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BRIEF REPORT

The less-is-better effect: a developmental perspective

Audrey E. Parrish[1] · Emma E. Sandgren[1]

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Abstract

The less-is-better effect emerges when an option of lesser quantitative value is preferred or overvalued relative to a quantitatively greater alternative (e.g., 24-piece dinnerware set > 24-piece dinnerware set with 16 additional broken dishes; Hsee, 1998, *Journal of Behavioral Decision Making, 11,* 107–121). This decisional bias emerges when the option of lesser quantitative value is perceived as qualitatively better (e.g., smaller set of intact dishes > larger set of partially broken dishes). Interestingly, this effect emerges for adult humans when options are evaluated separately but dissipates when options are considered simultaneously. The less-is-better bias has been attributed to the evaluability hypothesis: individuals judge objects on the basis of easy-to-evaluate attributes when judged in isolation, such as the brokenness of items within a set, yet shift to quantitative information when evaluated jointly, such as the overall number of dishes. This bias emerges for adult humans and chimpanzees in a variety of experimental settings but has not yet been evaluated among children. In the current study, we presented a joint evaluation task (larger yet qualitatively inferior option vs. smaller yet qualitatively superior option) to children aged 3 to 9 years old to better understand the developmental trajectory of the less-is-better effect. Children demonstrated the bias across all choice trials, preferring an objectively smaller set relative to a larger yet qualitatively poorer alternative. These developmental findings suggest that young children rely upon salient features of a set to guide decision-making under joint evaluation versus more objective attributes such as quantity/value.

Keywords Less-is-better bias · Judgment and decision-making · Heuristics · Biases · Cognitive development

People make a multitude of daily decisions, and these choices are influenced by not only objective value and subjective preferences but also by the context in which decisions are made. Decades of research into judgment and decision-making, as pioneered by Tversky and Kahneman (1974, 1981), demonstrate that heuristics or mental short-cuts often lead to optimal decision-making in most circumstances but sometimes result in predictable biases. The majority of such research has been conducted with young adults, although a growing number of experimental studies have presented choice tasks to young children and older adults to explore the ontogeny of heuristics and biases. Traditional cognitive-development models predict a gradual, linear progression in logical reasoning abilities over time and with experience and, as such, less biased decision-making with age (e.g., Bjorklund, 2022; Haines & Moore, 2003). To account for biased decision-making among adults, dual-processing approaches have been proposed to better situate heuristics within a more integrated cognitive system (e.g., Epstein, 1994; Evans, 2008; Kahneman, 2003; Stanovich & West, 2000). System 1 is typically described as rooted in heuristics, operating automatically and implicitly, and can be thought of as more associative and affective in nature. System 2 is described as more reflective, deliberative, and analytical, and is thus presumed to govern and correct System 1 if and when biases are detected. For example, the sunk cost fallacy appears to decrease over the life span, which occurs when a prior investment irrationally leads one to continue with future investments (e.g., higher likelihood to stay at a bad concert for longer if you paid for the tickets versus if the tickets were free; Strough et al., 2011). This decline in susceptibility to the sunk cost effect potentially reflects an increase in executive functioning over the life span associated with a strengthening of System 2 and its ability to monitor System 1 (i.e., metacognitive capacities) and/or a greater focus on maximizing positive experiences (Strough et al., 2011).

Although this pattern of responding (i.e., less biased decision-making across the life span) has been demonstrated for a number of biases, research also reveals the opposite

✉ Audrey E. Parrish
audrey.parrish1@gmail.com

[1] Department of Psychology, The Citadel, 171 Moultrie St, Charleston, SC 29409, USA

pattern. Developmental reversals occur when younger children respond more rationally and less biased than adolescents and adults. These reversals extend to a variety of judgment heuristics including stereotype knowledge and reasoning, base rate judgments, and the representativeness heuristics among others (e.g., Davidson, 1995; De Neys & Vanderputte, 2011; Felmban & Klaczynski, 2019; Jacobs & Potenza, 1991; Klaczynski et al., 2009, 2020). For example, when presented with a classic framing problem, younger children (preschoolers) responded based on quantitative differences in outcomes regardless of the frame (gain vs. loss), whereas older children (2nd- and 5th-graders) demonstrated the bias as seen among adult humans (e.g., risk-seeking for losses and risk-avoidance for gains; Reyna & Ellis, 1994). These counterintuitive developmental reversals are accounted for by fuzzy trace theory in which gist-based, intuitive decision-making develops with age/experience, giving rise to more frequent use of heuristics accompanied by a subsequent increase in biases over time (Brainerd et al., 2011; Reyna & Brainerd, 1991, 2011). Alternatively, young children are thought to be governed by literal, verbatim-based responding, resulting in more analytical, quantitative response patterns under some circumstances. Unlike age-related increases in cognitive skills such as executive functions, heuristics and biases may not exclusively progress in a linear fashion, with some becoming more prevalent throughout adolescence and stabilizing in adulthood whereas others decline into late adulthood (e.g., Toplak et al., 2013).

One particular judgment and decision-making bias that lends itself to developmental research is the less-is-better effect, which has not yet been presented to children. The less-is-better bias undermines utility maximization theory, which states that individuals will prefer options that maximize overall utility or outcomes (Kahneman & Tversky, 1979). Decisions are made primarily under two evaluation modes: joint (options evaluated simultaneously) or separate (options evaluated in isolation or sequentially), which impacts decision-making in marked ways (see Hsee, 2000; Hsee et al., 1999; Kahneman & Thaler, 2006). In Hsee's seminal work on the less-is-better effect, adults valued an option of lesser quantitative value as higher if the objectively more valuable option was degraded or mis-represented in some way. For example, participants rated a $45 scarf as more valuable (in terms of generosity of the gift-giver, happiness with the product, and expense rating) than a $55 coat. Participants also were willing to pay more for a smaller amount of ice cream (7 oz.) that overflowed its container as compared to a larger amount of ice cream (8 oz.) that did not fill its container. Crucially, higher evaluations for the quantitatively smaller/lesser options were evident when alternatives were rated separately yet reversed or disappeared when the alternatives were assessed jointly.

Preference reversals as a function of evaluation mode are attributed to the evaluability hypothesis, which states that individuals judge options based on easy-to-evaluate or salient attributes (e.g., container overflow) when assessed separately as there is no alternative with which to make the comparison. However, this bias dissipates under joint evaluation as difficult-to-evaluate attributes (e.g., quantitative differences) become more salient when assessed simultaneously (e.g., 8 oz. vs. 7 oz. of ice cream; Hsee, 1996, 1998; Hsee et al., 1999). The less-is-better bias has emerged in similar behavioral decision experiments pitting higher-valued alternatives against lower-valued alternatives that are qualitatively superior on some facet. For example, baseball card collectors bid more for 10 mint condition cards relative to 10 mint condition cards plus three cards in poor condition, even though the latter set had a higher total value ($18) versus the former ($15; List, 2002). This study was important as it validated the less-is-better phenomenon in an actual marketplace with real transactions.

In previous work, we observed the less-is-better effect across a variety of experimental settings with a nonhuman primate species, the chimpanzee. Within these tasks, the primates were presented with two food sets, one of which was optimal (larger quantity) yet devalued in quality or misrepresented by context in similar ways to Hsee's (1998) less-is-better work with adults. In control trials, chimpanzees reliably maximized returns, selecting the larger of two food sets when presented identically or without context. However, the great apes routinely failed to maximize if the larger set was degraded (smaller, intact chip set > larger, partially broken chip set; Parrish et al., 2015) or if the smaller set overflowed its container (overflowing cup of fewer marshmallows > under-filled cup of more marshmallows; Parrish & Beran, 2014). These results are intriguing given that chimpanzees are not only highly motivated to maximize food intake but highly adept at doing so, rivaling or exceeding human performance in quantity discrimination tasks (e.g., Menzel, 1960, 1961). These comparative studies demonstrate the generalizability of the less-is- better effect, suggesting that such a bias is not only phylogenetically widespread but likely to emerge readily across the human life span. Moreover, this comparative work also demonstrates that the less-is-better bias emerges under joint evaluation for animals versus exclusively in separate evaluation as is observed with adult humans (e.g., Hsee, 1998). The robustness of the less-is-better effect under joint evaluation choice settings by animals may reflect a reliance on easy-to-evaluate attributes (e.g., degraded items or context effects such as the relationship between container size and food amount) to guide choice behavior versus a switch to more objective features, such as quantity. Previous literature has not yet addressed this bias among young children, which was the focus of the current study. Developmental data will help bridge the gap between research with nonhuman primates and adult humans and shed light on the life span trajectory as well as the mechanisms underlying this cognitive bias.

In the current study, we extended the less is better effect to young children to determine if this bias emerges similarly in childhood as has been documented among adults and with nonhuman primates. We evaluated the response of young children (3 to 9 years old) to a series of choice scenarios similar to those in Hsee (1998), but specifically implemented a joint-evaluation task akin to the previous comparative work with chimpanzees as described above. This approach lends itself well to developmental testing as a joint-evaluation paradigm is intuitive (both choices are presented simultaneously) and requires little to no training or verbal instruction/responses. The joint-evaluation task presents a simple choice versus introducing a more complicated evaluation scenario as is typically employed with adults (e.g., price allocations, satisfaction ratings, etc.) The current literature suggests that this bias should be widespread given its emergence in animal species and a diverse range of scenarios for human adults. We predicted that the less-is-better effect would emerge for children under joint evaluation, such that they would prefer a quantitatively smaller set if the larger set was qualitatively compromised (e.g., defective, broken). Alternatively, a developmental reversal may be observed in which children opt for a more quantitative, verbatim-based approach to choice behavior, resulting in less biased decision-making. This research will provide greater insight to the emergence of the less-is-better phenomenon to better understand how children value options that diverge on their quantitative and qualitative features. Furthermore, the current study is critical in light of the relatively limited developmental work in similar judgment and decision-making biases as well as more broadly within this research domain.

Method

Participants

We recruited 122 children for the current study from a local children's museum in Charleston, SC. Four children were older than our age criterion (i.e., older than 9 years of age), and thus were not included in the analyses. The final sample consisted of 118 children, including 59 females and 59 males. A total of 107 of the 118 participants' families provided birth date information on the demographics form, for an average age of 66.2 months (SD = 19.7 months). Note that for 20 of these participants, parents provided their child's birth month and year only, and in these cases, the first day of the month was used to calculate age as a function of the study date. A total of 117 of the 118 participants' families provided information regarding race/ethnicity. The racial distribution of these participants included: Caucasian (N = 84), African American (N = 17), multi-racial (N = 12), Hispanic (N = 2), and Asian (N = 2).

Prior to study inclusion, parental permission was obtained, and the children provided consent for participation. Study protocols were approved via The Citadel's Institutional Review Board (IRB00007870) as well as through the directorship of the children's museum.

Materials

A variety of objects were used for the manual choice task. The pre-trials consisted of two fake toy apples, one of which was damaged so that it appeared in poor condition and one of which was in good condition, as well as counting blocks commonly used for educational purposes (five red blocks vs. 10 yellow blocks). These trials were intended to familiarize children with the two-choice procedure, which included alternatives that differed in quality (apples) or quantity (blocks). Children who failed to choose the more valuable stimulus in these trials (e.g., the 'good' apple and the larger set of blocks) were excluded from analysis (N = 2).

For each trial type, there were two choices, including Set A (the quantitatively inferior but qualitatively superior alternative) and Set B (the quantitatively superior but qualitatively inferior alternative). Set A represented the less-is-better option. Trial types were consistent with Hsee's (1998) work on the less-is-better effect with adults, including perceptual overflow trials (contextual misrepresentation of quantity; e.g., less ice cream that overflows its container vs. more ice cream that does not fill its container), devaluation trials (larger set is damaged or defective; e.g., smaller set of intact dishes vs. larger set of partially broken dishes), and quality-over-quantity trials (set with greater quantitative value reflects a lesser-valued item; e.g., $45 scarf vs. $55 coat). We modified these trial types to be applicable to children. Set A is described first for each trial, followed by Set B. Objects used for test trials are shown in Fig. 1 and described in detail in Table 1.

The perceptual overflow trials (ice cream and fruit) consisted of a small (3 oz.) and large (5 oz.) clear plastic cup filled with seven cotton balls and eight cotton balls, respectively, for the ice cream trial, and 11 pieces of toy fruit and 12 pieces of toy fruit, respectively, for the fruit trial. The small cups with fewer cotton balls ("ice cream scoops") and pieces of toy fruit appeared to overflow their container whereas the larger cups with more cotton balls/pieces of fruit filled the cup but did not overflow. The "ice cream" cups were featured with a plush toy bear and the fruit cups were featured with a plush toy bunny along with a narrative that each animal liked to eat the respective foods. Children were charged with selecting the cup that they thought the bunny and bear would choose to eat if they really liked ice cream or fruit. Selection of the smaller cup with overflowing 'food' would reflect the less-is-better effect in these trials as it represented the quantitively inferior yet qualitatively superior set.

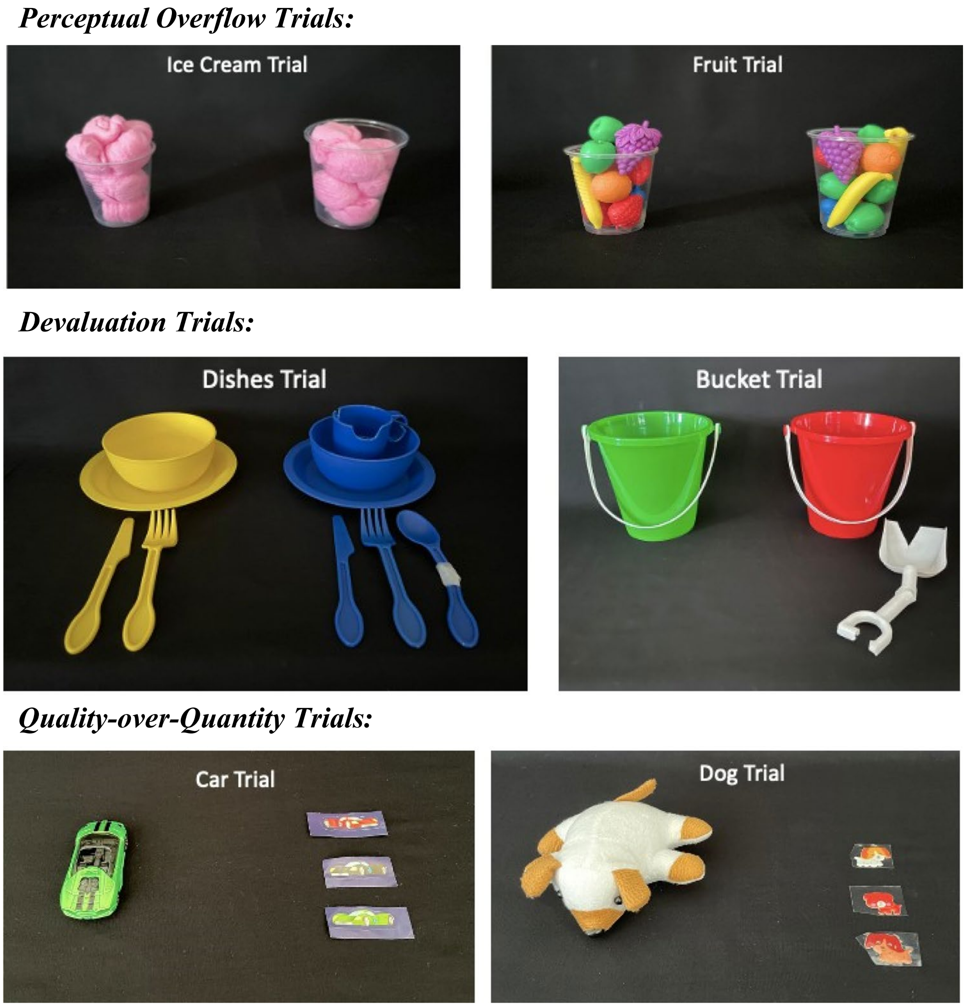

Fig. 1 Trial images, including the six trial types: Perceptual overflow trials (ice cream and fruit), devaluation trials (dishes and bucket), and quality-over-quantity trials (car and dog). Note that Set A (the less-is-better alternative, which was quantitatively inferior but qualitatively superior) is depicted on the left for each trial but left–right placement was randomized during testing. (Color figure online)

The devaluation trials included the dishes and bucket trials. The dishes trial consisted of four yellow dishes (toy plate, bowl, fork, and knife—all of which were intact) and six blue dishes (intact toy plate, bowl, fork, and knife, and a broken spoon and cup). The bucket trial included two sand buckets (one green bucket with no shovel and one red bucket with a broken shovel). Selection of the smaller yet wholly intact set (i.e., smaller intact yellow dish set; solo green bucket) would reflect the less-is-better effect in these trials as it represented the quantitively inferior yet qualitatively superior set.

The quality-over-quantity trials consisted of the car and dog trials, in which the smaller set included a more valuable toy category (i.e., higher in market value) versus a larger set of less valuable stickers. The car trial featured one toy car versus three car stickers, and the dog trial featured one plush dog versus three dog stickers. Selection of the solo high-category toy (i.e., single toy car; single plush dog) would reflect the less-is-better effect in these trials as it represented the quantitively inferior yet qualitatively superior set.

Design and procedure

General procedure

All participants were guests of the children's museum. Children engaged the task in a large open play area of the museum after parental permission was obtained. Participants further were informed that they could cease engagement with the task at any point during the study.

Children were first instructed that they would be playing a game to help us learn about how they make decisions. Participants completed eight total trials, including the two pretrials to determine whether they could make a choice via a pointing or verbal response and could follow simple instructions to

Table 1 Trial descriptions and percentage choice of Set A and Set B

Trial type	Trial	Set A	**Set B**	Set A	Set B	Binomial test
Perceptual overflow trials	Ice cream	Small cup (7 scoops)	Large cup (8 scoops)	80.17%	19.83%++	$P < .001$
	Fruit	Small cup (11 fruits)	Large cup (12 fruits)	76.72%	23.28%++	$P < .001$
Devaluation trials	Dishes	Small set (4 intact)	Large set (4 intact + 2 broken)	81.90%	18.10%	$P < .001$
	Bucket	Solo bucket	Bucket + broken shovel	66.38%	33.62%	$P < .001$
Quality-over-quantity trials	Car	1 toy car	3 car stickers	72.41%	27.59%	$P < .001$
	Dog	1 toy dog	3 dog stickers	65.52%	34.48%	$P < .001$

Note. Binomial tests assessed choice behavior (selection of Set A was calculated for each trial) against 50% responding. Significant preference for Set A reflected the less-is-better bias.

++ Approximately half (52.17%) and a third (33.33%) of children that selected Set B in the ice cream and fruit trials, respectively, indicated that they chose the larger cup as it appeared to have less food which was a better choice for the bear and bunny (e.g., to avoid a brain freeze or a stomachache or as a healthier option).

choose the set that they valued the most. Feedback was provided on these trials ("Good job, let's try another.") Criterion for data inclusion was selection of the "good" apple and the larger block set as described above. Children then completed the test trials in the following order: dishes, ice cream, car, fruit, bucket, dog. They were instructed to look at both options in each trial and choose the set that they would most like to have or, in the case of the Ice Cream and Fruit trials, which set the bear/bunny would most like to have. The goal was to create choice scenarios in which the children were motivated to maximize (i.e., select the alternative of greater value) to mimic work with adults and chimpanzees.

Trials were separated by opaque partitions so that Set A and Set B for a given trial were only visible during that trial's choice phase. Trials were not speeded or timed, thus progression through each trial was dependent upon each participant's self-pace. Left/right placement for Set A and Set B were randomized across trials. Children indicated their choice verbally or via pointing responses and were allowed to engage with the materials (inspecting, picking up, etc.) as they chose. The experimenter stood behind the child during the choice phase to limit potential cuing and feedback on performance was not provided. The experimenter encouraged participation via general statements: "Okay, let's try another one!" and answered queries with "You tell me!" Following task completion, children were given a small prize for participation. Choice behavior (Set A or Set B) as well as participant feedback regarding choice behavior were recorded in real time.

Results

All but two children passed the pre-trial criterion for the apple condition (selection of the "good" apple) and the blocks condition (selection of the larger block set). The two children that did not pass the pre-trials were not included in the following analyses.

Overall, children ($N = 116$) demonstrated a significant preference for less-is-better Set A (quantitatively inferior but qualitatively superior) collapsed across all trials (73.85%, Binomial test $p < .001$). Figure 2 depicts percent choice of Set A (the quantitatively inferior but qualitatively superior alternative) and Set B (the quantitatively superior but qualitatively inferior alternative) for the six trial types. We used Binomial tests to assess choice behavior (selection of Set A was calculated for each trial) against 50% responding. For all trials, children were significantly more likely to choose Set A as compared to chance, all *p*s < .001. Thus, for all trial types, children demonstrated the less-is-better bias that also was reflected when choices were collapsed across trials.

We then assessed for a potential age effect by correlating age in months with a child's total less-is-better score. Note that birth date information was not included on the demographic form for 11 participants, thus the following age analyses do not include these children. We first tallied the total possible Set A choices for each child across the six trials for an individual's less- is-better score, with a minimum score of 0 reflecting a choice of Set B in all trials and a maximum score of 6 reflecting a choice of Set A in all trials. A score of 6 yielded the strongest less-is-better effect, such that each trial reflected a selection of the quantitatively lesser/qualitatively superior. There was a significant, positive correlation between age in months and the total less-is-better scores, $r(103) = .284$, $p = .003$, 95% CI [.097, .451]. See Fig. 3. Thus, as age increased, selection frequency of the less-is-better set increased as well.

Discussion

The current study extended the less-is-better bias to young children to bridge the gap between the adult human and comparative judgment and decision-making literatures, which demonstrate similar, routine failures to maximize by adults

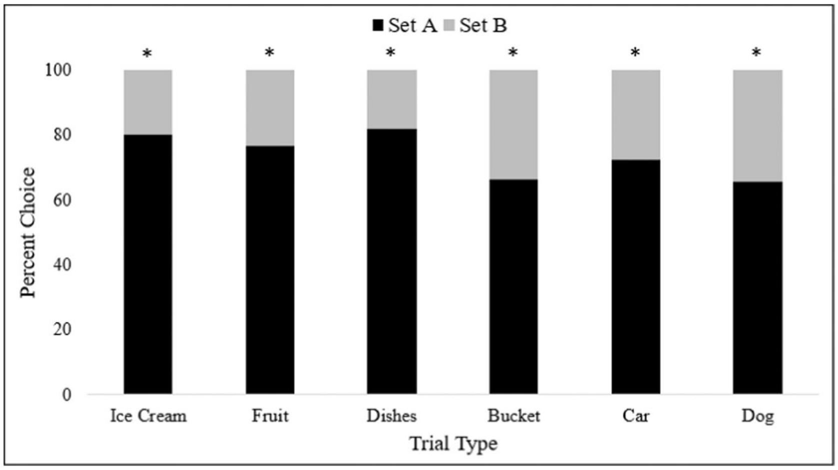

Fig. 2 Percentage choice of Set A (the less-is-better alternative; quantitatively inferior but qualitatively superior alternative) depicted in black and Set B (quantitatively superior but qualitatively inferior alternative) depicted in gray for the six trial types. Binomial tests assessed choice behavior (selection of Set A was calculated for each trial) against 50% responding. An asterisk indicates a significant bias to choose Set A, all *ps* < .001

and nonhuman primates. The less-is-better bias emerged under joint evaluation in the current study such that young children (3 to 9 years old) preferred an alternative that was objectively lesser in quantitative value if the larger set was qualitatively compromised in some way. This effect held across all trial types designed to replicate the original less-is-better study with adult humans (Hsee, 1998), including perceptual judgment trials in which the objectively smaller set overflowed its container relative to the quantitatively larger set that did not fill its container (ice cream and fruits). Beyond the perceptual domain, children preferred the smaller yet intact sets in the devaluation trials in which the larger set contained defective or damaged items (broken dishes and shovel). Finally, in the quality-over-quantity trials, children preferred the smaller yet more qualitatively desirable set (single toy car or plush toy dog) relative to a larger yet qualitatively less-valuable set of stickers.

Akin to chimpanzees, young children appeared to rely upon salient or easy-to-evaluate attributes of a set (e.g., brokenness of set items or relative container fullness) to guide decision-making under joint evaluation (Parrish & Beran, 2014; Parrish et al., 2015). These developmental results deviate from the adult findings, in which the less-is-better bias dissipates under joint evaluation, presumably as difficult-to-evaluate attributes such as amount or price become more salient when

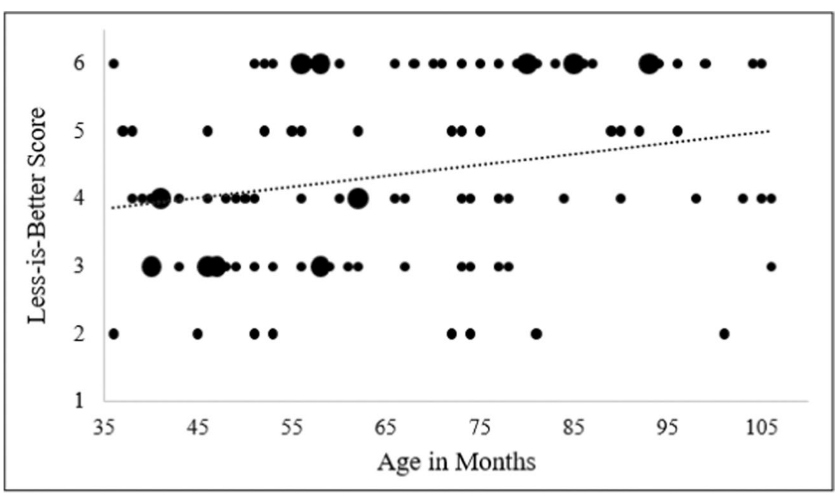

Fig. 3 The relationship between age in months to the children's overall less-is-better score, collapsing selection of Set A (the less-is-better alternative) across trials for a maximum possible score of 6. The size of the data point reflects the frequency of children with each less-is-better score for a particular age. As age increased, a child's choice of the less-is-better set also increased; this relationship was significant, $r(103) = .284$, $p = .003$, 95% CI [.097, .451]

assessed simultaneously (Hsee, 1996, 1998; Hsee et al., 1999). Although most studies in Hsee's (1998) experimental work with the less-is-better bias provided participants with precise quantitative features of the alternative sets (e.g., container size and amount of ice cream in oz.), Hsee also reported that the bias dissipated for adults under joint evaluation when this quantitative information was omitted. These results may indicate that joint evaluations among children and animals are more strongly governed by context effects in comparison to adults, for which a more developed cognitive-analytic system overrides such biases when faced with additional attributes to guide decision-making. Failures in utility maximization by children have been observed for other biases, including the peak-end effect, in which children who received a single highly desirable item (candy bar) were more satisfied than children who received the highly desirable item (candy bar) followed by a less desirable item (piece of bubble gum; Do et al., 2008; but see Mah & Bernstein, 2019).

Emergence of the less-is-better effect in young children underscores that decisions are not made in a vacuum, even in early childhood, instead they are context-dependent and reflective of a heuristics-based decisional system. The positive correlation between age and selection frequency of the less-is-better option across trials in the current sample demonstrates that as age increased, the bias strengthened. At face value, these results are unexpected given the prediction that the less-is-better bias should decrease with age/experience as adults do not demonstrate the bias under joint evaluation. It also may be that these results reflect a developmental reversal, in which younger children outperformed older children, the latter of whom demonstrated a stronger bias for the less-is-better alternatives. Developmental reversals have been documented in a variety of decisional tasks and reveal gist-based responding that develops with age/experience, and in turn gives rise to an increase in biases rather than a linear progression towards rationality (Brainerd et al., 2011; Reyna & Brainerd, 1991, 2011). It is important to note that this was a significant yet weak correlation and given that the age range was limited to 3 to 9 years old (with an average age of approximately 5.5 years old), future research should extend the age range assessed. Older children in early to late adolescence may demonstrate an increase in the less-is-better bias followed by a marked shift away from biased responding under joint evaluation to approximate adult responding. This would demonstrate a shift towards a more analytic approach to evaluating alternatives that emerges due to cognitive development and/or experience with decision-making.

Future developmental research also may consider the impact of experimental parameters on the less-is-better effect and related biases, particularly response time and choice outcome. Although the current task did not require speeded judgment, children moved through each choice at their own pacing and typically relatively quickly. Research with adult humans demonstrates a suppression of System 2 (cognitive-analytic) under time constraints (e.g., Finucane et al., 2000), thus the less-is-better bias may dissipate for children under conditions that favor slower and more deliberative decision-making. Also, these decisions were of relatively low consequence in that children were engaging in hypothetical choice scenarios, and thus this bias also may manifest differently in the face of real-world decisions (e.g., when judging actual food alternatives for personal consumption or when selecting among items that the children can keep). Application of such a bias in real-world settings (e.g., educational or home) will validate current experimental approaches, as has market-based research with adults exploring the less-is-better bias (e.g., List, 2002).

Biases such as the less-is-better effect reflect predictable failures in utility maximization, which are likely widespread among children as they are among nonhuman animals and adult humans in certain circumstances. Future studies that vary the quantitative and qualitative features of sets in addition to the context in which they are presented will shed light on factors relevant to the development of valuation systems among children and adolescents. Alternatively, the less-is-better bias may be viewed as rational versus a failure to maximize, such that the preference for a quantitatively smaller set is more beneficial in certain scenarios or reflective of personal preferences (e.g., desirability of smaller/quantitatively lesser sets or higher quality objects). Future research that queries children regarding their motivation for such choices may help to uncover the rationale behind such decisions. More broadly, studying decision-making from a developmental perspective can help us to better understand the mechanisms underpinning choice behavior, including heuristics, executive functions, and other key cognitive processes (e.g., quantitative and numerical cognition).

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Statement on data sharing All raw data for choice behavior as a function of trial type are freely available online (https://osf.io/5hpq6/).

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