The Role of Alternatives in Children's Reasoning about Constrained Choices

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Abstract

Research has documented children's understanding that a choice made when constrained to a single option is a poor indicator of another person's preference. However, when constraints are constant over time—as they often are in social contexts—they may lose their salience. We examined whether children (N = 133, 5- to 12-year-olds) were more likely to refrain from inferring that a constrained actor prefers their choice if they *first* observe unconstrained actors (Alternatives condition) compared to if they *only* observe constrained actors (Constant condition). Presence of alternatives was crossed with constraint type: either the second option was *hard to access* or there was *no other option*. In line with our predictions, results indicated that observing alternative situations with greater choice increased children's subsequent attention to constraints. Effects were stronger for the hard to access constraint and for older children.

Keywords: reasoning; alternatives; constraints; preferences

Introduction

To infer another person's desires from the choices they make, it is important to consider the constraints under which their choices were made. In particular, observers should recognize that a choice made from limited options provides incomplete information about another's preferences; the choice could have been based on the agent's desires or because there were few options available (Jara-Ettinger et al., 2015; Kushnir et al., 2010; Pesowski et al., 2016). Not only is understanding the causal ambiguity of constrained choices important for navigating daily social life, it is foundational for understanding more complex social issues (e.g., recognizing that *structural* constraints should temper intrinsic explanations for social inequality; Amemiya et al., 2021, 2022; Peretz-Lange et al., 2021; Vasilyeva et al., 2018).

Prior research suggests that a basic capacity to understand the ambiguity of constrained choices emerges in early childhood. In the typical toy choice paradigm, children observe an agent select a toy over one that is out of reach (Jara-Ettinger et al., 2015; Pesowski et al., 2016), or an agent selects a toy in which there is no other option available (Garvin & Woodward, 2015; Kushnir et al., 2010). This research finds that young children generally refrain from inferring a preference when observing these constrained actions. In the present study, we examined 5- to 12-year-old children's constraint reasoning in light of a particular characteristic of the social world: that constraints tend to remain constant. Specifically, the environmental conditions under which we typically observe people's choices (e.g., within neighborhoods, schools, and broader society) are often stable over time. We therefore adapted the established toy choice paradigm to address the impact of stable constraints on children's reasoning. We hypothesized that when constraints remain constant, children would be more likely to assume that an agent's choice is caused by their preferences.

Evidence for the hypothesis that reasoners are less likely to consider constant constraints as a causal factor appears in the adult literature on causal attribution. This research finds that people are less likely to attribute causal outcomes to typical over atypical events, even when both events are relevant causes (Cheng & Novick, 1991; Hilton & Slugoski, 1986). Kirfel and Lagnado (2021) describe two incidents that highlight this tendency: When explaining what caused a dust explosion in a warehouse, people were less likely to cite the presence of dust particles (a typical event) and more likely to reference a dropped cigarette (an atypical event). This attribution is reversed for contexts where smoking is more common than dust: When explaining what caused a dust explosion at a music festival, people were less likely to cite attendees' cigarette smoking (a typical event) and more likely to attribute the explosion to the spray of a combustible powder (an atypical event).

While the causal attribution literature describes how environmental contexts can *vary* in their perceived relevance based on their typicality, research on the inherence heuristic suggests that environmental causes are *generally* not salient to people (Cimpian & Salomon, 2014; Horne et al., 2019). This work finds that when children and adults are not reminded or informed about the presence of environmental causes, they tend to be biased toward inherent explanations that focus on intrinsic properties of the person or object (Salomon & Cimpian, 2014; Sutherland & Cimpian, 2019). Here, we aim to integrate these two proposals: We posit that children will be less attentive to constraints that are stable over time (in line with theories of causal attribution), and the fact that constraints are *often* stable in the real world may contribute to children's tendency to neglect environmental causes (in line with inherence heuristic).

Embedded in this proposal is the claim that children may be more likely to consider constraints when they are *atypical*. For example, constraints may become salient after first observing several choices made in *unconstrained* contexts. This contrast between situations that vary in the presence of constraints may help children keep the relevant alternative in mind when reasoning about constrained actors: that the

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environment could have been designed to provide greater choice. As a result, children may be more likely to recognize that a constrained choice is causally ambiguous, since it may have been driven either by the agent's desire *or* by the environmental constraint.

Although the availability of alternatives has not been examined in the context of constraint reasoning, this has been shown to scaffold more sophisticated reasoning across a wide range of inferences (see Namy & Clepper, 2010). For example, 4- and 5-year-olds are able to recognize when a teacher is providing under-informative instruction if they *first* observe a more informative teacher, but they fail to do so without this contrast (Gweon & Asaba, 2018). Relatedly, 3- and 4-year-olds generally reject testimony from an inaccurate informant when it is presented in contrast with testimony from a more accurate informant, but will *accept* this testimony in the absence of a conflicting viewpoint (Vanderbilt et al., 2014). A similar effect is found in children's pragmatic reasoning: 5-year-olds correctly infer that "some" implies "not all" when they first hear "all" in the proper context, but misinterpret "some" to mean "all" without this alternative (Skordos & Papafragou, 2016).

With respect to constraint reasoning, there is some research to suggest that contextual cues also matter. For example, while Kushnir et al. (2010) found that preschoolers rationally infer preferences when observing constrained actions, Garvin and Woodward (2015) found that slight deviations in framing (e.g., framing the task as figuring out what makes the agent "happy" versus what the agent "gets") changes the inferences that children make. Other constraint studies have included (but not manipulated) contextual supports, which may have been critical for children's understanding. In a study by Pesowski et al. (2016) the constrained toy was more *attractive* (i.e., larger and more colorful) than the unconstrained toy, perhaps highlighting that picking the available, less attractive toy did not necessarily reflect the agent's preference. Most relevant to the current study, Jara-Ettinger et al. (2015) found that 5- and 6-year-olds successfully refrained from inferring preferences from constrained actions when the relevant alternative was available (i.e., children were able to observe what the agent chooses when constrained *and* when unconstrained).

We also considered whether the presence of alternatives interacts with two factors: constraint type and children's age. Specifically, we examined two constraints used in prior work: when a second toy was *hard to access* (a probabilistic constraint that lowers the chances of accessing the other option), and when there was *no other option* (a deterministic constraint that completely forbids access to another choice) (Amemiya et al., 2021; Garvin & Woodward, 2015; Jara-Ettinger et al., 2015; Kushnir et al., 2010; Pesowski et al., 2016). One possibility is that alternatives may matter more when the constraint is *probabilistic*. Under probabilistic constraints, children may reason that the *actor* could have acted differently (e.g., persisted more to get the other option), and thus infer that the choice to remain constrained may reflect a true preference for that option. In line with this hypothesis, Kushnir et al. (2010) found that children make stronger preference inferences when constraints on choice are weakened (see also Walker et al., 2015).

Another open question is whether the presence of alternatives interacts with children's age. We consider two possible results. On the one hand, alternatives may be more beneficial to *younger* children, given that they struggle more with constraint reasoning (Amemiya et al., 2021; Pesowski et al., 2016; see also Gweon & Asaba, 2018). However, although older children show greater sensitivity to constraints, the robustness of this tendency can vary depending on the context (e.g., it weakens when they reason about stereotypical choices; Amemiya et al., 2021). As such, when relevant alternatives are made available, *older* children may be most able to benefit from such scaffolding. We included a wide age range (5 to 12 years) to test these possibilities.

The Present Study

The present study examined whether children are more sensitive to environmental constraints when they first observe alternative situations with greater choice (Alternatives condition), compared to when they *only* observe constrained choices (Constant condition). We tested whether the presence of alternatives interacts with constraint type (a probabilistic [*hard to access*] versus deterministic [*no other option*] constraint) and children's age (5 to 12 years old).

Methods

Participants

Participants were 133 children, aged 5 to 12 years, recruited via online platforms, including social media and ChildrenHelpingScience.com (M = 8.70 years, SD = 2.07; 55% female; 55% White, 34% Asian, 5% Latinx, and 3% mixed race or ethnicity; 91% from the United States, 2% from the United Kingdom, 2% from India, 2% from Canada, 2% from Israel, < 1% from Mexico). All interviews were conducted in English, with the exception of one interview that was conducted in Spanish. An additional three participants were excluded from analysis because of parental interference. All procedures were approved by the Institutional Review Board at the associated university and informed consent was obtained for all participants.

Procedure and Measures

Children were tested in a live Zoom session by an experimenter who narrated an animated PowerPoint presentation that was displayed on a shared screen. Participants were randomly assigned to one of four between-subjects conditions (Presence of Alternatives x Constraint Type): (1) *Alternatives/Hard to Access; (2) Constant/Hard to Access; (3) Alternatives/No Other Option; (4) Constant/No Other Option*. See Figure 1 for all study conditions.

Children observed three toy choices. Of interest was children's reasoning about the *third* trial, which was a constrained choice across all conditions. In the Alternatives

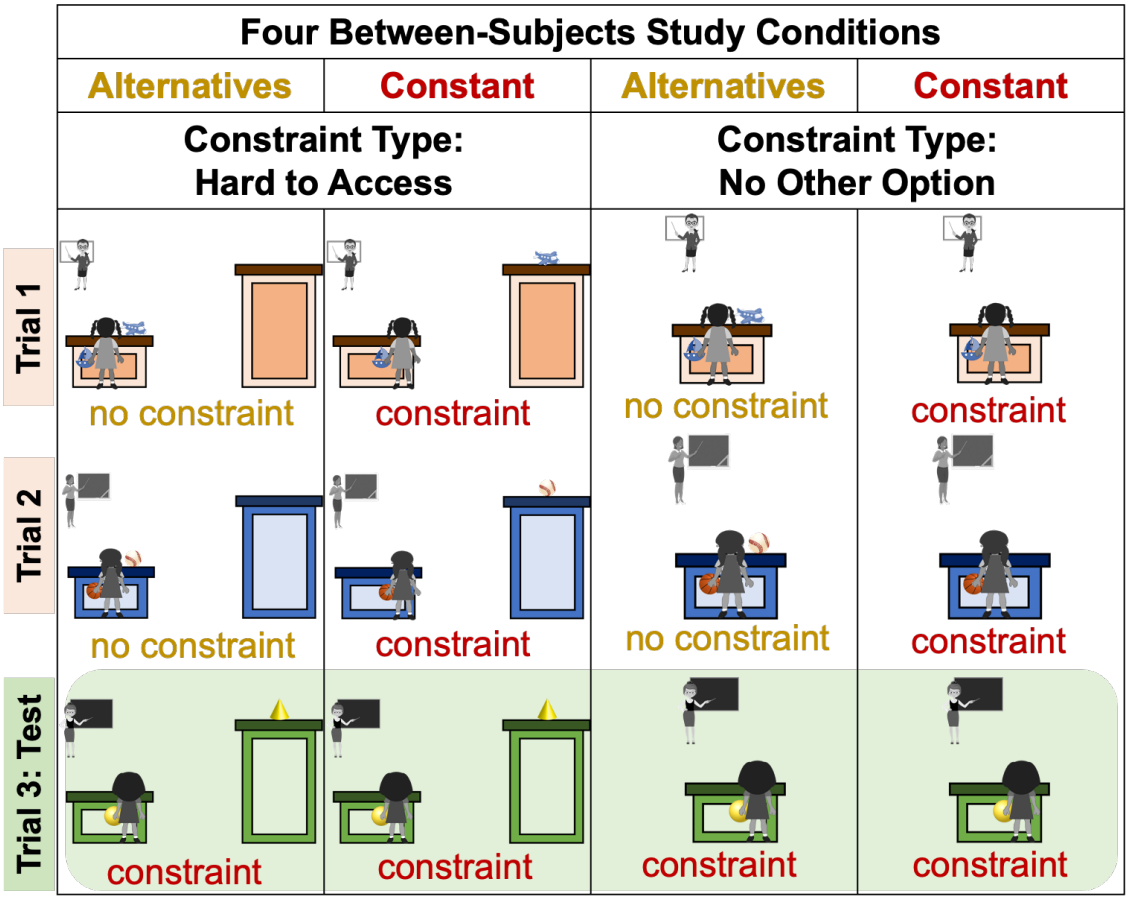


Figure 1: Study conditions (Presence of Alternatives X Constraint Type)

condition, the first two choices children observed were unconstrained (two protagonists had access to both toy options). In the Constant condition, the first two choices children observed were constrained. With respect to constraint type, the choice was constrained either because the second toy option was *hard to access* or because there was *no other option*.

We made several design decisions to ensure that the constrained choice was uninformative. First, we told participants that the protagonist *had* to pick a toy, and since there was no possibility of refraining from choosing, selecting the only toy available yields little information about the protagonist's desires. Second, because pilot work suggested that children paid attention to the character's facial expression to decide whether they liked the toy, we had the protagonist's face turned away so no affective reaction was available. We also had a comprehension check after each scenario to ensure children understood the constraint or lack thereof (i.e., children were asked which shelf the protagonist could reach or which toys were available); children passed this check on 99% of the trials.

Each of the scenarios featured *different* protagonists, which had several benefits. First, children had no information about the final protagonist (e.g., whether the protagonist typically takes what is available to them), again reducing the information they have about their preferences. Second, this was a more stringent test of the effect of observing alternatives on reasoning—we could determine whether viewing unconstrained choices *in general* prompts sensitivity to constraints on a *novel* individual's choice.

Finally, we included a *direct* assessment of a preference inference. Prior work has used an indirect measure in which children are asked which toy the character likes more; choosing at random indicates that they are not inferring a preference (e.g., Kushnir et al., 2010). Here we asked whether the character likes the selected toy *more than* the unselected toy. This decision was based on pilot work showing that children failed to refrain from inferring preferences when they were asked the indirect question. We also asked children to justify their inferences to assess whether they were explicitly attending to the constraint.

Below are the three scenarios for the *hard to access* constraint (see Appendix for the *no other option* constraint version). We have bolded the text that was manipulated across conditions:

[Trial 1: Pre-test Trial]
Here is a girl named Bailey and today is her first day at school. At Bailey's school there is a short toy shelf and a tall toy shelf. Bailey is really small, and she can only reach toys

from the short shelf. Can you remind me, which shelf can Bailey reach toys from?

For the first activity of the day, the teacher tells Bailey that she *has* to pick *one* toy. First Bailey sees this boat. This boat is on the shorter one and she can reach it. Then Bailey sees this plane. This plane is **[also on the shorter one and she can reach it/way up on the taller one and she cannot reach it]**. Then Bailey takes the boat. Now I have a question for you. Do you think that Bailey likes the boat *more* than the plane? Why is that?

[Trial 2: Pre-test Trial]
Here is a girl named Sam and today is her first day at school (a different-colored school is shown). At Sam's school there is a short toy shelf and a tall toy shelf. Sam is *also* really small, and she can only reach toys from the short shelf. Can you remind me, which shelf can Sam reach toys from?

For the first activity of the day, the teacher tells Sam that she *has* to pick *one* toy. First Sam sees this basketball. This basketball is on the shorter one and she can reach it. Then Sam sees this baseball. This baseball is **[also on the shorter one and she can reach it/way up on the taller one and she cannot reach it]**. Then Sam takes the basketball. Now I have a question for you. Do you think that Sam likes the basketball *more* than the baseball? Why is that?

[Trial 3: Test Trial]
Here is a girl named Cody and today is her first day at school (a different-colored school is shown). At Cody's school there is a short toy shelf and a tall toy shelf. Cody is *also* really small, and she can only reach toys from the short shelf. Can you remind me, which shelf can Cody reach toys from?

For the first activity of the day, the teacher tells Cody that she *has* to pick *one* toy. First Cody sees this circle toy. This circle toy is on the shorter one and she can reach it. Then Cody sees this triangle toy. This triangle toy is way up on the taller one and she cannot reach it. Then Cody takes the circle toy. Now I have a question for you. Do you think that Cody likes the circle toy *more* than the triangle toy? Why is that?

Dependent measures. At test (i.e., the final, third scenario), we examined children's tendency to (a) *refrain* from inferring a preference, and (b) tendency to mention the constraint.

Refraining from preference inference. Children were coded as refraining from inferring a preference if they responded negatively to the question, "Do you think that Cody likes the circle toy *more* than the triangle toy?" such as saying, "no," or "not really," or expressing uncertainty, such as, "I don't know." In contrast, inferring a preference included answers that were affirmative responses, for example, "yes," or explicitly stating the preference inference, such as, "I think she likes the circle toy better." Two coders showed high inter-rater agreement in categorizing children's preference inferences, Cohen's $\kappa = .98$.

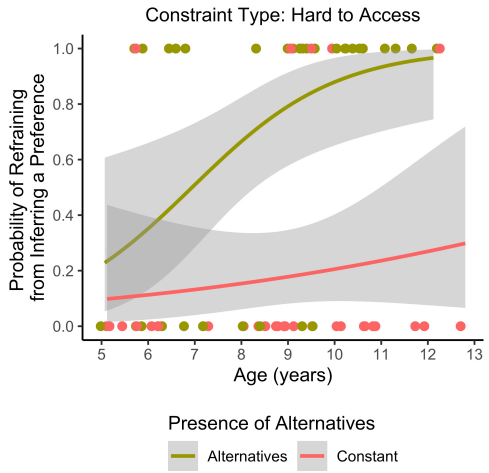
Mentioning constraint. Children were coded as mentioning the constraint if they referenced the barrier in their explanations for their preference judgments. For the *hard to access* constraint, this included mentioning the shelf height or the protagonist's inability to reach the other option, such as, "Because Cody cannot reach the higher shelf, so she can only pick the circle toy." For the *no other option* constraint, this included saying the protagonist lacking any other choice, such as, "Because the triangle toy wasn't on the toy shelf." Inter-rater agreement between the two coders was high, Cohen's $\kappa = .92$.

A logistic regression indicated these two measures were positively related, $B = 2.80$, $p < .001$, 95% CI [1.97, 3.72], $OR = 16.43$, such that children who *refrained* from inferring a preference were *more* likely to mention the constraint.

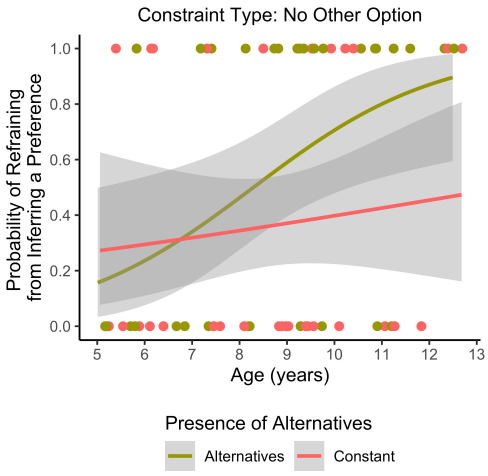
Results

Refraining from preference inference. We ran a logistic regression predicting whether children refrained from inferring a preference as a function of age (centered at the mean age, 8.70 years), alternatives condition (with the *Constant* condition as the reference group), constraint type (with *Hard to Access* as the reference group), and the interaction between alternatives condition and constraint type, and alternatives condition and age. The three-way interaction between age, alternatives condition, and constraint type was not significant and not included in the final model.

The logistic regression indicated a significant interaction between alternatives condition and constraint type, $B = -1.87$, $p < .05$, 95% CI [-3.55, -0.26], $OR = 0.15$, as well as between alternatives and age, $B = 0.43$, $p < .05$, 95% CI [0.02, 0.87], $OR = 1.54$. As shown in Figure 2, the presence of alternatives significantly increased children's tendency to refrain from inferring a preference for the *hard to access* constraint type, and the difference between conditions was greater among older children across constraint types.



(a)



(b)

Figure 2: Probability of refraining from preference inference as a function of constraint type, age, and alternatives condition. Means and 95% CIs around means are reported.

Mentioning constraint. We ran a logistic regression predicting whether children mentioned the constraint as a function of age (centered at the mean age, 8.70 years), alternatives condition (with the *Constant* condition as the reference group), and constraint type (with *Hard to Access* as the reference group). There were no significant 2- or 3-way interactions among these variables.

The logistic regression indicated that older children were more likely to mention the constraint, $B = 0.50$, $p < .001$, 95% CI [0.29, 0.73], $OR = 1.64$. Moreover, children who were observed the *no other option* constraint type were *less* likely to mention the constraint, $B = -1.11$, $p < .01$, 95% CI [-1.96, -0.31], $OR = 0.33$.

Critically, as shown in Figure 3, there was a main effect of alternatives condition, in which the presence of alternatives significantly increased children's tendency to mention the constraint across constraint types, $B = 1.46$, $p < .001$, 95% CI [0.65, 2.32], $OR = 4.29$.

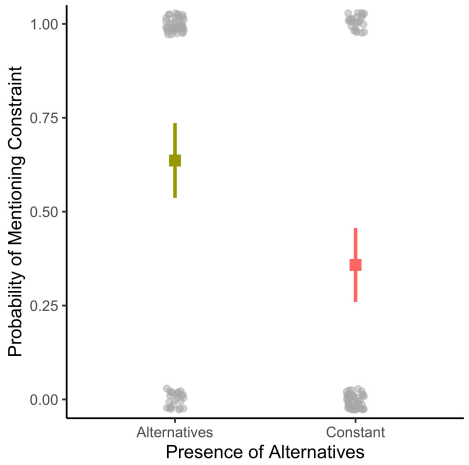


Figure 3: Probability of mentioning the constraint as a function of the alternatives condition. Means and 95% CIs around means are reported.

Discussion

This study examined the role of alternatives in children's constraint reasoning. Results indicated that, as hypothesized, presenting children with alternative scenarios with greater choice increased their attention to constraints when reasoning about a later constrained actor. We also found that the effects of alternatives were stronger for the hard to access constraint and for older children.

Overall, we find support for the hypothesis that children's observations of *unconstrained* choices can increase the salience of constraints on others' actions. The results align with prior studies that find providing children with the relevant alternatives can improve children's reasoning across a range of domains (Gweon & Asaba, 2018; Namy & Clepper, 2010; Skordos & Papafragou, 2016; Vanderbilt et al., 2014). The direct contrast between unconstrained and constrained choices may point to the constraint as a potential "difference-maker" for the agent's actions (see also Goddu & Gopnik, 2020), leading children to recognize that strong preference inferences are unwarranted. However, we also found that the strength of this effect varies by the type of constraint and children's age.

In explaining why alternatives mattered more for the *hard to access* constraint, we first consider why children easily misread this constrained choice as informative when no alternatives were provided. One possibility is that children interpreted this type of constraint to be probabilistic rather than deterministic, and in turn, reason that the agent could have could have tried harder to get the other toy option if they had strongly preferred it. Indeed, some children who inferred a preference stated that the agent could have asked the teacher for help if they really wanted the other option (see also Walker et al., 2015). However, we note that inferring a preference is still generally unwarranted in this case: Even if the agent chooses not to expend the energy to obtain the hard to access toy, it could be that the agent prefers both toys equally but selects the toy that has a lower cost associated with acquiring it (Jara-Ettinger et al., 2016).

When provided with alternatives, however, children were significantly more likely to attend to the hard to access constraint. Children in this condition may have had a different counterfactual in mind: the greater choice that the *environment* could have provided rather than the additional energy that the *agent* could have exerted. In this way, the environmental constraint may have been perceived as having a greater causal role in the agent's choice. This result and interpretation are supported by prior research findings indicating that reasoners are more likely to attribute blame to atypical, rather than typical, causal factors (Cheng & Novick, 1991; Hilton & Slugoski, 1986; Kirfel & Lagnado, 2021).

We also find that the presence of alternatives can have a stronger effect for older children than younger children. While older children can readily consider constraints when prompted with the relevant alternatives, younger children may need even stronger scaffolding. Here, we made the toys equally attractive, which might have reduced younger children's attention to the constrained toy. Indeed, 5-year-

olds in past research have shown greater sensitivity to constraints when the constrained actor takes a less attractive choice (Pesowski et al., 2016).

Taken together, our findings suggest that current theorizing about children's constraint reasoning may require some revision. Prior work typically characterizes children's consideration of constraints as robust, particularly once they reach 5 to 6 years of age (Jara-Ettinger et al., 2015; Pesowski et al., 2016). The current results provide evidence to the contrary, indicating that, in some contexts, this capacity continues to develop throughout middle to late childhood. Furthermore, we find that even much older children can fail to consider certain constraints without the presence of alternatives.

We designed the present study to provide information about how children reason about constraints that share certain characteristics with constraints in the social world. We found that even older children were likely to neglect the constraint when in the constant, hard to access (probabilistic) condition. Considering that real-world constraints tend to have these two characteristics—they are constant, but have probabilistic effects—our results may shine light on why people often fail to consider constraints in their explanations of societal outcomes (Salomon & Cimpian, 2014; Sutherland & Cimpian, 2019). An interesting future step is to see whether our results replicate with more realistic constraints, for example, asking children to reason about agents making academic choices when they have few educational opportunities.

Learning about others from the choices they make requires children to consider information about the constraints those individuals experience. The current findings suggest that, rather than representing an early-developing, robust, universal tendency, consideration of constraints depends on children's age, the presence of alternatives, and constraint type. Future research would benefit from further investigating when constraints are and are not salient to children, and what consequences this may have for the inferences they make about the social world.

Appendix

Below are the *no other option* constraint scenarios.

[Trial 1: Pre-test Trial]
Here is a girl named Bailey and today is her first day at school. At Bailey's school there is a toy shelf with **[a boat and a plane on it/a boat on it]**. Can you remind me, what is on the toy shelf?

For the first activity of the day, the teacher tells Bailey that she *has* to pick *one* toy. First Bailey sees the boat. **[Then Bailey sees the plane./(no other sentence)]** Then Bailey takes the boat. Now I have a question for you. Do you think that Bailey likes the boat *more* than **[the/this]** plane (for constrained choice, plane pops up on the righthand side of the screen)? Why is that?

[Trial 2: Pre-Test Trial]
Here is a girl named Sam and today is *her* first day at school (a different-colored school is shown). At Sam's school there is a toy shelf with **[a basketball and a baseball on it/a basketball on it]**. Can you remind me, what is on the toy shelf?

For the first activity of the day, the teacher tells Sam that she *has* to pick *one* toy. **[First/(nothing)]** Sam sees the basketball. **[Then Sam sees the basketball./(no other sentence)]** Then Sam takes the basketball. Now I have a question for you. Do you think that Sam likes the basketball *more* than **[the/this]** baseball (for constrained choice, baseball pops up on the righthand side of the screen)? Why is that?

[Trial 3: Test Trial]
Here is a girl named Cody and today is *her* first day at school (a different-colored school is shown). At Cody's school there is a toy shelf with a circle toy on it. Can you remind me, what is on the toy shelf?

For the first activity of the day, the teacher tells Cody that she *has* to pick *one* toy. Cody sees the circle toy. Then Cody takes the circle toy. Now I have a question for you. Do you think that Cody likes the circle toy *more* than this triangle toy (triangle toy pops up on the righthand side of the screen)? Why is that?

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