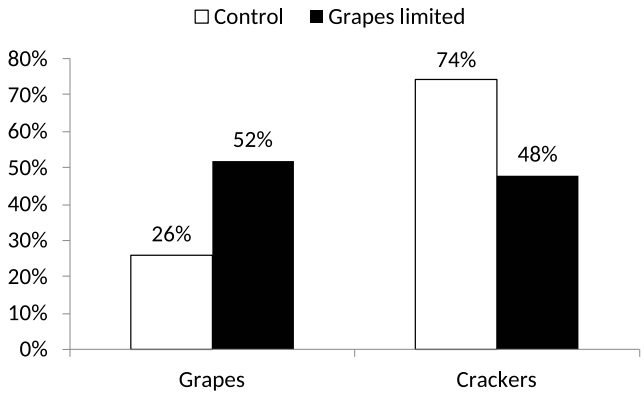

FIGURE 7: Children choose grapes when grapes are less available.

After the child made a choice the experimenter recorded which container the child chose, and this served as our dependent variable. The child then completed several tasks,[7] received the chosen snack container as a gift, and returned to the classroom.

4.2 Results and Discussion

Children's choices in the control condition indicate a preference for crackers over grapes. Specifically, about 74% of the children chose crackers in the control condition ($p < .01$ in a binomial test against 50%). Assuming choice frequencies are a proxy for the intensity of preferences (see McFadden (1974) for the theory of discrete choice connecting preferences and choice frequencies), these choice frequencies (74% for crackers vs. 26% for grapes) suggest crackers are preferred to grapes.

Choice frequencies changed in the grapes-limited condition, in which the proportion of children choosing grapes doubled from 26% to 52% (Yates corrected $\chi^2(1) = 2.89$, $p = .044$, one-tailed, phi = .26; see Figure 7), suggesting limited availability may trigger children to choose a less preferred option.

A possible mechanism that may explain why children choose a grape container more often when it becomes less available is saliency. Because there are fewer grape containers in the grapes-limit condition, they may stand out relative to the cracker containers, and as a consequence, children may choose them more often. Note, however, that this mechanism cannot explain the findings of Studies 1 and 2.

5 General Discussion

This paper demonstrated that limited availability affects young children's food consumption, taste ratings, task engagement, and choice behavior. First, children played longer when a playing activity was positioned as limited in time (Study 1). Second, children ate more of a particular food and rated it as tastier when it was positioned as limited in quantity (Study 1). Third, children increased their consumption of a less preferred food over a more preferred one when the less preferred food became less available (Study 2). Fourth, children were more likely to choose a less preferred option over a more preferred one when the former became less available (Study 3).

These findings have several implications. First, they highlight the potential for limited availability to lead to preference reversals. In Study 2, children had a preference for crackers over carrots, and in Study 3, for crackers over grapes. In both cases, positioning the less preferred object as less available, either through verbal cues (Study 2) or visual cues (Study 3), increased its consumption or choice frequency to about the same level of the more preferred object.

Second, the findings may be relevant for devising practical strategies to enhance children's decision making. Our experimental design focused on tasks children are familiar with and conduct on a daily basis. It involved simple cues parents can easily implement such as changing the frequency of options in a choice set or merely saying a certain food is limited in quantity. We demonstrated that these simple cues affect children's behavior, leading them to consume healthier food and engage longer in an activity.

Third, the findings indicate that the common practice of parents and caregivers to limit children's consumption of sweets or screen time embodies a non-trivial tradeoff. Although this practice can be effective in reducing the intake of sweets and screen time, it potentially has the unwanted effect of increasing the attractiveness of sweets and screen time.

It remains an open question why limited availability leads to increased desirability among children. One reason adults may place higher value on less available products is the positive sense of uniqueness and exclusivity owning such products can create (Berger and Heath 2007; Chan, Berger & Van Boven, 2012; Lynn, 1989; Lynn & Snyder, 2002). It seems

[7] In these tasks, children chose accessories for dolls as part of a study on gender differences.

https://doi.org/10.1017/S1930297500002928 Published online by Cambridge University Press

less likely that young children view less available products as more desirable due to uniqueness seeking, because concerns about self-reputation and uniqueness develop at a later age (Belk, Mayer & Driscoll, 1984; Chaplin & John, 2005; John, 1999). Another reason adults may view less available products as more desirable is that people may interpret the limited supply of a product as a signal of strong demand for the product and hence its high quality (Caminal & Vives 1996; Kardes, Posavac & Cronley, 2004; Van Harpen, Pieters & Zeelenberg, 2009; Worchel et al. 1975). This mechanism also seems less likely to operate among young children because their understanding of supply and demand forces is still developing (Thompson & Siegler, 2000; Webley, 2005).

It is possible that young children view less available products as more desirable simply due to fear of missing out (John et al. 2018). Another possible mechanism that may operate among young children is psychological reactance (Brehm, 1966; Brehm et al. 1966), which posits that when an individual's freedom is threatened, such as in the form of limiting the availability of certain options, the value the individual places on that freedom increases (Brehm, 1966; Brehm et al. 1966). Future research can look into exploring in detail the mechanism triggering children to view less available objects as more desirable.

Another open question is whether the findings will extend to domains in which children have stronger preferences. For example, it is possible that contrasting fruits and vegetables with sweets that children prefer to crackers will weaken the limited availability effect. We did not conduct such manipulations because of health and ethical considerations.

Future research may also study the effect of limited availability in other age groups, especially younger children. Because some of our manipulations involved simple visual cues, these manipulations and similar ones are age appropriate even with one- and two-year-old children. Documenting the effect with younger children would have practical implications given the importance of establishing healthy eating habits at as young an age as possible (Dovey et al. 2008; Nicklaus, 2009; Nicklaus et al. 2005), and the long-lasting effects of food-related manipulations on preferences (Albuquerque et al. 2018; Connell, Brucks & Nielsen, 2014).

Finally, it would be interesting to study whether limited availability can affect children's tendency to experiment and explore. The tendency of children in Study 2 to eat carrots before crackers when carrots were positioned as less available hints that children may be more likely to try an unfamiliar food or engage in a new activity when the food or the activity is positioned as less available. The potential to influence children's exploration and experimentation in this way cannot be underestimated.

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