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# Color and abundance: Influencing children's food choices

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ABSTRACT

Packaging color and product availability are factors influencing consumer preferences. However, their impact on children's choices is scarce. The current research examines whether the size of the set of items and the packaging color might shape children's choices. In three experiments (N = 887), we investigated the effect of these two variables on children's choices of food items in a laboratory setting. The results showed that food items provided in larger piles of identical products were preferred to those provided in smaller piles of identical products, even though children could only choose one item to take away, showing evidence of an "abundance bias". In addition, food products packaged in red were preferred to those packaged in green. A moderation effect was also observed whereby children preferred red-packaged items more when offered within a larger group of identical items (abundance) and less when offered within a smaller group of identical items. The findings provide insight into the psychology of color and abundance as choice attractors in children's consumer preferences for food products.

## 1. Introduction, theory, and hypotheses

Food packaging influences consumers' preferences in many ways (Grier & Davis, 2013; Hawkes, 2010; Spence & Van Doorn, 2022; Spence & Velasco, 2018). For instance, the pile size – the number of items in a set – has been shown to be influential in younger children's preferences (Van Loosbroek & Smitsman, 1990). When infants as young as five months old were presented with displays containing 0, 1, 2, or 3 objects, they showed a preference (i.e., they look more) for larger sets than smaller ones (Cohen & Marks, 2002). This might imply an innate preference for larger pile sizes over smaller ones, irrespective of product type. The authors write that "infants should look more when there is more to look at, i.e., when there are more objects on the stage" (Cohen & Marks, 2002, p. 193). This attentional bias toward larger sets could be instrumental in directing the choice toward sets that contain larger amounts of food, which would be of value in terms of survival. Indeed, infants as young as 10–12 months are known to prefer containers with more crackers (Feigenson et al., 2002).

Although past research indicates that children tend to prefer larger sets (Cohen & Marks, 2002), the question of whether this preference extends to cases where they are allowed to select only one item from the set remains unexplored. Replicating the effect of pile size within this context (of choosing a single product) would be significant. If confirmed, it would suggest that the abundance cue serves as a fundamental attractor, regardless of whether an individual personally benefits (i.e., obtain more products for themselves) from a larger set. An interesting practical application of the abundance effect can be observed in the allocation of shelf space. When displaying products in the retail marketplace, sellers need to make a crucial choice: should they showcase smaller quantities of a product than others or should they exhibit the same quantity for each product? According to the abundance hypothesis (Cohen & Marks, 2002), more products would be sold if offered within larger groups of items (i.e. a large pile of products) than if made available within smaller groups of items (i.e. a small pile of products). Preferring products from larger sets would be irrational when one can take away only one product; thereby, one could use the term abundance bias to denote the abundance effect within this context.

Apart from pile size, color packaging has been also found to influence food taste (Piqueras-Fiszman & Spence, 2015; Spence, 2011; Spence et al., 2010). Popcorn offered in red packaging was rated as sweeter than that offered in blue, yellow, or white packaging (Wang & Chang, 2022), and chocolate in black packaging triggered consumers' expectations of bitterness more than other colors (Baptista et al., 2021). The reason why color can change the perceived tastiness of foods might be tracked back

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to ancestral human motives (Foroni et al., 2016; Wallace, 1879; Walsh et al., 1990).

Although packaging color has been generally acknowledged as a significant influence on food preferences in adults (Spence & Van Doorn, 2022; Spence & Velasco, 2018), few studies have examined whether it influences food preferences also in children. Differently from adults, children are influenced more by "surface" cues (e.g., brand name) than "deep" cues (e.g., category similarity). Indeed, children rely on dominant perceptual features (color and size) when assessing products and brands (Macklin, 1996; Zhang & Sood, 2002). In line with this view, in a study in which cereal, cookies, and beverages were packaged in different colors, children aged 3–5 years chose the product with their favorite color, irrespective of the product type. For example, if a child's favorite color were pink, they would choose products in pink packaging (Marshall et al., 2006). As a result, children's choices seem to be triggered more by dominant perceptual surface cues (Zhang & Sood, 2002) such as the preferred color. Following the dominant perceptual surface cue, children simply chose the product packaged in the color they preferred, regardless of the type of product they were considering.

Following the presented literature, the current research examines whether the size of the set of items and the packaging color might shape children's choices. In the present study, we tested whether children showed a preference for larger sets even when they are limited to selecting only one product to take away. We hypothesized that children would prefer to pick a food item from a larger set of identical items rather than a smaller one (first hypothesis). We also examined how packaging of different colors (packaging color) can change children's choices of food products. In particular, in line with previous literature where food items with a red-packaged color were expected to be sweeter and tastier than those packaged in cold colors (Ares & Deliza, 2010; Rebollar et al., 2012; Tijssen et al., 2017), we hypothesized that red would make food products more attractive than green (second hypothesis). Finally, we investigated how the combination of pile size and packaging color influenced children's choices. According to the literature on dominant perceptual surface cues (Zhang & Sood, 2002) and the "set-size effect" (Cohen & Marks, 2002), we hypothesized that children would prefer foods packaged in red over foods packaged in green more when the former were offered within a larger group of identical items than when they were offered within a smaller group of identical items, thereby showing an "additive" effect of both factors (third hypothesis).

In three experiments, we tested this set of predictions in the following order: Experiment 1 tested the effect of pile size; Experiment 2 investigated children's preference for packaging color, and, finally, in Experiment 3, we tested the combination of the two effects.

Each participant was involved in only one experiment and allowed to choose only one item. Our experimental investigation involved children in grades three to six. We did not explicitly ask the age of the participants since it could appear to be unusual to ask for only that personal information and in turn might shift attention from the main task. The University Committee approved all activities as a unique project to ensure scientific and ethical validity. The project was realized in different phases between 2016 and 2018. The software R (version 4) was used for data analysis (R Core Team, 2023).

## 2. Experiment 1

In Experiment 1, we tested our first hypothesis that, following the set-size effect (Cohen & Marks, 2002), children would prefer to pick a food item from a larger set of identical items rather than a smaller one, despite being allowed to take away only one food item. This preference would confirm the existence of an abundance bias, where the abundance cue acts as a basic attractor, irrespective of any tangible personal benefit, obtaining more products for oneself.

### 2.1. Methods

A total of 617 children (51% females; mean grade level: 4 (SD = 1)) were tested in Experiment 1. All participants were recruited among children attending the 2016 and 2017 University for Children event at the University of Piemonte Orientale, an activity which typically takes place in September at the University of Piemonte Orientale, as a part of the European Researchers' Night promoting science among the public. The pupils were accompanied by their teachers.

Experiment 1 employed a design in which the number of available products (set-size: small vs. large) was systematically varied by presenting children with two groups of identical food products each, but different in quantity. Each set contained products in one of two set-size types (small or large) and was offered on one separate but adjacent desk. Despite always including a larger and a smaller pile size, the number of products in each set was not identical in all sessions. The small pile size varied between 3 and 8 paper sacks. The large pile size varied between 25 and 42 paper sacks. All products were packaged in the same white paper sacks. One desk, therefore, had many white paper sacks. In contrast, the other one had fewer white paper sacks. The products were paper sacks filled with a snack cake and a drink (i.e., a juice box or a small milk carton, depending on their availability: a limited quantity of milk cartons, used during the University for Children, was donated by local companies for the event; whereas (long-lasting) juices were purchased and used during the remaining sessions conducted at the University for Children (and in the school sessions of Experiments 2 and 3)—please note that children did not know in advance the type of drink used in the session they participated in, nor they can have seen other children with a different drink since the same one was used in each session). Before choosing, children were instructed that the paper sacks contained a snack and a drink and that the content was "identical" (Experiment 1a) or "similar" (Experiment 1b) in all of them. The participants were involved in only one experiment.

The pile size was counterbalanced for left- and right-side presentation in both experiments. Participants were tested individually and instructed to choose a paper sack from one of the two desks. The chosen one was given to them as a reward for participation in the experiment. Children were allowed to choose only one item. The experimental setting is represented in Fig. 1.

### 2.2. Results and discussion

As illustrated in Table 1, children in Experiment 1 systematically preferred the product from the larger food set in both Experiment 1a, *z-test* (1, n = 131) = 19.08, p <.001, and Experiment 1b, *z-test* (1, n = 486) = 45.68, p <.001.

These findings confirm the set-size effect for food products: products presented within a larger set are more attractive than those in smaller ones. This hold true even despite children being allowed to take away only one food item, confirming that the abundance cue acted as a basic

**Fig. 1.** Desks as displayed to children in Experiment 1.

**Table 1**
Product choices by participants in Experiment 1.

| | n | % | n | % | z-test[1] |
|---|---|---|---|---|---|
| | Smaller set-size | | Larger set-size | | |
| (a) "Identical" food items | 40 | 30.53% | 91 | 69.74% | 19.08 *** |
| (b) "Similar" food items | 168 | 34.57% | 318 | 65.43% | 45.68 *** |

[1] is one proportion z-test against 50–50 expected distribution (Binomial tests were computed when N < 30).
*** p >.001.

attractor (abundance bias), irrespective of any personal benefit.

A binary logit regression (dependent variable = 1 for large) was also run, which yielded a significant effect of grade level ($B$ = -0.25, SE = 0.08, Wald = 8.9, p <.01). The positive log odd of the grade level suggests that the set-size effect was stronger for younger children and less strong for older ones: the younger they were, the more they preferred to take the paper sack from the larger set. No significant effect was found for gender.

## 3. Experiment 2

Experiment 2 tested our second hypothesis that children will prefer products packaged in red rather than green when they are choosing between two food items.

### 3.1. Methods

A total of 59 children participated in the study (42% females; mean grade level: 3 (SD = 1)). Participants were recruited on a voluntary basis. More specifically, 39% of participants were pupils attending the 2018 "University for Children" event. The remaining 61% were enrolled in schools in three provinces of the Piedmont region of Italy (i.e., Alessandria, Turin, and Cuneo). Sessions were conducted in February and in June 2018 during school hours. In both samples, the pupils were accompanied by their teachers, and their parents were absent.

In Experiment 2, participants were asked to choose between two types of items packaged in a different color (i.e., red vs. green). Namely, children chose one sack from within two sets of 25 products each: a set of red-packaged products and a set of green-packaged products. Each product group was placed on a separate desk, and the two desks were adjacent. The products were paper sacks filled with a snack cake and a drink (i.e., a juice box or a small milk carton, depending on their availability—please refer to Experiment 1). One desk, therefore, had 25 red paper sacks, whereas the other one had 25 green paper sacks. Before choosing, children were instructed that the paper sacks contained a snack and a drink and that the content was identical in all of them. The packaging color was counterbalanced for left- and right-side presentation. Participants were tested individually and instructed to choose a paper sack from one of the two desks. The chosen one was given to them as a reward for participation in the experiment. Children were allowed to choose only one item. The experimental setting is represented in Fig. 2. None of the participants contributed to Experiments 1 or 3.

### 3.2. Results and discussion

Table 2 reports the number of product choices and percentages by color (red vs. green). In this experiment, 38 out of 59 children (64.41%) selected the red-packaged food product over the green one, *z-test* (1, n = 59) = 4.34, p <.05, when choosing between the two food items.

As hypothesized, children significantly preferred food products packaged in red. This is in line with our hypothesis that red exerts greater attraction than green for children when associated with food because, as in previous literature, food items with a red-packaged color are presumably associated with more pleasant tastes.

We also analyzed data using a binary logit regression (dependent variable = 1 for red); however, no significant effect was observed for the socio-demographics characteristics (gender and grade level) and the location of the experiment (university vs. school).

**Fig. 2.** Desks as displayed to children in Experiment 2.

**Table 2**
Product choices by participants in Experiment 2.

| | n | % | n | % | z-test[1] |
|---|---|---|---|---|---|
| | Red | | Green | | |
| Product choice | 38 | 64.41% | 21 | 35.59% | 4.34* |

[1] is one proportion z-test against 50–50 expected distribution (Binomial tests were computed when N < 30).
* = p <.05.

## 4. Experiment 3

In previous experiments, children preferred to take away a food item that was part of a larger group of identical items than one that was part of a smaller group of identical items (Experiment 1) and they preferred to take away a red-packaged food item rather than a green-packaged one (Experiment 2). In Experiment 3, we combined the two effects in order to test the (third) hypothesis that abundance would exert greater effect if coupled with red-packaged color, than if coupled with the green-packaged color. Indeed, the set-size effect (Cohen & Marks, 2002), confirmed in Experiment 1, suggests that larger sets of products should be preferred over smaller sets of products. Moreover, the third hypothesis suggests that children will prefer red-packaged items over green-packaged ones, as confirmed in Experiment 2. We wished to further support these results in Experiment 3 by combining packaging color and set-size effect to test for their interaction. Specifically, we predicted that children would prefer the food items part of larger sets rather than smaller ones, and this preference would be stronger when the larger set items are red-packaged than when they are green-packaged.

### 4.1. Methods

In Experiment 3, 211 children completed the experiment (50% females; grade level: 3 (SD = 1)). Most of the sample (47%) was recruited within the 2018 University for Children event, while the remaining (53%) were recruited in schools in the provinces of Alessandria and Turin in May and in November 2018. The pupils were accompanied by their teachers.

Experiment 3 employed a series of experiments in which the number of available products (pile size: small vs. large) and the packaging-color type (red vs. green) were systematically varied. The participants were involved in only one experiment. In Experiments 3a, they could choose one item either from a large set of red paper bags or a small set of green

paper bags. In Experiments 3b, they could choose one item either from a large set of green paper bags or a small set of red paper bags. In both Experiment 3a and 3b the same food products employed in Experiment 1 and 2 were used. The small set contained eight paper sacks, while the larger one contained 42 sacks. All levels of the factors were counter-balanced for left- and right-side presentation. Participants were tested individually and instructed to choose a paper sack from one of the two desks. The chosen one was given to them as a reward for participation in the experiment. Children were allowed to choose only one item. None of the participants contributed to Experiments 1 or 2. The experimental setting is represented in Fig. 3.

### 4.2. Results and discussion

Results showed that children preferred the food item packaged with red over the food item packaged with green, *z-test* (1, n = 104) = 25.01, p <.001, but only when the foods packaged in red were part of a larger set and those packaged with green were part of a smaller one (Table 3; Experiment 3a). On the contrary, the packaging-color effect was not observed when the large set was associated with green (Experiment 3b), *z-test* (1, n = 107) = 0.93, p <.33. As hypothesized, the effect of packaging color and the effect of pile size had an additive impact increasing the chances that children chose the red packaged food item from the larger set. Furthermore, no significant effect was found for gender, grade level, and location of the experiment by using a binary logit regression analysis (dependent variable = 1 for red).

**Table 3**
Product choices by participants in Experiment 3.

| | n | % | n | % | z-test[1] |
|---|---|---|---|---|---|
| | Red | | Green | | |
| (a) Red large set (8 green vs. 42 red) | 78 | 75.00% | 26 | 25.00% | 25.01*** |
| (b) Green large set (8 red vs. 42 green) | 59 | 55.14% | 48 | 44.86% | 0.93*n.s.* |

[1] is one proportion z-test against 50–50 expected distribution (Binomial tests were computed when N <30).
*** p >.001; *n.s.* not significant.

## 5. General discussion and conclusions

In three experiments, we explored the possibility that children's preferences for food items would be shaped by the number of available items and the packaging color.

Consistent with developmental studies on the preference for larger sets (Cohen & Marks, 2002), we found that presenting a food item in an abundant group (i.e., which included a larger number of identical items) increased the attractiveness of that item. This was true even though the children could only take one item away, especially for younger children. It has been suggested that the bias in favor of larger sets could be useful in directing choice toward sets that contain larger amounts of food, increasing the chances of survival (Cohen & Marks, 2002). This finding denotes an automatic decision tendency – a bias – in favor of abundant food sets. At a speculative level, one could say that the evolutionary sustained attraction effect toward abundance is meaningful for food (more food, more chances to survive). The observed positive correlation between grade level and preference for taking the paper sack from the larger set is consistent with the notion that younger children may rely more heavily on instinctive decision-making processes.

As predicted by a vast literature on the effect of packaging color on consumer choices (e.g., Spence & Van Doorn, 2022), we found that red increased the attractiveness of food items in our study, presumably because it induced a higher expectation of sweetness and tastiness (Ngo et al., 2013; Spence & Parise, 2012; Woods & Spence, 2016; Woods et al., 2013). In line with this finding, previous evidence showed that red increased the attractiveness of chewing gums and ice-creams (Rebollar et al., 2012) and triggered the expectation of sweetness (Spence et al., 2015; Velasco et al., 2015). As already anticipated in the introductory section, the interaction between the packaging colors and the product is likely triggered by the expectation of a taste induced by some colors (sweet with red or pink, salty with white or blue, etc.). Our findings extend the attractive effect of the red color to children food choices.

Finally, we also showed that the two factors have an additive effect: when abundance was coupled with red, the preferences for the food item increased the more than when it was coupled with green, in our study.

It is interesting to note that colors can be classified as warm or cold. The warm colors include colors of long-length waves (red, pink, and yellow), and the cold colors include those of short-length waves (i.e., blue, purple, and green). Warm colors are usually associated with sweeter and more pleasant tastes than cold colors. For example, dessert and milk drinks presented in a yellow or red packaging were expected to be sweeter and tastier than equivalent products presented in a black, purple, or blue packaging (Ares & Deliza, 2010; Tijssen et al., 2017). Chewing gums packaged in a warm color were expected to be sweeter, fruitier, and more acidic than those packaged in cold colors (Rebollar et al., 2012). Therefore, it is not surprising that red-packaged items significantly influences product choices when dealing with food as in the present study (Spence & Van Doorn, 2022; Spence & Velasco, 2018).

There are alternative possible explanations for the effects found in this study. In particular, preference for symmetry (Turoman et al., 2018) can be another possible reason for our findings. More specifically, selecting the sack from the abundant food set can reduce the impression of asymmetry, at least in subjects having this behavioral preference.

Overall, this study shed light on the psychological mechanisms that underpin the influence of superficial or heuristic cues on children's food choices. The findings also carry several practical implications. They


**Fig. 3.** Desks as displayed to children in Experiment 3 for the red large set (A) and small set (B). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

show that basic cues, such as the number of available items or packaging color, can significantly influence children's food choices. Unhealthy food products could, therefore, be easily marketed to children using these effects, given their greater vulnerability to such heuristic cues. Our study confirms that making a food product more available increases children's tendency to choose it (Grier & Davis, 2013), following an automatic and heuristic process. If increasing the numerosity of a product stimulates preferences, decreasing its availability might be a good strategy to reduce the consumption of unhealthy or unwanted foods. Identifying which factors influence children's food product preferences is important to discourage poor-quality diets that lead to unhealthy eating, a major health issue in younger consumers worldwide (Ng et al., 2014). Advocates from different fields have indeed urged for marketing restrictions on unhealthy food to youth (e.g., Hawkes, 2007). Traditional public health strategies, such as taxation and restrictions to child-targeted marketing, can be complemented with design strategies, such as packaging cues (Johnson et al., 2012; Wansink & Chandon, 2014) or availability of healthy food (e.g., Grier & Davis, 2013), as suggested by our findings. Food companies may already be familiar with packaging color cues and set-size effects, since they may rely on different types of data, and use these elements in conceiving their products, healthy or not. In this framework, research findings from academia results, which are increasingly public, may be informative for policy-makers in order to ensure that information about the factors influencing children's food preferences can be used for their well-being.

One limitation of the present research is that we did not take account of the color-blindness which may have prevented some children from accurately evaluating the colors in Experiment 2 and 3. Furthermore, several relevant issues remain to be investigated in future research. For instance, the psychology of color and abundance as choice attractors in children's consumer preferences for non-food products should also be investigated. Moreover, the preference for healthy and non-healthy food may also be tested using red- and green-packaged items. The preference for asymmetry mentioned before should be further examined as well as the possibility of an empathetic feeling towards other's chance to select the preferred color that may have influenced the set-size effect. Finally, the size of the single paper sack may have a role in participants' choice in the first experiment. To assess this possible relationship, the use of fewer sacks of larger size should be explored. In the meantime, the present findings tried to provide useful insight into the psychology of pile size and packaging color in children's consumer preferences for food products.

## CRediT authorship contribution statement

**Valeria Faralla:** Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing. **Lucia Savadori:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Luigi Mittone:** Conceptualization, Methodology, Writing – review & editing. **Marco Novarese:** Conceptualization, Methodology, Writing – review & editing, Funding acquisition. **Antonella Ardizzone:** Investigation, Writing – review & editing, Funding acquisition.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

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