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SHORT REPORT

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"Shape bias" goes social: Children categorize people by weight rather than race

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Abstract

Children tend to categorize novel objects according to their shape rather than their color, texture, or other salient properties—known as "shape bias." We investigated whether this bias also extends to the social domain, where it should lead children to categorize people according to their weight (their body shape) rather than their race (their skin color). In Study 1, participants (n = 50 US 4- and 5-year-olds) were asked to extend a novel label from a target object/person to either an object/person who shared the target's shape/weight, color/race, or neither. Children selected the shape-/weight-matched individual over the color-/race-matched individual ($d_{objects} = 1.58$, $d_{people} = 0.99$) and their shape biases were correlated across the two domains. In Study 2, participants (n = 20 US 4- and 5-year-olds) were asked to extend a novel internal property from a target person to either a person who shared the target's weight, race, or neither. Again, children selected the weight-matched individual ($d = 1.98$), suggesting they view an individual's weight as more predictive of their internal properties than their race. Overall, results suggest that children's early shape bias extends into the social domain. Implications for weight bias and early social cognition are discussed.

KEYWORDS
categorization, children, gender, race, Shape bias, weight

Research Highlights

- Preschoolers extend novel labels based on people's weight rather than their race.
- Preschoolers infer internal features based on people's weight rather than their race.
- Shape biases are present, and correlated, across the social and object domains.

1 | INTRODUCTION

Children tend to categorize novel objects according to their shape rather than their color, texture, or other salient properties—a tendency known as "shape bias" (Diesendruck & Bloom, 2003; Landau et al., 1988). To date, research on shape bias has primarily been conducted in the object domain. Here, we investigated whether this bias also extends to the social domain, where it should lead children to categorize people according to their weight (their body shape) rather than their race (their skin color).[1]

We aimed to inform research on weight-based prejudice, which is already strong by early childhood (for reviews, see Paxton & Damiano, 2017; Puhl & Latner, 2007). For example, preschoolers attribute more negative adjectives to fat than thin or average-weight targets (Cramer & Steinwert, 1998; Musher-Eizenman et al., 2004) and are less likely to pick fat targets to represent someone with strong academic, artistic, athletic, or social abilities (Penny & Haddock, 2007). In friendship-ranking tasks, children rank fat children lowest among children with various physical differences (e.g., facial disfigurement), a finding that has been replicated in racially and socioeconomically distinct samples across New York, New Jersey, Montana, and Greece (Koroni et al., 2009; Latner & Stunkard, 2003; Richardson et al., 1961). Despite this striking evidence that children show broad negative associations with fat peers, little research examines the cognitive factors driving these associations. Why is weight such a powerful social cue? We speculate that, in addition to pervasive anti-fat messaging (Berge et al., 2015; Janssen et al., 2004; Latner et al., 2007), an early bias toward shape as a category-diagnostic feature may also contribute to this early prejudice.

Some existing research examines how the shape bias differs across the object and natural kind domains, but results have been somewhat mixed, and also have not included the social domain. For example, some work finds that although 3-year-olds label novel objects based on their shape, they do not do so when those objects have eyes (Jones & Smith, 2002). Other work, however, finds that children extend labels based on shape across both object and animal domains, but that they also rely on certain additional features (e.g., texture) to extend labels in the animal domain (Booth & Waxman, 2002). Still other work finds that the shape bias is *stronger* for objects with eyes compared to objects without eyes (Jones et al., 1991, Experiment 2). These existing studies contrast the object and natural kind (animal) domains, rather than the object and social (human) domains.

In Study 1, we assessed children's shape bias using a lexical categorization task (adapted from, e.g., Diesendruck & Bloom, 2003; Landau et al., 1988). In this task, children were asked to extend a novel label from a target (either an object or a person) to one of three options (either objects or people): One shared the target's shape (object) or weight (person), another shared the target's color (object) or race (person), and a third shared neither. Race was selected as the primary contrastive characteristic because it is superficially analogous to color, and because preschoolers readily extend labels based on race (Aboud, 2003; Waxman, 2010). For example, when Waxman (2010) provided preschoolers with novel labels for target individuals (e.g., "This one is a Wayshan"), preschoolers extended novel properties of the targets' to same-race rather than different-race individuals (a large-sized effect, $\eta^2 = 0.22$). As a secondary investigation, and an even stronger test case against which to measure children's tendency to extend labels based on weight, we also included a set of trials featuring gender, rather than race, as the contrastive characteristic. While gender does not have a clear analog in the object domain (unlike weight and race), it is a famously potent cue for young children; their essentialist conceptions of gender are uniquely strong (Rhodes & Mandalaywala, 2017) and they use gender to infer everything from toy and activity preferences (Martin et al., 1995; Shutts et al., 2013) to brain and blood (Taylor et al., 2009).

We had four specific research questions: (1) Will children label objects based on their shape, rather than their color, thus replicating the classic shape bias effect in the object domain? (2) Will children label people based on their weight, rather than their race, thus extending the shape bias effect into the social domain? As a secondary and stronger test of children's reliance on weight, will children also label people based on their weight rather than their gender? (3) Will there be any correlation between children's shape-based, rather than color-based, labeling in the object and social domains? (4) How will the above effects shift over development?

We predicted that children would demonstrate shape bias in both the (1) object and (2) social domains. We made no a priori hypotheses about (3) relations between shape bias in the object and social domains, as we were not aware of work finding stable individual differences in shape biases even within the object domain. We also predicted that (4) shape bias would grow stronger over development (consistent with previous work; e.g., Landau et al., 1988).

Our research questions, hypotheses, procedure, and sampling plan were preregistered at osf.io/c5gn7.

2 | STUDY 1

2.1 | Method

2.1.1 | Participants

Participants were 50 four- and five-year-old children[2] (M = 5.08, SD = 0.5), diverse in gender (28F/21 M/1NB) and race (56% White, 16% Asian, 10% Multiracial, 4% Latinx, 4% Black, 10% did not report). Participants were recruited from a child participant database ($n = 43$) and social media ($n = 7$). An a priori power analysis suggested that this sample size would enable us to detect medium-sized main effects of age and domain, as well as a medium-sized correlation in within-subjects judgments across domains, at a power level of 80%.

2.1.2 | Materials and procedure

The procedure was conducted virtually over Zoom. A researcher met individually with each participant and their caregiver. Researchers shared PowerPoint slides featuring cartoon images (created using *Vyond*, see Supplemental Materials for the full set of stimuli and for additional information about stimuli creation).

First, participants completed two practice trials designed to familiarize them with the procedure, especially the manner by which they would verbally indicate their choices over Zoom. These practice trials featured familiar animals (see Figure 1, top panel). On the first trial, participants were presented with an image of a dog and told, "This is a dog! See, it's a dog!" and asked, "Which one of these is also a dog? Red, blue, or yellow?" As each color choice was spoken, the researcher revealed a frog (above a red line), a different dog (above a blue line), and a bird (above a yellow line). Participants answered verbally by expressing their color choice, and received feedback ("Great job! That's how we play this game!") Participants then completed a second practice trial featuring a cat as the target. All participants answered the practice trial questions correctly.

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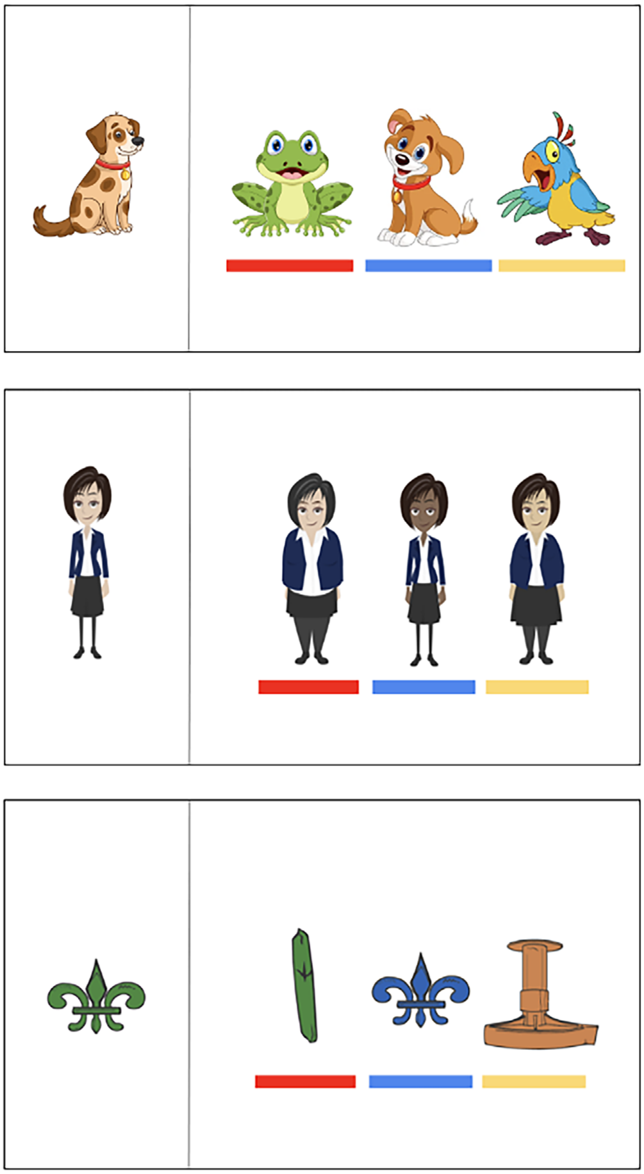

FIGURE 1 Example slides from a practice trial (top panel), a social domain test trial (middle panel), and an object domain test trial (bottom panel). Practice and social domain trial stimuli were used in both Studies 1 and 2, while object domain trial stimuli were used in Study 1 only.

Next, participants completed ten social domain test trials (see Figure 1, middle panel), including five Weight-Race trials followed by five Weight-Gender trials. On each trial, participants were shown a target individual and told, for example, "He is a Zarpie! See, he's a Zarpie!" They were then shown three more individuals and asked, "Who else is also a Zarpie? Red, blue, or yellow?" On the first five trials, these were a weight-matched, race-matched, and distractor individual (different in both weight and race). On the next five trials, these were a weight-matched, gender-matched, and distractor individual (different in both gender and race). See Supplemental Materials for full set of stimuli.[3] The target's weight, race, and gender were varied across trials, as was the visual arrangement of the three individuals. The three individuals were always identical aside from the two characteristics of interest to avoid extraneous characteristics affecting responses.

Finally, participants completed five object domain test trials (see Figure 1, bottom panel). On each trial, participants were asked to extend a novel label from a target object to either a shape-matched, color-matched, or distractor object (different in both shape and color). For example, participants were shown the target object and told, "This is a toma! See, it's a toma!" They were then shown three more objects and asked, "Which one is also a toma? Red, blue, or yellow?" The visual arrangement of objects was again varied across trials. The order of trials was fixed in order to prevent participants' choices on the object domain trials (on which we expected to observe a strong shape bias) from influencing their choices on the social domain trials.[4]

We computed an Object Shape Bias Score for each participant as proportion of trials (out of five) on which they selected the object with the same *shape* as the target. We also computed a Social Shape Bias Score for each participant as the proportion of trials (out of five) on which they selected the person with the same *weight* as the target on the Weight-Race trials. We computed a similar score on the Weight-Gender trials.

2.2 | Results

First, we confirmed that participants demonstrated the classic shape bias in the object domain, replicating previous work. A one-sample *t*-test compared participants' Object Shape Bias Scores (0–1) to chance-level (defined conservatively as 0.5, given that children rarely chose the distractor object). The analysis revealed a large shape bias effect in the object domain: participants extended the novel labels to the shape-matched object at above-chance rates ($M = 0.87$, $SD = 0.24$, $t(49) = 11.2$, $p < 0.001$, Cohen's $d = 1.58$, Figure 2 top panel), confirming our first hypothesis.

Next, we investigated whether our participants demonstrated a "shape" bias in the social domain by comparing participants' Social Shape Bias Scores (0–1) to chance (0.5) on the Weight-Race trials. We observed a large shape bias effect, with participants extending the novel labels to the weight-matched individual at above-chance rates ($M = 0.78$, $SD = 0.28$, $t(49) = 7.0$, $p < 0.001$, Cohen's $d = 0.99$, Figure 2 bottom panel), confirming our second hypothesis. A paired-samples *t*-test revealed no difference in the rates at which participants chose the race-matched individual versus the distractor ($t(49) = 1.31$, $p = 0.2$), as both choices were rare ($M_{racematch} = 0.09$, $SD_{racematch} = 0.17$, $M_{distractor} = 0.13$, $SD_{distractor} = 0.15$). On the Weight-Gender trials, we found that participants were equally likely to select the weight-matched and the gender-matched individual ($M_{gendermatch} = 0.46$, $SD_{racematch} = 0.40$, $M_{distractor} = 0.45$, $SD_{distractor} = 0.40$, $p = 0.99$).

We were also interested in potential relations between participants' Object Shape Bias Scores (their tendency to label objects by shape rather than color) and their Social Shape Bias Scores (their tendency to label people by weight rather than race). A correlation was conducted to investigate whether these variables would be positively correlated, and revealed a significant result ($r(48) = 0.28$, $p = 0.026$) indicating a

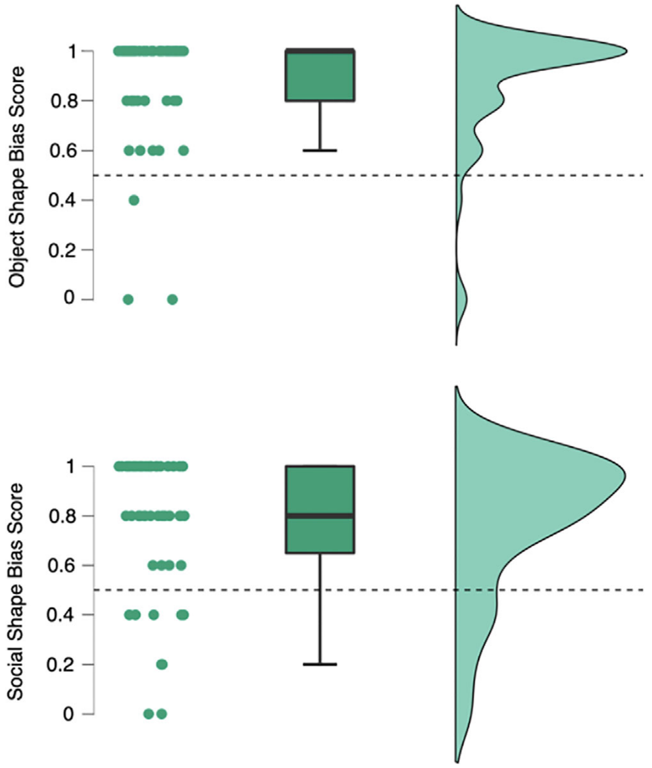

FIGURE 2 Distributions of Object (top) and Social (bottom) Shape Bias Scores in Study 1. Dotted lines represent chance-level responses.

weak positive correlation between Shape Bias scores across the two domains.

Finally, we investigated the role of age in the above effects. A linear mixed-effects model was conducted with age (continuous), domain (object vs. social), and their interaction as fixed effects, as well as random intercepts for participants. The model revealed no main effect of age ($p = 0.63$) and no significant interaction between age and domain ($p = 0.83$), in contrast to our final hypothesis. There was also no significant main effect of domain ($p = 0.67$).

3 | DISCUSSION

In Study 1, participants demonstrated powerful shape biases in their extension of labels to both objects and people, as predicted. Just as children relied more on objects' shape than on their color when extending labels, children also relied more on people's weight than on their race, and they relied equally on people's weight and on their gender. Moreover, shape biases were positively correlated across the object and social domains, which may suggest a shared underlying mechanism. We note that the differences in shape were more pronounced in the object than the social domain, potentially inflating shape biases in the object domain; as such, our results should not be used to draw conclusions about the *relative* size of shape biases in the social versus object domains. We conclude only that shape biases exist, and are correlated, across both domains.

We did not detect any effects of age. Although our preregistered hypothesis was that the shape bias would strengthen with age, post-hoc examination of the literature revealed that although the shape bias does increase between the first and third year of life (Perry & Samuelson, 2011; Poulin-Dubois et al., 1999), arguably driven by increases in vocabulary as children learn that words tend to be associated with objects of the same shape (Samuelson, 2002), there are often no age-related changes among 3- to 6-year-olds (e.g., Davidson et al., 2018). The narrow 2-year age range of our participants may have made it especially difficult to detect any age effects that did exist.

Why might shape be such a powerful cue for young children? Preschoolers have a strong understanding that social categories reflect internal shared features, not just perceptual similarity (Gelman & Davidson, 2013; Gelman & Wellman, 1991). For example, preschoolers report that a girl has female internal parts even if she visually resembles a boy (Gelman et al., 1986) and that a person's race can't be changed by painting their skin (Pauker et al., 2010). Overall, preschoolers understand that insides, rather than merely outsides, are relevant for social category membership. Thus, children's shape bias may indicate category membership by implying shared internal features. However, this claim is only indirectly supported by the results of Study 1. Study 2 tested this possibility directly.

4 | STUDY 2

Study 2 examined how children extend novel internal properties to people based on their weight versus their race. If children do extend novel internal properties based on shape, this would provide more direct evidence that children's reliance on shape may reflect a conceptual understanding of kindhood (in particular, an understanding that kindhood involves shared internal features) rather than merely reflecting perceptual matching. Our hypothesis was that participants would extend internal properties to individuals based on their weight, rather than their race, extending the primary finding from Study 1. We also examined whether participants would extend internal properties based on weight rather than gender as a stronger test of children's reliance on weight.

4.1 | Participants

Participants were 20 four- and five-year-old children ($M = 5.08$, $SD = 0.5$), diverse in gender (12F/7 M/1NB) and race (40% White, 25% Asian, 20% Multiracial, 10% Latinx, 5% Black). Participants were recruited via social media.

This sample size was selected based on a power analysis for a two-tailed one sample t-test using the effect size for weight bias in the social domain obtained in Study 1 (Cohen's $d = 1.0$) and a power level of 80%, which revealed that 10 participants would be sufficient to detect an effect. We chose to double this sample size to 20, given that we were not certain that the effect would be as large in Study 2 as it was in Study 1.

4.2 | Materials and procedure

As in Study 1, the procedure was conducted virtually over Zoom. Materials consisted of the practice and social domain trials from Study 1. Here, however, participants were asked to extend novel properties rather than novel labels.

First, participants completed two practice trials featuring familiar properties of familiar animals (see Figure 1, top panel). On the first trial, participants were presented with an image of a dog and told, “He says ‘woof woof!’ See, he says ‘woof woof!’” and asked “Which one of these also says ‘woof woof’? Red, blue, or yellow?” As each color choice was spoken, the researcher revealed a frog (above a red line), a different dog (above a blue line), and a bird (above a yellow line). Participants answered verbally and received feedback, as in Study 1. Participants then completed a second practice trial featuring a cat (“…Which one of these also says ‘meow meow’?”). All participants answered the practice trial questions correctly.

Next, participants completed ten test trials.[5] They were presented with slides (identical to Study 1; see Figure 1, middle panel) and were asked on each slide to extend a novel internal property from a target individual to one of three individuals. For example, participants were told, “She has Flurp in her blood! See, she has Flurp in her blood!” and asked, “Who else has Flurp in her blood? Red, blue, or yellow?” On the first five trials, they were presented with a weight-matched, race-matched, or distractor individual. On the next five trials, they were presented with a weight-matched, *gender*-matched, or distractor individual. The visual arrangement of the individuals was varied across trials. The internal properties included “Zazz in her bones,” “Zarpie inside her body,” “Blicket under his skin,” and “Gazzer in his brain” (adapted from Ahn et al., 2000). We computed a Social Shape Bias Score as the proportion of trials (out of five) on which participants selected the individual with the same *weight* as the target on the Weight-Race trials. We also computed this tendency on the Weight-Gender trials.

4.3 | Results

A one-sample *t*-test compared participants’ Social Shape Bias Scores (0–1) to chance-level (defined conservatively as 0.5). Confirming our hypothesis, the analysis revealed that participants chose the weight-matched individual at above-chance rates ($M = 0.88$, $SD = 0.20$, $t(19) = 8.54$, $p < 0.001$, Cohen’s $d = 1.98$, Figure 3), a large-sized effect. A paired-samples *t*-test revealed no difference in the rates at which participants chose the race-matched individual versus the distractor ($t(19) = 0.81$, $p = 0.43$; $M_{racematch} = 0.05$, $SD_{racematch} = 0.11$, $M_{distractor} = 0.07$, $SD_{distractor} = 0.12$).

Next, a paired-samples *t*-test investigated participants’ choices on the Weight-Gender trials. Results indicated that participants were equally likely to choose the gender-matched as the weight-matched individual ($M_{gendermatch} = 0.33$, $SD_{gendermatch} = 0.26$, $M_{weightmatch} = 0.48$, $SD_{weightmatch} = 0.41$).

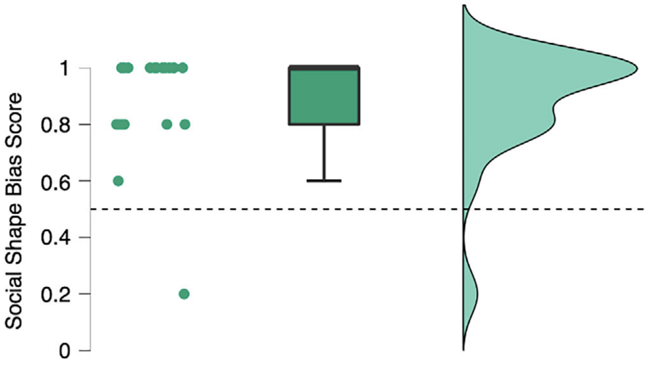

FIGURE 3 Distribution of Social Shape Bias Scores in Study 2. Dotted line represents chance-level responses.

5 | GENERAL DISCUSSION

We investigated whether children’s shape bias—their tendency to form categories based on shape rather than color—extended to the social domain. We found strong evidence that children extend novel labels (Study 1) and novel internal properties (Study 2) according to people’s weight rather than their race. Children’s use of weight was also similar to their use of gender, a hugely potent cue for young children that, unlike weight, has been well-studied.

5.1 | Implications

Weight-based prejudice has largely been ignored in the early social cognition literature. Despite striking evidence for the early emergence of this prejudice, little is known about its cognitive and conceptual underpinnings. The present studies suggest that one reason children regard weight as a meaningful and informative category may be because weight indicates something about how people are “on the inside.” This aligns with recent findings that children essentialize weight (Peretz-Lange et al., 2023). This conception may be further enhanced by messages from peers, parents, and media emphasizing weight as meaningful (Berge et al., 2015; Janssen et al., 2004; Latner et al., 2007).

Our findings also align with evidence that children tend not to view race as determined by an internal essence (Mandalaywala et al., 2019; see Rhodes & Mandalaywala, 2017 for a discussion). This is surprising given children’s sensitivity to race as a social category and their broad essentialist proclivities. We speculate that one reason children may *not* hold the essentialist view that race is determined by internal properties, but *do* appear to hold such views of weight, may be their domain-general view of shape as more informative about kind than color is (i.e., shape bias). That said, we caution readers against using our results to draw strong conclusions about children’s conceptions on race, given that our focus in this study was on weight.

Our findings also have implications for the etiology of the shape bias. Some accounts argue that this bias reflects learned associations between objects’ shapes and functions; in other words, that shape predicts an object’s function, and therefore its label, better than color does

(Booth et al., 2010; Nelson et al., 2000). However, our results suggest that reasoning about function alone cannot fully account for the shape bias, since humans do not have functions in the same way that objects do. Thus, the shape bias may reflect a more domain-general cognitive process.

5.2 | Limitations

It is difficult to create weight- and race-matched individuals that are equally visually similar to a target, given the "apples and oranges" nature of these characteristics. It is possible, therefore, that weight was more visually salient than race in our stimuli, and therefore that children's choices reflect perceptual matching rather than conceptual reasoning. Further work using a range of different social stimuli is needed to understand the generalizability of our results beyond the stimuli used here.

A second limitation concerns the generalizability of our results beyond our US-based sample. Our sample lives in a relatively bodily- and racially-heterogenous context, which may reduce their racial essentialism (Mandalaywala et al., 2019; Pauker et al., 2016) and weight essentialism (through the same mechanism, potentially). As such, we might expect effects to be more pronounced in more homogenous contexts, but future research should investigate cultural differences directly.

6 | CONCLUSIONS

We found that children's shape biases extend into the social domain. Our results suggest that early shape biases support a view of shape as a highly meaningful and informative characteristic of people, not only of objects. We hope that future research on the shape bias includes the social domain as providing a new window into its nature. Similarly, we hope that future research on early social cognition includes weight as a characteristic worthy of study.

ACKNOWLEDGMENTS

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

ETHICS STATEMENT

All research was approved by Institutional Review Boards at Boston University (Protocol #3981E) and SUNY Purchase (Protocol #2122-11).

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are publicly available on the Open Science Framework at osf.io/c5gn7.

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ENDNOTES

[1] It is important to note that race is a complex social construct that involves much more than skin tone or even phenotype in general (Roth, 2016). We operationalize race as skin tone in this study for the purposes of analogizing to differently-colored objects, and supported by research indicating that young children's perceptions of race are based almost entirely on skin color (Dunham et al., 2015). Similarly, differences in weight do not neatly map onto differences in body shape, as weight also reflects height, muscle mass, bone mineral density, and more. We operationalize weight as body shape in this study for the purposes of analogizing to differently-shaped objects.

[2] The children in our study were older than children in previous studies that have investigated the emergence of shape bias (e.g., Landau et al., 1988; Diesendruck & Bloom, 2003). We chose children of this age because we were interested in examining shape bias in the social domain in children for whom a strong shape bias in the object domain was already present.

[3] There was an error in the creation of our stimuli for the Weight-Race trials which led to the distractor individual having the same weight as the race-matched individual. This trial nevertheless featured only one race-matched and one weight-matched individual, as intended. Removal of this trial from analyses did not impact our results. Further information is provided in the Supplemental Materials.

[4] The full procedure involved fifteen trials in the social domain (five each pitting weight vs. race, weight vs. gender, and gender vs. race, in that order), five in the agent domain (i.e., objects with eyes), and five in the object domain (i.e., objects without eyes). As per our preregistration, the agent domain was included so that *if* participants showed a shape bias in the object but not the social domain, performance in the agent domain could clarify the nature of this difference. However, that pattern of results did not emerge, and thus we do not report on results from this domain in this manuscript. Instead, these results are included in the Supplemental Materials. Similarly, we made no a priori hypotheses about the gender vs. race trials, but included them for their potential to contextualize children's performance on the other trials should that prove relevant. We do not report on results from these trials in this manuscript, but they are included in the Supplemental Materials.

[5] The full procedure involved fifteen trials in the social domain (five each pitting weight against race, weight against gender, and gender against race, in that order), as in Study 1. We do not report on results from the final set of trials in this manuscript, but these results are included in the Supplemental Materials.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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