Let's talk structure: the positive outcomes of structural thinking

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Abstract

Group disparities, such as the gender wage or racial achievement gap in the US, pervade societies. Unfortunately, children and adults often attribute these disparities to inherent (e.g. biological) features of groups, which leads to problematic outcomes (e.g., overgeneralizing, endorsing disparities). In contrast to inherent thinking, structural thinking about social disparities, which attributes disparities to a stable external structure, could lead to more positive social outcomes. Here, we induced biological, cultural, or structural thinking about an occupational disparity, and found that the latter caused adults (n = 90) to show more context-sensitive generalizations, judge the disparity as less acceptable, and provide more structural interventions. 7- to 9-year-olds (n = 70) showed similar but weaker results for more context-sensitive generalizations and judging the disparity as less acceptable. Cultural thinking showed an intermediate pattern between biological and structural thinking. Overall, structural thinking could be a fruitful way of mobilizing progress on social disparities.

Keywords: social groups; social disparities; structural reasoning; inherent reasoning

Introduction

Social disparities are pervasive throughout societies. For example, people are socialized differently into social roles, they work different jobs, and they receive different resources based on gender. Children and adults are often biased to attribute these disparities to internal features of groups, for example, attributing gender occupational disparities to inherent gender differences in ability or interest. This bias to favor inherent explanations is known as *inherence bias*, and emerges early in development across a variety of domains (Cimpian & Salomon, 2014). Inherence bias can contribute to the even deeper belief of *psychological essentialism*, where groups are thought to be fundamentally different (often at a biological level) in a way that causes observable group differences and disparities (Gelman, 2004). For example, biological essentialism of gender might posit some fundamental biological difference between men and women (e.g., testosterone vs estrogen) that causes observable gender occupational disparities. As a result of inherent and essentialist thinking, people are biased towards internal, often biological, explanations for social disparities.

In contrast, *structural reasoning* attributes group properties to a stable external context that group members are situated in (Vasilyeva et al., 2018). For example, structural reasoning about gender differences might attribute gender differences to the distinct and stable patterns of socialization and discrimination that people face depending on their perceived sex. While inherent reasoning focuses on the causal role of something inherent to group members, structural thinking focuses on temporally stable structures that are external to group members. In reality, structural factors are important determinants of social disparities, such as gender occupational disparities, which are rooted in how men and women are socialized, treated, and the resources and opportunities they have access to (Hill et al., 2010). As such, our preference for inherent over structural reasoning can lead us to overlook important structural causes of social disparities, and even lead us to inaccuracies. Although children generally default to inherent reasoning (Cimpian & Steinberg, 2014), children are capable of attributing a group's behavior or status to structural causes when given appropriate evidence, starting around 5 to 6 years and doing so more robustly around 7 to 8 years of age (Peretz-Lange et al., 2021; Vasilyeva et al., 2018; Yang et al., 2021).

Building on prior work, we hypothesize that structural reasoning about social disparities could lead to more socially positive outcomes, compared to the well-known problematic outcomes of inherent reasoning. Specifically, structural reasoning about social disparities could lead to more socially positive outcomes for what we think is the case (*generalization*), what should be the case (*acceptability*), and how to change the case (*intervention*). First, while inherent reasoning leads to overgeneralization across the entire group (e.g., women aren't interested in pursuing science), structural reasoning makes adults' and children's generalizations about social differences more sensitive to context (Vasilyeva et al., 2018), suggesting that it could lead to more context-sensitive generalizations about social disparities as well (e.g., predicting that a woman in a non-sexist environment could pursue science). Second, inherent reasoning treats group disparities as natural outcomes, leading adults and children to justify disparities (Hussak & Cimpian, 2015). In contrast, structural reasoning makes no normative commitment to the status quo, potentially allowing adults and children to reject disparities (e.g., gender gaps in science). Lastly, since different causal frameworks suggest different interventions, inherent reasoning may suggest that the group must change (e.g., women need to be smarter), while structural reasoning may suggest the very structural interventions needed to address real-world social disparities (e.g., providing resources, support, oppor-

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tunity access). In past work, verbally highlighting structural features relevant to a momentary status disparity (a group winning or losing a game) made children more likely to provide structural interventions (Peretz-Lange et al., 2021), but this result remains to be tested with more sustained and realistic social disparities. Could structural reasoning about social disparities lead to more socially positive outcomes than inherent reasoning?

A third framework to contrast is *cultural reasoning*, which we define as attributing group properties to shared beliefs or values held by a group. A group's culture may not be inherent to any individual group member, as in biological reasoning, but cultural reasoning may still involve some level of inherence, since a group's culture is something inherent to a group. Although cultural reasoning is a common belief, cultural reasoning could lead to outcomes just as problematic as inherent reasoning. Cultural thinking could suggest that groups' values are responsible for social disparities (e.g., Asians succeed because they value hard work, Black people don't because they have a culture of poverty) (Osajima, 2005; Sue & Okazaki, 1990), leading to similar levels of stereotyping as biological essentialism (Bailey et al., 2021). Like biological explanations, cultural explanations also often fail to capture historical ground truth, representing potentially another form of bias (Kersting et al., 2020). What are the outcomes of cultural reasoning about social disparities?

In the context of mere social differences, rather than social disparities, structural reasoning does lead to more positive outcomes than biological or cultural reasoning (Zhang & Markman, 2021). 5- to 8-year-olds and adults learned that a novel group difference (two groups eat different foods) had either a biological cause (group physiology), a cultural cause (group taboos), or a structural cause (food availability in the group's environment). Compared to those who learned a biological or cultural cause, those who learned a structural cause were more likely to make context-sensitive generalizations, accept non-conformity, and suggest structural interventions on the group difference. These results were seen even in children, whose strong essentialist and normative tendencies are well-documented (Gelman, 2003; Roberts et al., 2016).

However, the group differences we reason about in the real-world often are not neutral differences, or even momentary status differences, but sustained social disparities where groups differ in social status or desirable outcomes. For instance, currently in the US, many gender and racial minorities work low-wage, low-status jobs due to structural factors like economic discrimination (Bertrand & Mullainathan, 2003). Could structural reasoning about group disparities lead to positive outcomes for children and adults?

Current studies

The current studies contrast the outcomes of structural thinking, inherent thinking, and cultural thinking about a novel social disparity, specifically a novel occupational, economic, and status disparity.

For inherent reasoning, we used biological reasoning about physiology, since essentialism of social groups often takes the form of biological essentialism (Gelman, 2003). In addition, group physiology is commonly cited in inherent explanations for occupational disparities (e.g., the belief that Black people are physically stronger for why there are many Black athletes), and prior work has contrasted structural reasoning with reasoning about group physiology (Peretz-Lange et al., 2021).

To maximize our ability to induce different ways of thinking about social disparities, we used novel social groups. To experimentally induce biological, cultural, or structural thinking about the novel disparity, adults (Study 1) and children (Study 2) heard one of three explanations for why one novel group worked a novel low-status job: their physiology is well-suited to the job, their beliefs/values are well-suited to the job, or they are targeted by a discriminatory policy that restricts access to the high-status job, respectively. Finally, we contrasted the outcomes of these ways of thinking for reasoning about what is the case (generalization), what should be the case (acceptability), and how to change the case (intervention).

We hypothesized that participants in the structural condition would 1) show more context-sensitive generalization, 2) judge the disparity as less acceptable, and 3) suggest more structural interventions, compared to the biological condition. We also expected the cultural condition to fall between the biological and structural conditions on all measures.

Study 1: adults

We first tested these hypotheses in adults. This study's preregistration is not viewable due to an accidental archiving failure (caused by minor changes to a file in the linked repository after pre-registration submission). Nonetheless, all hypotheses, methods, and results are reported as stated in the pre-registration, except where noted. Materials and data are available on OSF.

Participants

The sample was 90 US adults recruited from Amazon Mechanical Turk via CloudResearch and paid $1.00 for participating (Litman et al., 2017). Another 8 participants were excluded due to failing attention check questions about each group's jobs, and 19 participants for accidental assignment to receive no explanation.

Compared to US demographics at the time of sampling, the sample was largely representative of gender (53% identified as male, 47% as female), and oversampled White and undersampled Hispanic/Latinx populations (72% identified as White, 9% Black or African American, 6% East Asian, 3% Hispanic or Latino, 2% South or Southeast Asian, and 8% two or more races) and was slightly more educated (13% reported completing a GED, 29% some college, 50% a Bachelor's, 1% a Master's) (*QuickFacts*, 2021).

Methods

Participants read a vignette about two novel social groups, Zarpies and Vawns (depicted as cartoon people with different color bodies), who lived on an island far away and worked different novel jobs. Zarpies work a low-status job as "aquafruit farmers" and "dive into the ocean to harvest aquafruit." Aquafruit farming is "dangerous, because there are many sharks in the water", and Zarpies are "paid very little for harvesting aquafruit." Vawns work a high-status job as "distribution managers" at a food distributing company, which is "a relatively low risk job" where Vawns "earn a comfortable wage."

Participants were randomly assigned to 1 of 3 conditions: biological, cultural, or structural. In the *biological condition*, participants learned one group's physiology made them well-suited to the low-status job: "Zarpies see better in the water... their bodies are... powerfully built... they have big hands and feet that are good for swimming... Zarpies' bodies are well-suited to farming aquafruit." In the *cultural condition*, the group's shared beliefs and values were well-suited to the low-status job: "Zarpies grow aquafruit by tradition... passed down knowledge of how to farm aquafruit... feel a special attachment to the ocean. Zarpies' traditions and values are well-suited to farming aquafruit." In the *structural condition*, a stable external social structure limited the group's opportunities: "Zarpies are required by this island's government to fill out complex and expensive paperwork to be hired in other jobs," analogous to the real-life costs associated with securing work permits or business licenses.

To measure the context-sensitivity of their *generalization*, participants predicted what job a Zarpie who was "born and raised in a different island country" works in their country on a 4-point scale (1 as "for sure aquafruit farmer" - 4 as "for sure different job"). Next, participants rated the *acceptability* of the disparity on a 6-point scale (1 as "very, very bad" - 6 as "very, very good").

Lastly, in an open-ended measure, participants were asked how they would *intervene* to "get the Zarpies to work as distribution managers," and rated the *difficulty* of their proposed intervention on a 4-point scale (1 as "very easy" - 4 as "very difficult"). Interventions that targeted the group's physiology were coded as "biological." Interventions that provided additional job training, equipment, or education to help group members attain the higher-status job were coded as "occupational training." Interventions that targeted a shared belief, value, or practice among the group, such as convincing group members to take on a different job, were coded as "cultural." Interventions that targeted properties of the job itself, such as by increasing wages, but did not directly address the unequal job distribution were coded as "aspects of occupation." The interventions of interest, "structural" interventions, included responses that expanded job opportunities for the group, such as by increasing the number of jobs available or by removing policies that block economic opportunity. Interventions that could not be coded as any of the above were coded as "other." Two coders blind to condition independently coded interventions (79% agreement, Cohen's $\kappa = .72$), with disagreements resolved through discussion.

Additional measures, asking how different the groups were and endorsement of various explanations for the disparity, are not reported here but can be found in the OSF repository.

Results

As planned, condition and intervention difficulty were entered as individual predictors in linear models to predict generalization and acceptability, and in a logistic model with Firth bias reduction (Firth, 1993) to predict frequency of structural interventions. All analyses below thus control for intervention difficulty, due to our concern that differences between conditions could reflect idiosyncratic differences about the particular biological, cultural, or structural factors presented, rather than biological, cultural, or structural causes more generally. Adults' ratings of the difficulty of their interventions did not differ by condition ($F(2) = 0.32$, $p = .73$).

Our initial analysis was an ANOVA for a main effect of condition, followed by FDR-corrected pairwise comparisons between each of the three conditions.

Generalization When predicting what job a novel group member in a different social context works, adults generalized differently across conditions ($F(2) = 6.16$, $p = .003$). Adults in the structural condition predicted that the group member worked a different job rather than the same job ($t(29) = 4.66$, $p < .001$), and, as predicted, were more likely to do so than adults in the biological condition ($t(86) = -3.51$, $p = .002$) (Fig 1a). Adults in the cultural condition were marginally more likely to predict a different job, compared to the structural condition ($t(86) = -1.86$, $p = .10$).

Acceptability of disparity Adults also judged the acceptability of the occupational disparity differently across conditions ($F(2) = 26.55$, $p < .001$). Adults in the structural condition generally considered the disparity unacceptable ($t(29) = -5.98$, $p < .001$), more than adults in the cultural condition ($t(86) = 5.50$, $p < .001$), and as predicted, more than adults in the biological condition ($t(86) = 6.84$, $p < .001$) (Fig 1b). Adults in the biological condition generally endorsed the disparity ($t(29) = 3.86$, $p < .001$).

Intervention on disparity Adults suggested different interventions to fix the social disparity across conditions (Fisher's exact, $p < .001$) (Fig 1c). Structural interventions (in teal on Fig 1c) varied across conditions ($F(2) = 17.22$, $p < .001$). As predicted, adults were more likely to provide structural interventions in the structural condition than in biological condition ($OR = 7.93$, $p = .001$) or in the cultural condition ($OR = 29.96$, $p < .001$).

Even if occupational training interventions are counted as structural interventions as well, structural interventions still varied across conditions ($F(2) = 9.30$, $p < .001$), and were more common in the structural condition than in the biological condition ($OR = 10.24$, $p = .001$) or in the cultural condi-

tion (OR = 10.89, p = .001).

Discussion

In contrast to biological reasoning, a paradigmatic form of inherent reasoning, structural reasoning about a sustained social disparity led adults to make more context-sensitive generalizations about what group members work which jobs, judge the disparity as less acceptable, and suggest more structural interventions. Cultural reasoning generally led adults to intermediate outcomes between biological and structural reasoning, possibly reflecting the status of culture as an intermediate level of inherence: culture is not inherent to an individual but still inherent to a group.

Study 2: children

Could structural reasoning lead to similar outcomes for children, who are just starting to reason about real-world social disparities? We targeted 7- to 9-year-olds, because 7-year-olds show robust structural reasoning (Peretz-Lange et al., 2021), and our task involved more complex explanations and greater memory demands than studies for younger children on structural thinking (Vasilyeva et al., 2018; Zhang & Markman, 2021).

Although we expected to find similar outcomes of structural reasoning for children as for adults, we expected potentially smaller effect sizes due to resistance from children's stronger inherent bias (Cimpian & Steinberg, 2014), essentialism (Taylor et al., 2009), and normative reasoning (Roberts et al., 2016). As a result, we increased the sensitivity of some measures.

This study's pre-registration and materials and data are on OSF.

Participants

The final sample included 70 seven- to nine-year-olds (mean age = 8.39 years, n = 23-24 per condition) recruited from a US-based laboratory database and tested over video conferencing sessions in 2022. The sample size was based on slightly smaller effect sizes than those in study 1, and was the same as in a previous study testing the outcomes of children's structural reasoning about neutral group differences (Zhang & Markman, 2021). Families were given a $5.00 gift card for participating. An additional 5 participants were tested but were excluded due to being out of the age range (n = 2), repeat participation (n = 2), or inattention (n = 1).

The sample was representative of US children's gender at the time of sampling (50% of participants were identified by their parents as male, 49% as female, 1% did not specify). The sample was largely Asian, White, or multi-racial, oversampling Asian and multi-racial populations and undersampling Black and Hispanic/Latinx populations (37% were identified by their parents as Asian, 34% as White, 6% as Hispanic/Latinx, 1.5% as Native American, 20% identified as belonging to two or more races, and 1.5% did not specify their race/ethnicity), compared to US 5- to 10-year-old demographics at the time of sampling (*Child Population by Race and Ethnicity and Age Group*, 2021).

Methods

The procedure was identical to Study 1, except that job descriptions and explanations were simplified to facilitate comprehension by the age group. The higher-status job was described as "bosses" instead of "distribution managers", who were "in charge of the island". Children were told although it was "not dangerous to be a boss", the group "gets a lot of money. . . for working as bosses." The description of aquafruit farmers was similar (see OSF for exact script). In the structural condition, the explanation about "complex and expensive paperwork" was simplified to a "rule" on the island that "Zarpies have to pay a lot of money to become bosses."

Lastly, generalization and intervention difficulty were measured on 6-point scales, instead of the 4-point scales used in Study 1, for increased sensitivity given the potentially smaller effect sizes with children. Two coders blind to condition independently coded interventions (71% agreement, Cohen's κ = .55), with disagreements resolved through discussion.

Results

As in study 1, we planned to model each of the three dependent variables (generalization, acceptability, and frequency of structural interventions) with condition and intervention difficulty as predictors.

Unexpectedly, however, we were unable to collect intervention difficulty responses from every participant. 7 children responded "I don't know" to the intervention question, perhaps due to the complexity required to provide an open-ended response. Since no intervention was provided, these 7 participants were not asked to rate the difficulty of their intervention. Thus, we also ran an exploratory analysis for each measure using a simpler model with condition as the lone predictor. Results from both models are reported below. Children's ratings of the difficulty of their interventions did not differ by condition ($F(2) = 0.91$, p = .41).

There were no effects of children's age (continuous) or interactions between age and condition unless otherwise noted.

Generalization When predicting what job a group member would work in a different social context, children's generalization did not differ across conditions, whether controlling for intervention difficulty ($F(2) = 1.10$, p = .34) or not ($F(2) = 1.68$, p = .19) (Fig 2a). However, children's generalization showed a qualitative trend similar to adults, such that generalization was numerically more context-sensitive in the structural than cultural than biological condition. An exploratory comparison found no statistically significant difference between children's generalization and adults' generalization from Study 1 ($F(1) = 2.60$, p = .11).

Acceptability of disparity After controlling for intervention difficulty, children's acceptability responses differed marginally by condition ($F(2)$ =2.65, p = .08). Children in the structural condition (M = 3.22) were marginally less likely to

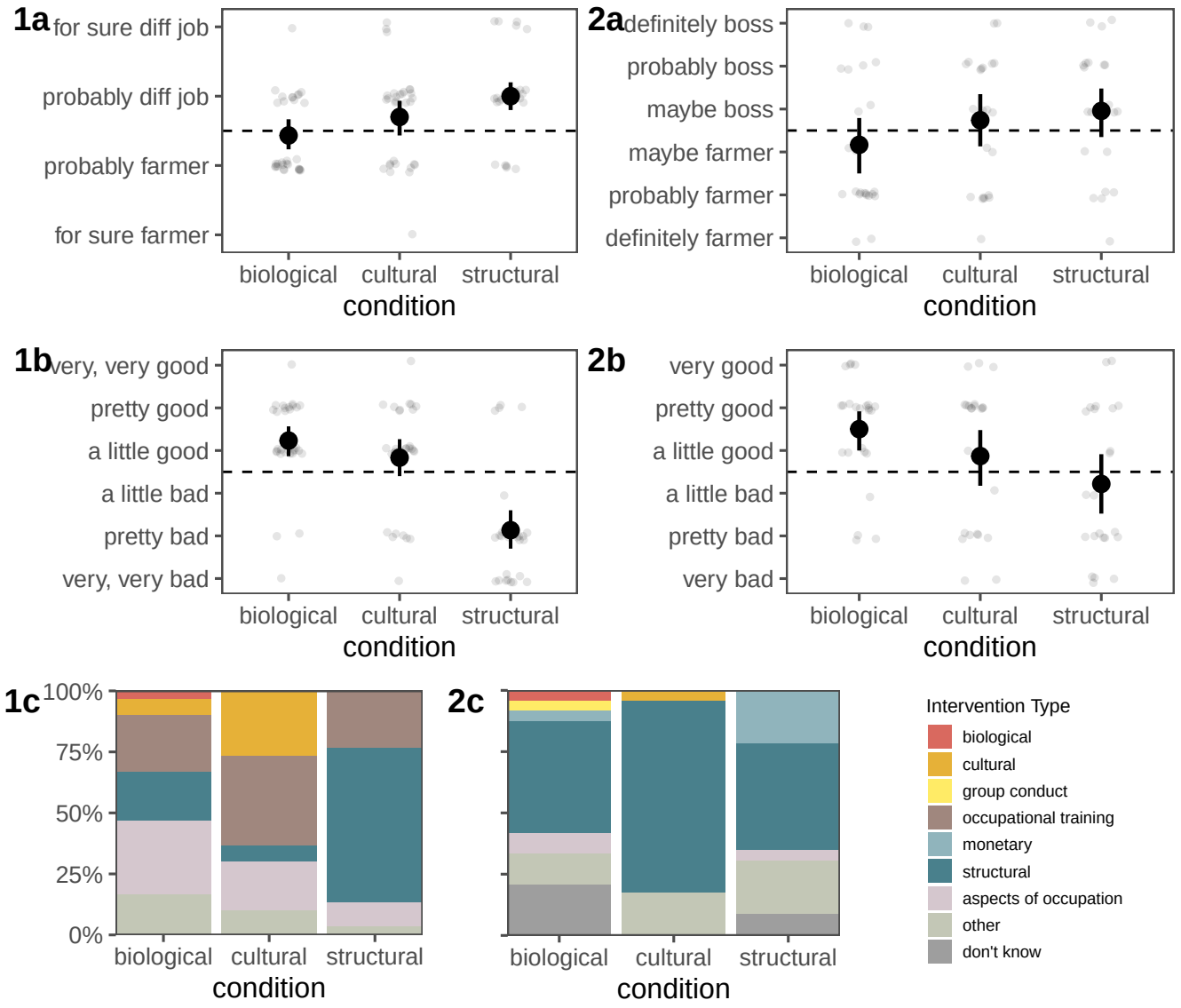

Figure 1: Structural reasoning generally led adults (left) and children (right) to more socially positive outcomes for generalization (a), acceptability of disparities (b), and intervention on disparities (c). Error bars are 95% confidence intervals.

accept the occupational disparity compared to children in the biological condition (M = 4.50, $t(59)$=2.25, p = .09).

Children's acceptability responses differed significantly by condition without controlling for intervention difficulty ($F(2)$ = 3.93, p = .02) (Fig 2b). Children in the structural condition were significantly less likely to endorse the disparity than children in the biological condition ($t(67)$ = 2.81, p = .02).

With age, children in the structural condition were less likely to endorse the disparity, as signified by an interaction of condition and age ($F(2)$ = 3.35, p = .04). Adults in Study 1 were even less likely to accept the disparity than children ($F(1)$ = 5.04, p = .03), indicating a gradual developmental decrease in the tendency to justify social disparities.

Intervention on disparity Children provided some unexpected interventions, which could explain our slightly lower coding reliability. Children's interventions did differ by condition (Fisher's exact, p = .019) (Fig 2c). However, contrary to predictions, structural interventions (in teal) did not differ significantly between conditions after controlling for intervention difficulty ($F(2)$ = 2.36, p = .10), but did differ significantly between conditions without controlling for intervention difficulty ($F(2)$ = 3.77, p = .03). Surprisingly, children in the cultural condition were more likely to provide structural interventions than those in the biological (OR = 4.25, p = .04) or structural conditions (OR = 4.68, p = .04).

Unexpectedly, some children suggested monetary interventions (e.g., "give the group more money") (Fig 2c, in green). The frequency of monetary interventions differed by condi-

tion, controlling for intervention difficulty ($F(2) = 4.29$, $p = .02$) or not ($F(2) = 4.23$, $p = .02$), and were numerically most common in the structural condition, although not rising to statistical significance.

Discussion

Structural reasoning led children, like adults, to judge a novel occupational disparity as less acceptable, compared to biological reasoning. Children's generalization trended similarly to but weaker than adults, with structural reasoning possibly leading to more context-sensitive generalization.

Children's interventions on the disparity were surprising in two ways. First, children overwhelmingly offered structural interventions across all conditions, and did so more than adults. This result is surprising, given that children generally show stronger inherent thinking than adults (Cimpian & Steinberg, 2014). Even in studies where children offered more structural interventions than inherent interventions, children still offered fewer structural interventions than adults (Peretz-Lange et al., 2021). A closer look reveals that children's structural interventions were often to "switch off jobs", such as switching the groups' jobs every other day. These "switch off" interventions, rare among adults, could reflect children's immature understanding of jobs as a temporary and easily-rotated position, perhaps due to experience with rotating elementary school classroom jobs.

Second, some children unexpectedly suggested monetary interventions. These monetary interventions could be genuine structural interventions, since in adapting the structural condition for use with children, study 2's structural condition specified an explicitly financial barrier to accessing the high-status job ("have to pay a lot of money to become bosses"), as opposed to the "complex and expensive paperwork" explanation adults heard. Monetary interventions could intend to address the financial barrier preventing the group from accessing the high-status job in the structural condition. The fact that monetary interventions were numerically most common in the structural condition could support this interpretation. Alternatively, monetary interventions could reflect children's focus on addressing the group's low socioeconomic status, ignoring the prompt about intervening on the occupational disparity. Indeed, 8-year-olds often suggest giving money to people when asked to solve poverty (Chafel & Neitzel, 2005). Unfortunately, our study cannot definitively disambiguate these interpretations of monetary interventions.

General Discussion

Across 2 studies, we found that structural thinking about social disparities generally leads to more socially positive outcomes than inherent thinking, as it does for social differences (Zhang & Markman, 2021). Structural thinking may help people avoid the pitfalls of inherent thinking and, instead, shape what people think is the case (generalizing properties in a context-sensitive manner), what should be the case (rejecting present disparities), and how to change the case (suggesting structural interventions to resolve disparities) for the better. These outcomes are especially clear among adults, while the evidence is weaker among children. Children were less accepting of social disparities when the disparities were presented as structural, rather than biological or cultural in nature, which complements a prior finding that inherent reasoning promotes adults' and children's support for group status disparities (Hussak & Cimpian, 2015). These findings suggest structural thinking not only presents a more accurate view, but also serves as a socially useful way of thinking that could mobilize social change.

We also found that cultural reasoning, or attributing social disparities to a group's shared beliefs or values, had an intermediate pattern of outcomes between biological and structural reasoning. A group's shared beliefs and values surpass any single individual but may still be seen as inherent to the group as a whole, representing an intermediate level of inherence that could be explored in further research.

Although structural reasoning led to positive outcomes in these studies, structural reasoning may not be a panacea under all conditions. Just as inherent reasoning occasionally leads to socially beneficial outcomes (e.g., the "born this way" narrative boosted support for LGBTQ+ rights) (Peretz-Lange, 2021), structural reasoning may have detrimental outcomes under some conditions as well. For example, boarding schools established by American, Canadian, and Australian governments to assimilate indigenous peoples were justified as structural interventions through structural reasoning. The belief that differences between indigenous and White people were the result of socialization in different environments, rather than fundamental biological differences, justified government intervention to take indigenous children from their communities and raise them in boarding schools (Pratt, 1892). Future research could establish under what conditions people see the need for intervention on a group disparity, and more generally, the conditions under which the benefits of structural reasoning emerge.

Our current work focused on an occupational socioeconomic disparity. Yet, children and adults must reason about many social disparities, including other types of disparities such as educational achievement disparities, which could be explored in future research. Nonetheless, occupational socioeconomic disparities do significantly contribute to broader disparities between social groups; for example, the skewed gender distribution of high-paying versus low-paying jobs is a significant contributor to the gender pay gap (Blau & Kahn, 2017). Teaching structural explanations for such disparities, even from early in life, help mobilize support for social change to close group disparities.

Overall, these studies contribute to our understanding of structural thinking, particularly its downstream outcomes. Compared to biological inherent or cultural reasoning, structural reasoning could be a more socially fruitful framework of reasoning about social disparities to promote.

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