Do children think others should avoid wasting resources?

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Abstract

People tend to avoid wasting resources, but little is known about when this emerges in development. Though young children are often wasteful with food and other items, previous work suggests that children consider waste in other judgments. Here, we examined if children anticipate that others should minimize waste. In two experiments (total N = 195), children chose which of two foods someone should eat (Experiment 1; 3-7-year-olds) or two papers someone should make a snowflake with (Experiment 2; 5-year-olds). One of the options would result in minimal waste (i.e., a small food/paper) while the other would result in greater waste (i.e., a large food/paper). Children did not anticipate that others would choose smaller foods, however, at around five years they predicted that others would choose smaller paper. These findings contribute to our knowledge of the development of waste aversion and may extend our understanding of waste aversion as a form of efficiency.

Keywords: waste aversion; waste reduction; cognitive development

Introduction

Imagine that you are at a dinner party, and you are being served Greek salad. You hate olives but are willing to eat the rest of the salad and plan to throw the olives away. There are two bowls to choose from: one with two olives in it and the other that has twelve. Which bowl should you choose?

You probably think you should pick the bowl with fewer olives because less food will be wasted. People tend to believe it is wrong to waste food and resources, and they try to avoid appearing and feeling wasteful (Bolton & Alba, 2012; Choshen-Hillel et al., 2015; Moore & Taylor, 2010; Neff et al., 2015; Zultan et al., 2010). People even make irrational choices in order to avoid feeling wasteful. For instance, people persist in a failing project in order to avoid the feeling that their initial investment went to waste (Arkes, 1996; Arkes & Blumer, 1985; for an exception with children, see Sehl et al., 2021). However, though waste aversion is a fairly widespread value, there are cross-cultural differences. Some cultures have stronger attitudes about waste (Inglehart et al., 2014; see also Gammoh et al., 2019) and even seek to minimize waste more than other cultures (Mintz et al., 2019).

Though adults are averse to wasting resources, little is known about the development of waste aversion in childhood. Children can often be quite wasteful— taps are left on when not in use, food is left uneaten after meals, masses of toothpaste are poured down the drain, and chocolate chips are picked out of pancakes that are left to be discarded. Indeed, almost half of the food served in school cafeterias is wasted (Byker et al., 2014), and food waste in households is largely attributed to children (Williams et al., 2012). Understanding the development of waste aversion has clear implications for environmentalism and conservation efforts, especially for the design of interventions aimed at reducing waste in the home and community (e.g., Boyd, 2020; Piras et al., 2023). If children are insensitive to wasted resources themselves, they might not think that others should avoid waste. So, children may not see why you should choose the salad with fewer olives.

Alternatively, children may see the waste in choosing the bowl with lots of olives and may recognize this as undesirable. Recent work shows that children make social evaluations based on waste. In one study, children watched two agents put away their leftover food: one was wasteful and threw theirs in the garbage, and the other was not wasteful and put their leftover food in the fridge. By age five, children like others less when they waste food, and by age ten children share less food with those who waste (Sorokowska et al., 2020). Though this work suggests that children may see waste as undesirable, an alternative explanation is that children used a simple location-match heuristic. Children may have preferred the less wasteful agent simply because their food ended up in the correct location (the fridge), not because they avoided waste.

Additionally, findings in resource allocation studies show that children may value minimizing waste in their own choices. In one study, six- to eight-year-olds distributed resources amongst two characters who did equally well at a task. There were an odd number of resources, so children decided whether to distribute the remainder unequally (such that one of the two characters had more than the other) or to

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throw the remainder away. Children were more willing to throw away low-value resources (like erasers) than high-value ones (like $20 bills) to avoid an inequitable allocation of resources (Choshen-Hillel et al., 2020; for related work see Shaw & Olson, 2012; 2014; Shaw, 2013; Zhang & Benozio, 2021), suggesting that children may avoid waste when resources are valuable and desirable. However, children's reluctance to throw out desirable resources does not necessarily imply they believe that waste should be generally avoided. Instead, children might again think that valuable resources do not belong in the garbage. Further, children in these studies were age six years and older, so it is largely unknown at what age children prioritize avoiding wasted resources.

Finally, the development of the concept of efficiency may indicate that children are concerned about waste. Efficiency and waste are related—the more efficient a process or decision is, the less waste it generates. So, improvements in efficiency often involve reducing waste. Children consider efficiency when making inferences about artifacts and other people. For instance, preschoolers have adult-like inferences about efficient objects functions, like how easily they can perform their functions (Kelemen et al., 2012) and infer that someone is more competent if they complete a complex task at the same speed as someone who completed an easier task (Leonard et al., 2019). Further, infants even consider efficiency when observing others' actions. Twelve-month-olds look longer at an agent who took an inefficient route to a goal than an agent who took the most efficient route to a goal (Gergely et al., 1995; see also Gergely & Csibra, 2003; Liu & Spelke, 2017; Scott & Baillargeon, 2013), and even prefer to take more efficient paths themselves (Paulus & Sodian, 2015). And by age four, children predict that an agent will take an efficient path over an inefficient path towards a goal (Gönül & Paulus, 2021; see also Jara-Ettinger et al., 2015; Sehl et al., 2021).

Taken together, children could value waste aversion and seek to minimize waste in their own decisions. But might children expect that others will similarly be waste averse? For instance, if observing *someone else* choosing between two bowls of Greek salad, children may anticipate that this person will choose the smaller bowl to reduce the number of olives in the trash. Conversely, if children do not think that waste should be avoided, then they may not expect others to select courses of action that will conform to that rule.

Across two experiments, we investigated whether children feel that others should take courses of action that minimize wasted resources. Our sample included children from ages three- to seven-years-old to investigate the age when waste aversion develops. In Experiment 1, children predicted which of two foods a character should pick if the character only wanted one component of it (like the olives example). In Experiment 2, children made judgments in a similar scenario, but with a material resource to examine whether children's judgments about waste extend beyond judgments about wasting foods.

Experiment 1

Methods

Participants We tested 75 children: 15 three-year-olds (M_{age} = 3;6 [years;months], range = 3;0 – 3;11, 8 female), 15 four-year-olds (M_{age} = 4;6, range = 4;0 – 4;11, 7 female), 15 five-year-olds (M_{age} = 5;6, range = 5;0 – 5;11, 7 female), 15 six-year-olds (M_{age} = 6;7, range = 6;0 – 6;11, 6 female), 15 seven-year-olds (M_{age} = 7;4, range = 7;0 – 7;11, 5 female). Children were tested individually online in a live video call, in the presence of their parent or guardian. Parents were instructed to look down or to turn away from the screen while testing took place.

Materials and Procedure Children were first shown a photo of a girl and were told they were going to guess which things the character would pick. For each of two trials, the character was presented with a small food and a large food. Children were told that the character only wanted to eat one part of the food. In the first trial, the foods were cakes and the character only wanted to eat the decorative strawberries on top. In the second trial, the foods were pizzas and the character only wanted to eat the pepperonis. Notably, both foods had the same number of strawberries and pepperonis on top, so the only difference across both foods was their size. The experimenter then explained that the rest of the food that the

Figure 1. Images and script for Experiment 1.

character did not eat would have to go in the garbage. Children were asked which food the character should pick, and they responded by indicating the color box it was in.

The location of the foods was counter-balanced across trials (i.e., small food on the left in first trial and on the right in second trial). Colors were counter-balanced across trials. The smaller food was in the yellow box in the first trial, and the larger food was in the yellow box on the second trial.

The foods were identifiable by the color box they were in. A warm-up task was used to ensure children could refer to items on screen by indicating the color of its surrounding box. In the warm-up, children saw two trials in which a dinosaur appeared in different colored boxes. When asked where the dinosaur was, children typically identified its location by referring to the color box it was in. If they gave other responses (e.g., "right there" or "on the left"), they were prompted to refer to the dinosaur's location by using color.

Results

In both experiments, we analyzed the results using generalized estimating equation models (GEE; binary logistic, independent correlation matrix). In this experiment, age in months (mean-centered) was entered as a covariate. Children's responses were coded as 1 if they selected the smaller food and 0 for the larger food. There was no main effect of age, $F(1) = 2.58$, $p = .108$ (see Figure 2). A single-sample test (using an intercept-only GEE) revealed that children's responses did not differ from chance, $p = .205$.[1]

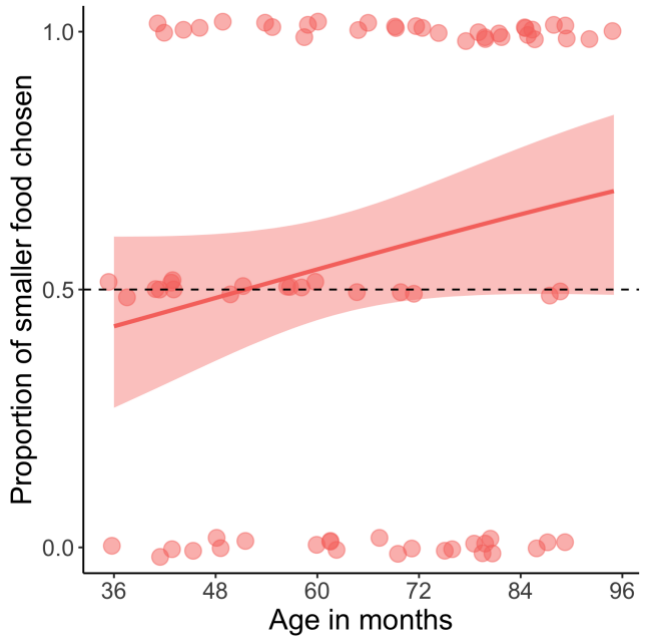

Figure 2. Results from Experiment 1. For all graphs, colored bands show 95% confidence intervals, and points are jittered to avoid overplotting.

Discussion

Children were not sensitive to waste at any age. When judging which of two foods a character would choose to eat, three- to seven-year-olds did not infer that the character would select the food that would minimize food waste. Instead, they chose between both options at chance-level. It is surprising that at no age did children select the smaller food above-chance levels in light of previous work suggesting that children may be waste averse around five to six years-old (e.g., Choshen-Hillel et al., 2020; Sorokowska et al., 2020).

There are a few explanations for why children in this experiment did not consider waste aversion in their judgments. One reason is that choosing the less wasteful item could require inhibitory control. Children had to go against a desire to select the larger cake and pizza in favor of the less wasteful option. Inhibitory control develops between the ages of three and six years (Carlson & Wang, 2007; Zelazo et al., 2003), so this may explain why younger children in this experiment responded at chance-levels. This account cannot completely explain the results though, because older children are not subject to the same inhibitory demands as younger children, yet they made the same judgments. Another explanation is that perhaps children struggle to see foods as wasted. Food waste is common in households and at schools (e.g., Williams et al., 2012), but perhaps they consider waste when reasoning about other domains, like material resources.

In the next experiment, we made some changes to the procedure. To investigate whether children's responses would differ in another domain, the resource was changed from foods to craft paper, and children predicted which paper would be used to create a paper snowflake. Second, children were not asked about a hypothetical character. Instead, children predicted which paper the experimenter would use. Third, we included a control condition to ensure that children's responses could not be attributed to a baseline response pattern. Finally, in the next experiment, we only tested older children aged five- to seven-years-old, since we considered that it may be unlikely to see effects earlier than five years based on past work (Choshen-Hillel et al., 2020; Sorokowska et al., 2020).

[1] We also conducted two exploratory analyses to follow-up on children's chance-level responses. In the first analysis, we performed a median split with age to determine whether analyzing older children's responses together (instead of treating age as continuous) would impact the results. There was still no effect of age, $p = .245$, and children above the median age chose between the foods at chance, $p = .115$. In the second analysis, we investigated whether the lack of an effect of age was due to a smaller sample size. To do this, data were simulated by duplicating 35 responses (7 from each age) and coding them as additional participants, thus artificially increasing the sample size by ~50%. Results again showed no effect of age, $p = .062$, and at no age did children chose between the foods above or below chance-level, $p = .183$.

Experiment 2

Methods

Participants We tested 120 children: 40 five-year-olds (M_{age} = 5;5, range = 5;0 – 5;11, 21 female), 40 six-year-olds (M_{age} = 6;5, range = 6;0 – 6;11, 19 female), and 40 seven-year-olds (M_{age} = 7;5, range = 7;0 – 7;11, 21 female). We tested children online (N = 81), and in-person at schools and a museum in the Waterloo region (N = 39). Online testing procedures were identical to Experiment 1. For in-person testing, children were tested individually in a quiet room. The Waterloo region is predominantly middle-class, and approximately 79% of residents are White, with Chinese and South Asians as the most visible minorities.

Materials and Procedure Children were shown a brief description of how a paper snowflake is made (see Figure 3). In one between-subjects condition (Garbage condition), children were shown a piece of paper that was cut into a snowflake, and some paper scraps that were left behind. The experimenter explained that the leftover paper scraps had to be thrown out in the garbage. In the other between-subjects condition (Baseline condition), children were also shown a piece of paper cut into a snowflake, but there was no mention of leftover paper scraps or the garbage can.

Children then completed four test trials. In each, they were shown a snowflake and two sheets of paper. One sheet was about the same size as the snowflake, and the other was at least double in size. For each trial, the experimenter asked, "I want to make this exact same snowflake. Which piece of paper should I use?". Children responded verbally ("bigger" or "smaller") or by pointing. The Baseline condition was included to control for any baseline pattern of responses that children may have. Although an aversion to waste could lead children to choose the smaller piece of paper in both conditions, we anticipated that these responses might be more common in the Garbage condition since waste was explicitly mentioned.

Test trials across conditions were identical, except that a garbage can was displayed in the Garbage condition trials. To ensure that children were not responding similarly across all four test trials, children also completed two filler trials. One piece of paper was the same size as the snowflake and the other was about a sixth of the size of the snowflake. Children were asked the same questions across test and filler trials. In these trials, we anticipated that children would select the paper that is the same size as the snowflake because it would be impossible to use the other one. These trials were included to interrupt any pattern of responses on test trials (i.e., if children consistently chose the smaller piece of paper on test trials). The order of trials was fixed (Test-Test-Filler-Test-Filler-Test), and the location of the same-size paper was counterbalanced across trials (right-left-right-right-left-left).

Results

Children's responses were coded as 1 if they chose the smaller piece of paper, and 0 if they chose the larger piece of paper. Age in months (mean-centered) was entered as a covariate in the GEE, with condition as a between-subjects factor. This analysis only included test trials because they assessed whether children would avoid the larger paper to minimize waste. The filler only contrasted children's choices for small or extra small pieces of paper. So, children would only select the small paper because it is impossible to use the extra-small one, not because they are avoiding waste[2].

Children were more likely to choose the smaller piece of paper in the garbage condition than the baseline condition, $F(1) = 6.343$, $p = .012$, see Figure 4. Children's responses did not differ across age, $F(1) = 2.11$, $p = .146$, and there was no interaction between condition and age, $F(1) = 0.00$, $p = .998$. Single-sample test using intercept-only GEEs revealed that children chose the smaller piece of paper in the Garbage condition, $p < .001$, though their choices in the Baseline condition did not differ from chance, $p = .253$.

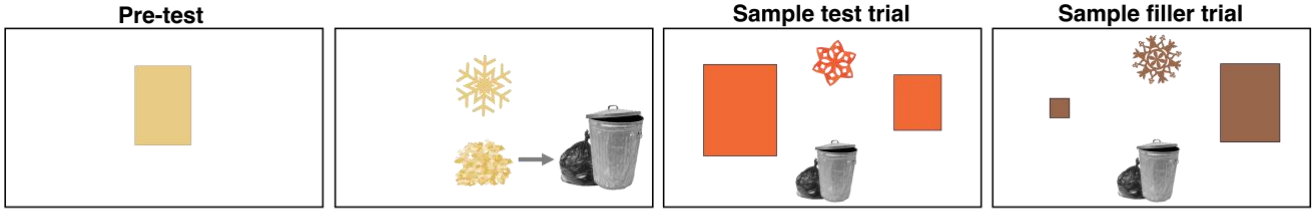

Figure 3. Sample images and script for Experiment 2.

[2] Of the 120 children, only 11 selected the extra small paper in at least one of the filler trials (10 five-year-olds and 1 six-year-old). An exploratory analysis of filler trials showed that children's responses in these trials did not differ across condition, $p = .957$, though choices of the extra small paper significantly decreased across age, $p < .001$.

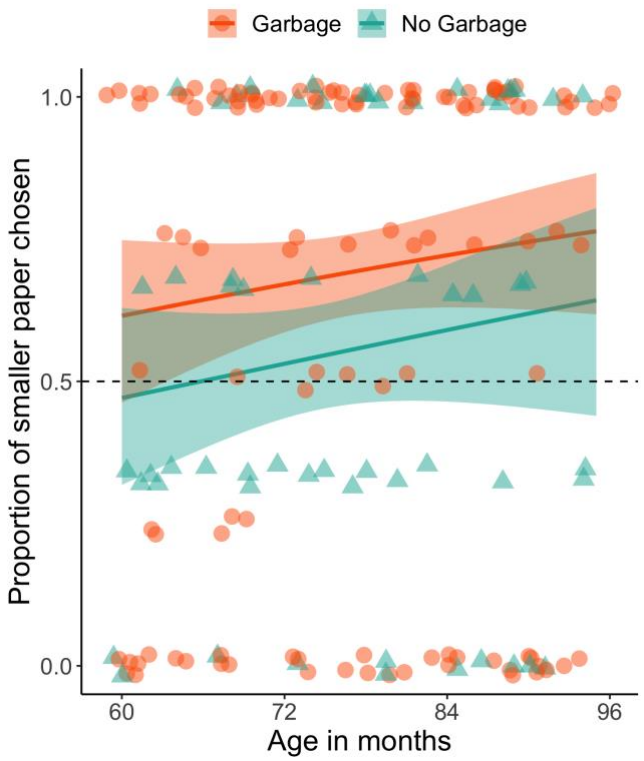

Figure 4. Results for Experiment 2.

Discussion

Children selected resources that minimized waste. Children judged that the smaller resource should be used when they were told that leftover paper scraps would be thrown away. However, when leftover paper scraps were not mentioned (Baseline condition), children chose between the larger and the smaller resource, suggesting that they had no baseline preference for which paper should be used.

General Discussion

Across two experiments, we found mixed evidence for whether children think others should minimize wasting resources. Children did not anticipate that someone should choose a smaller food to reduce the amount thrown away. However, children as young as five years felt that someone should choose a smaller piece of paper when creating a snowflake, but only when children were reminded that remaining paper scraps would have to be thrown away. These findings suggest that in some circumstances, children feel that others should pursue actions that minimize waste.

Previous work has found that beginning at age five, children negatively evaluate others who are wasteful (Sorokowska et al., 2020), and six- to eight-year-olds may avoid waste in resource distribution scenarios (e.g., Choshen-Hillel et al., 2020; Zhang & Benozio, 2021). Although this earlier body of work suggested the children may prefer minimizing waste, children may instead have based responses on judgments about where things belong and do not belong (e.g., food belongs in the fridge and resources do not belong in the garbage). A key difference between this work and the present findings is the degree of waste. Sorokowska et al. (2020) contrasted a wasteful agent with a non-wasteful one, however, our experiments contrasted a very wasteful choice with a slightly less wasteful choice. That is, the decision always resulted in some food or paper thrown out, but children judged just how much would be wasted.

Further, this work contributes to the research on efficiency. Previous research indicates that beginning in infancy and early childhood, people are sensitive to inefficiencies (Gergely et al., 1995), and avoid inefficient paths towards goals (Gönül & Paulus, 2021; Paulus & Sodian, 2015, Jara-Ettinger et al., 2015; Sehl et al., 2021). Much of this work has examined efficiency in terms of minimizing effort and path length. Our findings extend this notion of efficiency by exploring efficiency in terms of minimizing material waste: taking a long route is inefficient because it wastes time and energy, whereas consuming more resources than necessary is inefficient because unused resources are then wasted.

Why were children indifferent to waste in the first experiment (cakes and pizzas) but not in the second (snowflakes)? We see three possibilities. The first is that children's waste aversiveness may differ across domains. Children may be less waste averse with foods than with resources because food waste may be more common in their daily lives. Further, the food scenarios in Experiment 1 were unusual—people typically do not intend to eat a small component of a food and waste the rest. Moreover, it is typically unnecessary to waste food. When making paper snowflakes, not all the paper is used—it is necessary that pieces are cut out and are wasted. However, this is not true of selecting food to eat. It is atypical to select a food with the intention to waste the rest. So, whether the character selected the small slice or large slice of pizza, they would be wasting a whole slice of pizza. A related possibility is that paper scraps belong in the garbage, but foods do not. So, throwing away either cake may seem wrong because each choice will result in foods going in the incorrect location.

A second possibility is that children are sensitive to the value of resources. In the food trials, since the character only wanted to eat a part of the foods (i.e., strawberries and pepperonis), children may have inferred that the other parts were low-value (i.e., cake and pizza), and so children were less waste averse. In contrast, in the snowflake trials, there was a uniform material that was presumably valuable.

A final possibility is that there were additional cues for waste in the snowflakes task. Though children in both experiments were told that unused resources are thrown away, the snowflakes task provided an additional prompt demonstrating that the unused resources were definitively gone (i.e., children saw the paper scraps thrown out in the garbage). Further, discarding paper may have involved a greater opportunity cost than discarding food—someone could have used the discarded paper, whereas it may be unlikely that someone might eat the leftover food.

One question raised by the present work is whether children see waste aversion as a moral norm—whether they think it is wrong to waste resources. Previous work found that children often expect that others should behave in accordance with norms (Kanngiesser et al., 2017; see also Kalish & Cornelius, 2007), enforce moral norms (Hardecker et al., 2016; Riedl et al., 2015; Vaish et al., 2011), and negatively evaluate rule violators (Riggs & Kalish, 2016). Though the present experiments did not explicitly test if children consider waste aversion as a rule or norm, children did anticipate that others should choose courses of action that minimize waste. Future work could investigate whether children judge that others ought to reduce waste, whether it is wrong to waste, and whether children protest when others make unnecessary waste.

One final consideration is the role of culture in these judgments. In inequity aversion studies (e.g., Choshen-Hillel et al., 2019; Zhang & Benozio, 2021), children from WEIRD cultures (Western, Educated, Industrialized, Rich, and Democratic) were more willing to waste resources to uphold equality, as opposed to children from non-WEIRD cultures (e.g., China). This may be because of a difference in cultural values. According to the "World Values Survey" (Inglehart et al., 2014), the value of thrift is much more important in Chinese culture than in the United States—64% of Chinese adults consider that it is important to teach children about thrift, while only about 32% of American adults view this as important. So, the development of waste aversiveness could differ across cultures.

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