Do children predict the sunk cost bias if prompted to consider effort and emotion?

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Abstract

Adults expect others' choices will be biased by investments of effort, time, or money. However, children do not similarly consider past investments when anticipating others' actions. We examined whether prompting children about effort and emotion impacts their predictions about sunk costs. Children aged 5 to 7 years (N = 180) saw scenarios where a character collected two identical objects, one easy to obtain and the other difficult. Before children were asked which of the two objects the character will keep (sunk cost prediction), they were either asked an effort, sadness, or a control prompt. Children in the effort and sadness prompts selected the high-cost objects, suggesting they expected the character to be biased by sunk costs. However, similar to previous findings, children in the control prompt condition selected objects at chance-level. These findings suggest that if prompted, young children can anticipate others will be biased by sunk costs.

Keywords: sunk cost bias; emotion; action prediction; cognitive development

Introduction

People value objects they spent time, money, or effort pursuing. For example, if someone paid for two dinners but can only eat one and must throw the other out, people predict they would eat the one that costed more (Arkes & Blumer, 1985). Similarly, if someone accidentally booked two non-refundable vacations for the same weekend, people predict that they would go on the more expensive trip, even if it was less enjoyable than the alternative trip (e.g., Garland & Newport, 1991).

These examples suggest that people overvalue objects and courses of action when greater investments were incurred toward them. Sometimes the only reason people value one object over another is because they invested more in it, like in the opening scenario about the dinners. Though the dinners are identical, people expect others to choose the more expensive one because it feels like the money spent on it is not wasted. Past investments towards objects can even trump preferences, like in the vacation scenario. Even though the cheaper vacation is expected to be more fun, people predict others will choose the more expensive vacation because they feel that it will recover the money spent on it (Thaler, 1980).

The sunk cost bias has been observed in first-person scenarios where people predict what they would do in a hypothetical situation (Dijkstra & Hong, 2019; Garland, 1990; Klaczynski, 2001; van Putten et al., 2010), and in real life where researchers track decisions in actual situations (Cunha Jr & Caldieraro, 2009; Navarro & Fantino, 2009; Ronayne et al., 2021; for an exception, see Devoto & DeFulio, 2022). People also expect others will base decisions on sunk costs (e.g., Bornstein & Chapman, 1995), and people even honor sunk costs incurred by others (Olivola, 2018). For example, when imagining they have to choose between two vacations that two friends separately purchased for them, people feel obligated to go on the vacation that was more expensive, even though they did not incur any costs themselves!

Further, people show the bias in two main types of choice structures: adoption and progress situations (see Moon et al., 2001; Roth et al., 2015). Adoption scenarios involve the choice between two objects or alternatives that they invested in, like the opening examples about the dinners and vacations. Progress scenarios, on the other hand, involve the classic stay-shift decision where someone chooses whether to make further investments towards a project. For example, when imagining to be the president of an airline company, people choose to invest the remaining 10% of R&D funds towards creating a new radar-blank plane even if informed it is likely to fail (e.g., Arkes & Blumer, 1985). Another example is when people predict they would still drive through a bad snowstorm to attend a basketball game if they paid hundreds of dollars for a ticket, but would instead prefer to watch it on television if they received the ticket for free (Olivola, 2018; Thaler, 1980). Notably, choices in progress and adoption situations are both driven by sunk costs—people are committed to a course of action or project when they have invested in it.

Sunk cost studies in childhood

Despite the many situations where adults predict choices will be biased by sunk costs, there is little evidence that children are biased by them. Most studies on children have investigated progress scenarios. In the earliest exploration of the sunk cost bias in childhood, 5-12-year-olds imagined they were being driven to the circus by a family friend (Webley & Plaisier, 1998). Children either imagined that they paid for the circus ticket themselves or that it was paid for by someone else. On route to the circus, the car broke

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down, and children decided whether they would rather go home or spend a week's worth of allowance to take the bus to the circus. Children chose to take the bus regardless of whether they incurred sunk costs (paid for the ticket) or not (ticket given as a gift), whereas adults in similar studies will only persist towards their goal if they incurred costs towards it (Thaler, 1980; for a review see Thaler, 1993).

In another study, 7-14-year-olds considered similar progress scenarios, and appeared to be biased by sunk costs (Klaczynski & Cottrell, 2004; see also Morsanyi & Handley, 2008). In this study, children imagined 'sunk-cost' and 'no-sunk-cost' scenarios about a character who initially had an idea for an art project and either almost finished completing it (sunk-cost condition) or did not act on it (no-sunk-cost condition). The character then had an even better idea for their art project, and children predicted whether the character would create a project based on the new idea or stick with the old one. In the no-sunk-cost condition, children chose the new idea since the character thought it was the better idea. But in the sunk-cost condition, children at all ages chose the old idea, suggesting they were biased by the effort incurred towards the old idea.

However, there are factors other than sunk costs that likely led to this pattern of responses. In the sunk cost condition, choosing the new idea required the character to erase their drawing of the old idea. Progress scenarios typically do not involve *erasing*, *taking back,* or *undoing* actions. Instead, they usually only involve *abandoning* courses of action. For instance, people imagining to be the president of the airline company in Arkes & Blumer (1985) can either invest remaining funds towards their failing project or abandon the project altogether—this choice does not involve dismantling the plane in order to create a new one (see also Olivola, 2018; Thaler, 1980). So, children may have chosen their old idea because they were averse to the character destroying their nearly-completed drawing. Further, choosing to stick with the old idea requires less future effort than starting over with the new idea, so children may have simply predicted the character would incur the least amount of effort to finish a drawing for the art project. After all, young children expect others will minimize the costs of their actions towards goals (Gönül & Paulus, 2021; Jara-Ettinger et al., 2015; Paulus & Sodian, 2015; Sehl et al., 2021).

Turning to adoption scenarios, in one study 7-15-year-olds were asked about a series of situations involving investments of time, money, and effort (Baron et al., 1993). For example, children imagined they worked really hard on a drawing for an art exhibit, but at the last moment, quickly drew something else they liked more. When deciding which drawing to submit to the exhibit, children chose between the drawings at chance-level, suggesting that they were not biased by the effort they put towards the first drawing.

A more recent study investigated 5-6-year-olds' third-person predictions (Sehl et al., 2021). Children were told stories about characters who collected two identical objects. One object was easy to get and the other was difficult to get, and only after collecting both did the character learn they could only keep one. While adults predicted the character would keep the object that was difficult to obtain (the sunk-cost response), children did not consider effort and chose between objects at chance-level. One interpretation of the findings was that children may not have seen incurred effort as a cost, and so did not expect others' actions to be impacted by incurred effort. However, in a control condition, the character did not collect the objects yet and could choose to obtain one of them. Children expected the character would collect low-cost objects, providing evidence that children saw effort as a cost that should be minimized in future actions.

Why are children insensitive to sunk costs?

In all, there is little evidence that children are sensitive to sunk costs. So why are people only biased towards sunk costs by adulthood? One perspective is that children are not sensitive to previous investments towards objects. That is, children may not acknowledge when sunk costs have been incurred towards objects, and so do not see them as impacting others' choices. This proposal may be unlikely because children widely consider costs and effort when making inferences, valuations, and choices. As mentioned earlier, children and infants expect others to minimize the cost of their actions towards goals (e.g., Gergeley et al., 1995; Jara-Ettinger et al., 2015; Paulus & Sodian, 2015). Furthermore, children are sensitive to the histories of objects, including effort towards them. Children value objects they created more than identical-looking objects made by others (Marsh et al., 2018; see also Kiefer et al., 2023), and by age 6, they are less likely to distribute resources that were effortful for them to obtain (Benozio & Diesendruck, 2015). And around age 4-5, children infer that objects are more valuable if they were previously owned by famous people (Gelman et al., 2015; see also Frazier & Gelman, 2009; Hood & Bloom, 2008; Pesowski & Friedman, 2019; for a review, see Gelman & Echelbarger, 2019).

An alternative perspective is that children can understand sunk costs as impacting choices, but do not make this connection *spontaneously*. On this account, children are sensitive to invested effort towards objects, but they do not automatically see this as impacting present behaviors or choices like adults do. If so, children might be more likely to make sunk cost predictions if prompted to think about the effort invested towards objects.

Other kinds of prompts might also affect children's predictions. For example, adults may see a link between sunk costs and subsequent action by considering *emotions*. Adults often cite emotions when explaining why they predict others will be biased on sunk costs—they anticipate an individual will persist towards a goal because they are upset about or regret having invested a greater sunk cost towards the goal (Arkes, 1996; Dijkstra & Hong, 2019; Wong & Kwong, 2007; Zeelenberg & Van Dijk; 1997; see also Zeelenberg, 1999). Young children may also see the

link between emotions and sunk costs. Children infer emotions based on events and outcomes (e.g., Ahl et al., 2023; Asaba et al., 2019; Doan et al., 2020; Hadwin & Perner, 1991; Harris et al., 1987; Lagattuta, 2005; Lara et al., 2019). For instance, children understand that people feel sad from negative past events (Lagattuta, 2014), and if they incurred great effort to obtain items they cannot keep (Sehl et al., 2023).

In sum, children might make sunk cost predictions if they were explicitly prompted to consider effort and emotion before making action predictions. In this experiment, we investigated whether prompting children about effort and emotion will lead them to expect others will be biased by sunk costs in an adoption scenario. Five- to seven-year-olds were told stories about a character collecting identical objects. One object was very costly to obtain (e.g., a rock at the bottom of a large sandpit), and the other object was not costly to obtain (e.g., a rock at the bottom of a small sandpit). Children were prompted with an emotion, effort, or control question, before being asked to predict which object the character would keep. Importantly, while all three prompt questions point children towards the greater sunk cost, we predicted that only the sad and effort prompts will lead children to consider sunk costs in their action predictions.

Method

Participants

We tested 180 children: 60 five-year-olds (M_{age} = 5 years 5 months, range = 5 years 0 months – 5 years 10 months, 27 female, 32 male, 1 undisclosed), 60 six-year-olds (M_{age} = 6 years 5 months, range = 6 years 0 months – 6 years 11 months, 23 female, 37 male), 60 seven-year-olds (M_{age} = 7 years 5 months, range = 7 years 0 months – 7 years 11 months, 34 female, 26 male). Children were randomly assigned to one of three between-subjects conditions. We tested 20 children per age, per between-subjects condition. Ages were similar across conditions: sad condition, M_{age} = 5 years 5 months; effort condition, M_{age} = 5 years 5 months; control condition, M_{age} = 5 years 6 months. Previous work using similar methods has also investigated this age range (e.g., Sehl et al., 2021, 2024).

Children were mostly tested individually in-person at schools in the Waterloo region in Canada (N = 163). We did not formally collect demographic information, but the population is predominantly middle-class, approximately 79% of residents are White, and Chinese and South Asians residents are the main visible minority. Some children were tested individually online (N = 16) 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 shown two stories about a character who wanted to collect two identical objects. One object was easily retrieved from an accessible location (i.e., the 'low-cost' object) while the other was retrieved with difficulty from a more inaccessible location (i.e., the 'high-cost' object). For example, in one scenario, children were told:

> "Here is a boy at the park, and he wants to get both of the rocks. It's really easy for him to climb into the small hole, and it's really hard for him to climb into the big hole. Look! The boy climbed into both of the holes, and he got both of the rocks. The boy's mom says that he can't keep the rocks."

Children were randomly assigned to one of three prompt conditions (between-subjects): Sad, Effort, or Control. In the Sad condition, children were asked, "The boy is sad that he cannot keep both of the rocks. Which rock is he sadder about?". In the Effort condition, children were asked, "The boy worked hard to get both rocks. Which rock was harder for him to get?". In the Control condition, children were asked, "The boy climbed into the holes to get both rocks. Which rock is from the bigger hole?". Crucially, the correct answer to the Sad, Effort, and Control prompts was the high-cost item.

Immediately after the prompt question was asked, children were asked the action question, "The boy's mom says that he can keep one of the rocks. Which rock will he keep?".

Some children did not pass the prompt (see Results). If children did not respond to the prompt question or answered incorrectly, the story was repeated from the beginning and the prompt was asked again. If children failed to respond or answered incorrectly on their second try, the experimenter told them the correct answer and then asked the action prediction question.

Stories were told in a fixed order (boy with rocks first, girl with flowers second). The location of the high-cost object was counterbalanced across stories: the high-cost object was on the right side of the screen in the first story, and on the left side in the second story. The character was always standing exactly between the two locations.

Results

Prompt questions

Most children passed the prompt question. Figure 1 displays responses to prompt questions according to age. In the Sad condition, 55% (33 of 60) passed the prompt question in both trials on their first try: 40% of 5-year-olds, 55% of 6-year-olds, and 70% of 7-year-olds. In the effort condition, 95% (57 of 60) passed the prompt question in both trials on their first try: 95% of 5-year-olds, 90% of 6-year-olds, and 100% of 7-year-olds. In the control condition, 92% (55 of 60) passed in both trials on first try: 95% of 5-year-olds, 90% of 6-year-olds, and 90% of 7-year-olds.

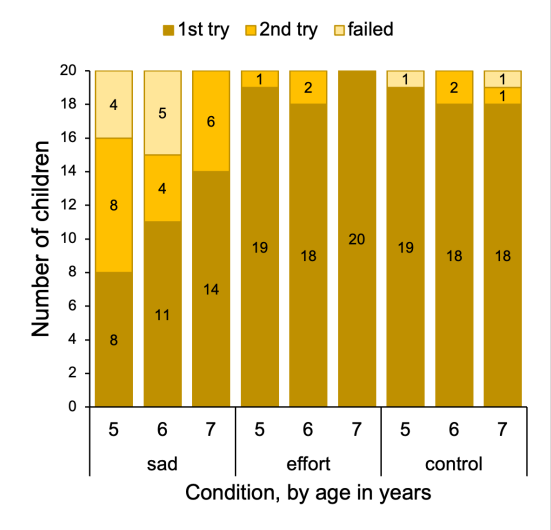

Figure 1. Children's performance on the prompt questions, broken down by age.

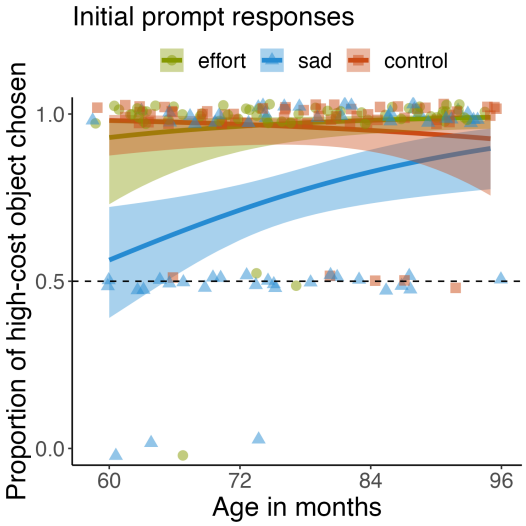

Figure 2. Children's initial responses to prompts. In all graphs, bands show 95% CIs; points are jittered to avoid overplotting.

Before analyzing children's responses to the keep question, we first analyzed children's *initial responses* to the prompt questions, see Figure 2. Children's responses were coded as 1 if they selected the high-cost object and 0 for the low-cost object. Results were analyzed using a generalized estimating equation model (GEE; binary logistic, independent correlation matrix). The model was run using 'geepack' for R (Højsgaard et al., 2006), and passed through the 'joint_tests' function from the 'emmeans' package to produce an omnibus test (Lenth et al., 2019). Bonferroni-corrected pairwise comparisons were also conducted using the 'emmeans' package. Single-sample tests comparing children's performance to chance were performed by running separate intercept-only GEE models for each condition. The outcome variable for this analysis was children's responses to the prompt question. Prompt question was entered as a predictor, and age in months (mean-centered) was entered as a covariate.

Results revealed a main effect of condition, $F(1) = 13.10$, $p < .001$. Pairwise comparisons using a Bonferroni correction for three tests showed that children were more likely to select the high-cost object in the effort and control prompts than the sadness prompt, $ps < .001$, but responses in the effort and control prompts did not differ, $p > .999$. There was no main effect of age $F(1) = 1.68$, $p = .195$, nor an interaction between condition and age, $F(1) = 2.25$, $p = .106$. Single-sample tests against chance showed that children chose the high-cost object more than would be expected by chance in the sadness, effort, and control prompts, all $ps < .001$.

Action prediction

Of primary interest was whether children who were asked the sad and effort prompt questions would be more likely to select the high-cost objects than children who were asked the control prompt question. Figure 3 shows children's responses to the keep question by prompting condition. Children's responses were again analyzed using a GEE, with their keep response as the outcome variable. We retained data from all children regardless of their success on the prompt question. Exclusion of this data does not impact the results.

There was a main effect of age, $F(1) = 9.22$, $p = .002$, as older children were more likely to select the high-cost object than younger children. There was also a main effect of condition, $F(1) = 4.69$, $p = .009$. Pairwise comparisons using a Bonferroni correction for three tests revealed that children were more likely to select the high-cost objects in the effort condition than the control condition, $p = .010$, but the sad condition did not differ from the effort condition, $p = .129$, or the control condition, $p = .907$. There was no interaction between age and condition, $F(1) = 1.04$, $p = .352$.

To pinpoint when children's responses in each condition differed from chance, we examined 95% confidence intervals. This analysis may seem unjustified, given that there is no interaction between age and condition. However, alternative methods such as single-sample tests for each condition, would not capture the effect of age, and instead could only determine whether children's results *overall* in each condition differed from chance-level. The confidence intervals revealed that children's responses in the effort condition first diverged from chance at 5 years 11 months, $CI_{95\%}$ [0.52, 0.75]. In the sad condition, children's responses only differed from chance by 6 years 5 months, $CI_{95\%}$ [0.51, 0.73]. Responses in the control condition never differed from chance.

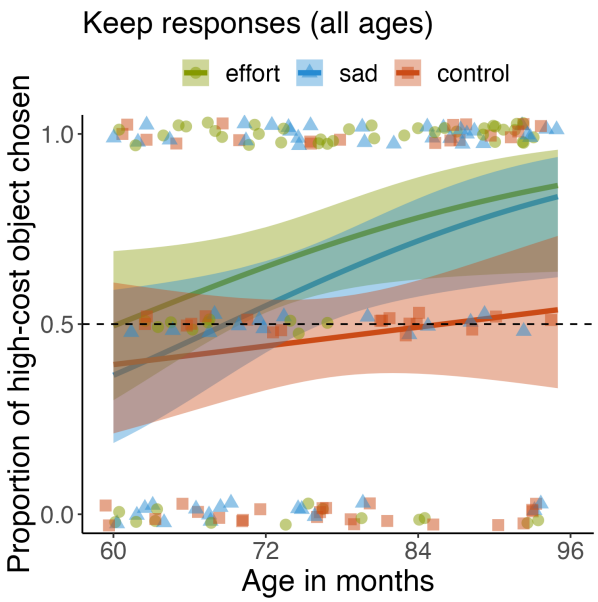

Figure 3. Children's responses to the keep question by prompt type.

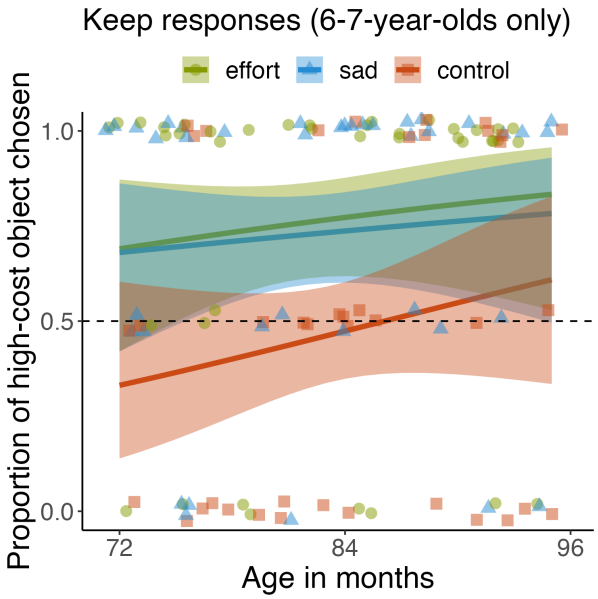

Figure 4. Six- to seven-year-olds' responses to the keep question by prompt type.

Exploratory analysis

We also conducted an exploratory analysis to follow-up on the mixed results for the keep question in the sad condition. Children's responses in the sad condition did not differ from the effort condition (i.e., when responses were above chance-level) nor the control condition (i.e., when responses were at chance-level). But, the confidence interval shows that responses in the sad condition differed from chance with age.

To further explore children's responses, we conducted the same analysis but omitted 5-year-olds' data, see Figure 4. This is because visual observation of the graphed data suggested that 5-year-olds responded at chance-level in all three conditions, and so their responses may be impacting our interpretation of 6-7-year-olds' data. We also were interested in omitting 5-year-olds' data since they were more likely to respond incorrectly to the prompt questions than 6-7-year-olds.

The GEE revealed a main effect of condition, $F(1) = 6.09$, $p = .002$, as children were more likely to select the high-cost object in the effort and the sad conditions than the control condition, $ps \leq .014$. However, responses did not differ across the sad and effort conditions, $p > .999$. There was no effect of age, $F(1) = 1.81$, $p = .179$, nor an interaction between condition and age, $F(1) = 0.09$, $p = .914$. Single-sample tests revealed that children selected the high-cost object greater than chance-level in the sad condition and the effort condition, $p < .001$, but children chose between objects at chance-level in the control condition, $p = .705$.

Discussion

In this experiment, we found evidence that children can anticipate that others can be biased by sunk costs in their choices. In the effort condition, children identified that the high-cost objects were more effortful to obtain, and thereafter predicted that characters would keep them. There were mixed results for the sad condition, when children inferred that characters would be sadder about not being able to keep high-cost objects. An exploratory analysis showed that considering characters' sadness did not impact 5-year-olds' predictions of which objects characters would keep, however, it did lead 6-7-year-olds to predict characters would keep high-cost objects. Finally, in the control condition, children identified the initial location of the high-cost object, but this did not lead them to predict the characters would keep them.

This work contributes to our understanding of how children think about sunk costs in object valuation. Children successfully responded to prompt questions about sadness and effort, providing further evidence that children infer others' emotions from past events and outcomes (e.g., Ahl et al., 2023; Lagattuta et al., 2014), and can make assessments about effort incurred towards goals (e.g., Jara-Ettinger et al., 2015; Kiefer et al., 2023). Furthermore, while previous work hinted that children do not consider incurred effort when choosing between objects (e.g., Klaczynski & Cottrell, 2004; Sehl et al., 2021), this experiment shows that children can consider sunk costs when prompted with emotion and effort.

This experiment also broadly joins developmental research showing that children's judgments and inferences improve when they are asked prompting questions. One instance is children's struggle to infer others' surprise about unlikely events. For example, 6-year-olds do not predict characters feel surprised when they get a rare gumball from a

machine (e.g., a blue gumball from a machine with mostly red gumballs). However, if 6-year-olds are prompted to consider the likelihood of receiving a rare gumball, they can successfully predict a character would feel surprised about this unlikely event (Doan et al., 2020). Another instance is children's failure to match sets based on abstract relations, such as '*same'* or '*different'* concepts (see Premack, 1983). In the Relational Match to Sample task, children incorrectly match a pair with a 'same' relation (A-A) to a pair with a 'different' relation including a similar component part (A-B). However, if prompted to explain the relation between the objects, children can correctly match pairs based on their relations (e.g., 'same' pairs like A-A and C-C; Brockbank et al., 2023). Similar increases in performance with prompting questions have been documented in many other instances, such as in the false-belief task (Clements & Perner, 1994; see also Rubio-Fernández & Geurts, 2013) and in the day-night task (Ling et al., 2016).

Why did prompting help children consider sunk costs? A low-level explanation is that prompting simply worked by directing children's attention to the high-cost item. When not prompted, children may have neglected to consider the incurred costs. This would have left them with no reason to choose high-cost objects over low-cost ones. This view is supported by findings in previous experiments where children choose between high- and low-cost objects at chance-level (Sehl et al., 2021). After all, if children had other considerations to arrive at their responses (instead of choosing arbitrarily), then we would expect their responses differ from chance-level.

However, this low-level account may also predict that children should have made sunk cost predictions in the control condition. That condition also included a prompt question which required children to identify the high-cost object—the question asked which object was from the larger obstacle (i.e., the deeper hole and the taller hill). Answering this question also would have shifted children's attention to the high-cost objects and their original locations. Nonetheless, results from this experiment showed that merely orienting children towards the high-cost objects was not enough for them to predict others would keep high-cost objects.

Another view that can account for responses across all three conditions is that prompting helped children to engage in sunk cost reasoning. While all three prompts required children to focus their attention on the high-cost object, it was only the sadness and effort prompts that led children to predict others would keep the high-cost object. Answering the effort and sadness prompts likely required children to consider sunk costs, and so this increased the likelihood of children considering sunk costs in the keep question that followed.

Future work could further test between these two accounts by asking other prompt questions that either require or do not require reasoning about sunk costs. For example, children could be asked prompts relevant to sunk costs, like which object was a bigger mistake for the character to get or which object the character regretted getting. Conversely, children could be asked prompts irrelevant to sunk costs, such as which object is a darker color or which object is upside down (that is, if objects were changed to slightly differ from each other on these dimensions). If both prompts were equally effective in leading children to be biased by sunk costs, this would provide support for the low-level attention account, where simply having children think more about the high-cost object leads them to the sunk cost response. However, if only the relevant prompts led children to predict others will be biased by sunk costs, then this would provide support that prompting helps children engage in sunk cost reasoning. This future work could also help determine which aspects of sunk cost reasoning (e.g., effort, sadness, regret, mistakes, etc.) are most central to the sunk cost bias.

Another area for future research is to examine if prompting leads to similar improvements in children's ability to predict the sunk cost bias in first-person scenarios. While some adult studies use third-person scenarios (e.g., Bornstein & Chapman, 1995), most previous studies in adoption scenarios ask people about first-person predictions (e.g., Arkes & Blumer, 1985; Dijkstra & Hong, 2019; Garland, 1990; Klaczynski, 2001; van Putten et al., 2010). Similarly, only a few developmental studies examine third-person scenarios (Klaczynski & Cottrell, 2004; Sehl et al., 2021), as most developmental work involves children predicting their own choices to imagined sunk cost scenarios (Baron et al., 1993; Klaczynski, 2001; Morsanyi & Handley, 2008; Olivola, 2018; Webley & Plaisier, 1998; see also Exp. 3 in Sehl et al., 2021). Prompting children about their own effort and emotions could help our understanding of how children reason about their own sunk costs. This work could show whether children successfully consider their own effort and sadness associated with sunk costs towards objects, and whether this similarly leads them to considering sunk costs in their resulting choices and behavior.

Conclusions

We found evidence that prompting led children to reason about sunk costs when predicting actions. From as young as age 5, considering others' effort helped children reason about sunk costs, but the exploratory analyses showed that it was only by age 6-7 years that considering sadness helped children reason about sunk costs.

We also found that children could identify high-cost objects as more effortful to obtain and were associated with greater sadness when neither object could be kept. In all, these findings provide some clarity about the missing link in children's ability to consider sunk costs in their action predictions.

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