How origin stories shape children's social reasoning

Throughout the lifespan, the average American will meet approximately 80,000 people. How do we make sense of the behavior of so many people? While we sometimes expect people's traits and behaviors to be individual and idiosyncratic, often we take the shortcut of making predictions based on categories. For example, when considering what gift to buy for a child, we might make guesses based on gender (e.g., that a girl might like a doll) or age (e.g., that a young child might like simple puzzles). Not all social categories are equally useful for making these inferences, however—some groupings (e.g., “people in line at the grocery store”) we view as arbitrary, with membership due to mere happenstance. Others (e.g., gender) people often view as deeply structured, with membership due to stable underlying causal “essences” that lead category members to be fundamentally similar to each other (Gelman, 2004; Lickel et al., 2000; Medin & Ortony, 1989). When we hold these essentialist beliefs about categories, we use them as powerful tools to predict and explain what their members will do and be like. The goal of the present paper is to test how children's causal beliefs about how categories come to be might influence their use of these categories to predict and explain social behavior.

It is often unclear whether or not one should use a social category to understand what other people are like. For example, children could explain why a particular boy is good at math by reasoning that the trait reflects something deep and inherent about what it means to be a boy, or they could view the trait as simply reflecting individual interests and experiences. The ambiguous nature of category-based reasoning becomes especially clear when information about categories conflicts with information about individuals. For example, children might predict that a particular girl likes pink because she is a girl, or they might predict that she prefers blue after seeing her wear blue often. In these examples, using a person's gender to predict and explain behavior reflects psychological essentialism: a suite of interrelated beliefs about the structure of categories, which include believing that social categories mark distinct, fundamentally different kinds of people, that people within categories are deeply similar to each

other and dissimilar to non-members, and that people are the way they are because of something innate, inherent, and inevitable (Gelman, 2003; Rhodes & Mandalaywala, 2017).

Whether or not people view a particular social category in essentialist terms—and thus use it to understand people’s behavior—varies across individuals and cultural contexts. Intuitions about category origins comprise one important factor that people consider when deciding whether or not to base their judgments of people on category membership. For example, people are more likely to view a category as constraining the behavior of its members if they view membership in that category as biologically determined by genes (Dar-Nimrod & Heine, 2011). Similarly, in some cultures, children develop essentialist beliefs about categories they view as determined by blood (Waxman, Medin, & Ross, 2007). Beliefs about the causal determiners of social groups can have dramatic consequences for people’s behavior. For example, viewing social groups as genetically distinct leads to more out-group hostility (Kimel, Huesmann, Kunst & Halperin, 2016). Believing that racial groups are genetically determined also leads to increased prejudice (Cornell and Hartmann, 1998; Donovan, 2016; Heine et al., 2017; Williams & Eberhardt, 2008; Yaylaci, Roth, & Jaffe, 2019). These beliefs can even shape our behavior in more subtle ways—for example, viewing obesity as primarily due to genetic causes leads people to hold less biased attitudes towards others who are obese (Pearl & Lebowitz, 2014), but also to engage in more unhealthy behavior themselves (e.g., eating cookies; Dar-Nimrod, Cheung, Ruby, & Heine, 2014). Thus, causal reasoning about the origins of social categories has far-reaching consequences for people’s social reasoning and behavior.

In addition to quasi-scientific beliefs about blood and genes, beliefs about supernatural causes can also give rise to essentialism. For example, Christian and Jewish creationist beliefs—endorsed by roughly half of adults in the United States—hold to the biblical dictum that the world and everything in it, including all categories of plants, animals, and people, were created individually by God about 6,000 years ago (Almquist & Cronin, 1988; Boyer, 2001; Cavanaugh, 1985; Harold, Eve, & Goede, 1995; Kehoe, 1995; Miller, 1987; Numbers, 1992).

This belief in the immutability of kinds—that different kinds of things are what they are because it is the will of a powerful creator—is fundamentally essentialist in nature, depicting categories as stable, homogenous, and objectively true (Diesendruck & Gelman, 1999; Gelman, 2003; Emmons & Kelemen, 2015; Medin & Ortony, 1989; Shtulman & Schulz, 2008). Indeed, adults who endorse creationist explanations about the origins of the natural world hold more essentialist beliefs about animal kinds than those who do not (Clément, 2015; Hill, 2014; Miller, Scott, & Okamoto, 2006). More religious adults also report higher levels of gender essentialism, and they endorse stricter normative beliefs about what members of gender categories are supposed to do and be like (Robinson & Smetana, 2019).

Children reason about the origins of categories from at least age 4 (Gelman & Kremer, 1991; Springer & Keil, 1989). While young children tend to think of many categories as intentionally created (e.g., Evans, 2001; Kelemen, 2004; Kelemen & DiYanni, 2005), they rely on adults to provide both scientific and supernatural explanations (Harris & Koenig, 2006), and children's creationist origin beliefs vary in line with those of their parents (Boyer & Walker, 2000; Evans, 2001; Sperber, 1982). Their essentialist beliefs vary as well: Children attending religious schools hold more essentialist beliefs about ethnic categories than children in secular schools (Diesendruck & Haber, 2009). Despite these correlations, however, it is unclear whether creationist origin beliefs play a causal role in adults' and children's social essentialism and, if so, what the underlying mechanisms might be.

Creationist beliefs that are part of religious doctrines involve a variety of interrelated views—including beliefs in an all-powerful creator and that categories reflect the non-arbitrary structure of the world. Since previous work examining creationist origin stories and social reasoning have all been correlational, it is unclear which specific aspects of these beliefs might influence how people think about the social world. Further, while children growing up in religious homes might hear creationist origin stories more often than children growing up in secular homes, their experiences likely differ in other ways as well. For example, children learn about

which categories are meaningful by listening to how adults talk (Gelman, Ware, & Kleinberg, 2010), and adults talk differently about the categories that they view as essential kinds (Gelman, Goetz, Sarnecka, & Flukes, 2008; Rhodes, Leslie, & Tworeck, 2012; Segall, Birnbaum, Deeb, & Diesendruck, 2014). Indeed, children's beliefs about which categories are useful for predicting and understanding people's behavior vary widely across cultural contexts, highlighting the importance of cultural cues in shaping these beliefs (Chalik, Leslie, & Rhodes, 2017; Mandalaywala, Ranger-Murdock, Amodio, & Rhodes, 2018; Rhodes & Gelman, 2009). Thus, observing correlations between essentialism and creationist beliefs does not provide evidence that children's beliefs about the origins of a category *lead* them to hold more essentialist beliefs or to be more likely to use a particular category to guide their inferences about category members, nor does it elucidate *how* creationist stories might have these effects on children's reasoning about categories and people.

In the current studies, we examine how children's causal beliefs about how categories come to be might shape their judgments of what members of those categories are like. We address two key questions. First, is there a causal effect of children's beliefs about category origins on their social reasoning? Second, if so, *how* do stories about category origins have these effects? As described above, creationist beliefs that are part of religious doctrines involve several interrelated views. Specifically, one possibility is that creationist beliefs shape social reasoning by signaling to children that the categories they see around them were designed by an intentional creator. If this is the case, then creationist origins stories that reference an intentional powerful being would have a unique role in signaling to children that categories strongly constrain the behavior of their members. Creator's intentions are a fundamental aspect of how people reason about artifact categories (Bloom, 1996; Diesendruck, Markson, & Bloom, 2003; Lombrozo, 2010) but design goals have received little attention as a potential feature of people's social reasoning. Alternately, stories about category origins could more generally serve as one type of signal marking the categories that children see around them as non-arbitrary. If

this is the case, then creationist stories that reference a powerful intentional creator would operate as one way to signal this non-arbitrary structure, but other descriptions of the category that specify a non-arbitrary causal structure would do so as well. Thus, in the current studies we aimed to identify which components of origin stories elicit children's essentialist beliefs about categories—the particular idea of an intentional creator, or the more general notion that the world is not structured arbitrarily.

In three studies, 4- to 5-year-old children heard different types of explanations about the origins of novel categories. These studies focused on children ages 4-5 because children of this age are actively engaged in the process of determining which categories mark meaningful kinds in their environments (Mandalaywala et al., 2018; Rhodes & Gelman, 2009). In Study 1, to test the causal role that beliefs about category origins have on children's reasoning, children learned about a novel category of people or animals that were either found by someone "just like you and me," or intentionally created by a powerful supernatural being. We then measured whether children used the category to reason about what individual people or animals in those categories would be like. Here we focused on two key components of how essentialism shapes reasoning: (1) whether children explained individuals' behavior by referring to causes that were intrinsic to the category, or to causes that were individual and idiosyncratic, and (2) whether they thought behavior was based on inherited category membership or individual experience. Because previous work has considered the effects of creationism on children's reasoning about both the social and biological world (Diesendruck & Haber, 2009), we included categories of both people and animals in this first study to examine whether similar processes operate across different conceptual domains. While beliefs that animal categories mark fundamental distinctions are early-emerging and relatively stable across cultural contexts, beliefs about social categories are more variable and dependent on cultural input (Diesendruck et al., 2013; Liberman, Woodward, & Kinzler, 2017; Rhodes & Gelman, 2009; Taylor, Rhodes, & Gelman, 2009). In Studies 2 and 3, we focused on beliefs about social categories in particular, to

separately examine how two key facets of causal explanations shape person judgments: (1) beliefs that social categories were intentionally created by a powerful agent, and (2) cues that social categories are non-arbitrary.

Study 1

Method

Participants

Participants in Study 1 were 71 4- to 5-year-old children ($M_{\text{age}} = 4$ years, 11 months; 44 male; 27 female). Of our sample of children whose parents reported demographic information (8% chose not to), 44% were White, 24% were Hispanic or Latino, 10% were Black, 7% were Asian, 1% were Middle Eastern or North African, and 10% were more than one race. Children in Studies 1-3 were recruited and tested between 2015 and 2017 at a children's museum in a large, urban, and diverse northeastern city. Children completed the studies one-on-one with a trained experimenter in a quiet room. Parents provided written consent and children gave verbal assent. Children received a small prize for participating. All study procedures were approved by the Institutional Review Board of the authors' university. All materials, data, and analysis code are available at https://osf.io/t8vbm/?view_only=07a86fcdf1d4a8cb3df0326b2e85635.

Materials and Procedure

Warm-up. Before beginning the study, children completed a short warm-up activity designed to increase the response rate in the test phase, particularly for open-ended explanation questions, which can be difficult for young children. In the warm-up activity, children were shown a series of three pictures and were asked to explain why something was happening in the picture. For example, participants saw one picture of a child with a cookie, which they were told was really hot, and they were asked to say why the cookie might be hot. The experimenter responded enthusiastically to any answer the child provided (e.g., by saying,

“Great answer!”). If the child had difficulty generating an explanation, the experimenter asked a leading question (e.g., “Do you think maybe someone just baked the cookie?”).

Storybook Phase. After the warm-up, children were presented with the condition manipulation in the form of a colorful storybook, read to each child by a trained experimenter. Each child was randomly assigned to one of two conditions pertaining to the origin story of the category presented (found, created) and one of two conditions pertaining to the domain of the category (animal, people) in a 2 x 2 between-participants design. Depending on condition, children learned either about a person “just like you and me” who used magical powers to visit a whole new world (*found* condition), or about a powerful being who used magical powers to create a whole new world (*created* condition); the character either found or created new kinds of people (*people* condition) or animals (*animal* condition) called *Modies* living in the world. The powerful being [person like you and me] was never depicted in the storybook, and the Modies were shown only as silhouettes (Fig. 1). After reading the storybook from start to finish once, the experimenter read it a second time and asked children to fill in key details about the story on each page to ensure they understood the condition manipulation (e.g., “She used her magical powers to...do what? What did she do? Right, she created [visited] a whole new world!”). If children could not remember the details, the experimenter reminded them and asked them to repeat the answer.

Test Phase. After the storybook, the experimenter moved on to the test phase. First, children were asked open-ended explanation questions in which they explained why a particular Modie was displaying a novel property (e.g., “Why does this Modie love to eat flowers?”). The experimenter transcribed children’s explanations, which were later coded by another trained experimenter for scope (1 = generic scope, e.g., “Because Modies like flowers;” 0 = specific scope, e.g., “Because she likes them”) and content (1 = stable, intrinsic content, e.g., “Because he loves flowers;” 0 = not stable, intrinsic content, e.g., “Because he’s hungry”), following a schema used in previous work examining children’s explanations as a window into their

category judgments (Cimpian & Markman, 2011; Gelman, Ware, & Kleinberg, 2010; Rhodes, Leslie & Tworeck, 2012; Rhodes, 2014). We included a total of three open-ended explanation questions: (a) Why does this Modie love to eat flowers? (b) Why does this Modie have hollow bones? (c) Why does this Modie sleep in tall trees?

Next, children were asked inheritance questions, in the form of a switched-at-birth story about a Modie mom who had a baby that was then raised by a mom from another category. Responses on inheritance measures were coded with higher numbers reflecting more essentialist (i.e., birth mother) responses. Children were first asked which mother's features the baby would have when it grew up (1 = birth mother, 0 = other mother). After each initial response, children were asked if the baby might also have the feature they did not select (1 = no, 0 = yes). After the first question only, children were also asked if the baby could change to display the unselected feature if it wanted to (1 = no, 0 = yes). Children were asked to make judgments about three features of the birth and adoptive mothers. At the end of the study, for exploratory purposes, we also asked children a series of questions about the powerful being they had heard described in the storybook (see Supplementary Information at https://osf.io/t8vbm/?view_only=07a86fcdf1d4a8cb3df0326b2e85635).

Storybook Phase (condition manipulation)

Page 1

Page 2

Page 3 (Animals)

Page 3 (People)

Created: Once there was a **very powerful being** who had magical powers. She used her magical powers to **create** a whole new world. She **created** a big ocean and a big blue sky, and she **created** new kinds of trees and flowers. [Page 3]: She **created** different kinds of people [creatures] to live in this new world. She called some of the people [creatures] that she **made** Modies.

Discovered: Once there was a **person just like you and me** except she had magical powers. She used her magical powers to **visit** a whole new world. She **found** a big ocean and a big blue sky, and she **found** new kinds of trees and flowers. [Page 3]: She **found** different kinds of people [creatures] living in this new world. Some of the people [creatures] that she **found** were called Modies.

Test Phase (same across origin conditions)

Open-ended Explanations

Animals

People

Why does this Modie love to eat flowers?

Switched-at-birth Task

Animals

Modie Gorp

People

Modie Gorp

Which mom will the baby be like?

Figure 1

Method in Study 1. The first two pages of the storybook condition manipulation (top panel) differed only in the text read to children; the third page differed also in the “Modies” (animals or people) depicted. After the storybook, children answered open-ended explanation questions (bottom left panel) and questions about a switched-at-birth story (bottom right panel, see https://osf.io/t8vbm/?view_only=07a86fcdfe1d4a8cb3df0326b2e85635 for the full study script).

Results

Explanations

We analyzed explanation responses, which included the binary codes for scope and content across all trials, with the lme4 package in R version 3.6.2. We used a Generalized Linear Mixed Model (GLMM) to specify a binomial distribution, and we included in the model the main and interactive effects of domain (animal, social) and origin condition (found, created). In all models, we also included random intercepts for each item and participant, to control for the variance associated with these factors without data aggregation (Judd, Westfall, & Kenny, 2012).

Since the ages of our participants spanned two years during which children undergo developmental change in their explanatory abilities, we also included children's exact age in all models. For all measures, we report the results of likelihood ratio tests (LRTs); means are reported as the probability of giving category-based responses with 95% confidence intervals (CIs). Data, analysis code, and full study protocols for all studies are available at https://osf.io/t8vbm/?view_only=07a86fcdf1d4a8cb3df0326b2e85635.

Children's explanations differed by origin condition ($LR \chi^2 (1) = 5.33, p = 0.02$): Children who heard that Modies were created by a powerful being referred to the category and to stable, intrinsic causes in their ($M = 0.40$, CI: [0.33, 0.46]) more often than children who heard that Modies were found ($M = 0.27$, CI: [0.21, 0.33]). The odds of using a category-based explanation were 3.66 times as high for children in the created conditions than those in the found conditions (95% CI [1.12, 11.97]). The pattern of means was similar for both scope (created: $M = 0.19$, CI: [0.11, 0.27]; found: $M = 0.12$, CI: [0.06, 0.18]) and content (created: $M = 0.60$, CI: [0.50, 0.70]; found: $M = 0.42$, CI: [0.32, 0.51]). The effect of origin condition on children's explanations were very similar across domain; as shown in Figure 2, there were no main or interactive effects of whether "Modies" were described as animals or people. The effect of age was not significant.

Figure 2
Probabilities with Wald 95% confidence intervals of explaining the features of Modies by referring to the category and stable intrinsic causes, by origin condition, in Study 1. Large shapes represent group means, and small lines show average responses per participant.

Inheritance

Children’s answers to the switched-at-birth story also consisted of a series of binary responses (1 = essentialist, birth-parent response, 0 = non-essentialist, adoptive-parent response); these responses were analyzed in the same manner as explanations. On this measure, there were no effects of origin condition, domain, or age on children’s responses.

Discussion

In Study 1, when children were told that categories were intentionally created by a powerful being, they were more likely to explain the behavior of category members as determined by intrinsic causes (e.g., explaining why a particular Modie eats flowers as “because

Modies like flowers”) than they were when they were not given information about how the categories came to be. This provides causal evidence that information about category origins can shape how and when children use categories to explain the behavior of individual members. Information about category origins did not shape children’s beliefs about whether features associated with those categories were inherited in this experiment (on the switched-at-birth measure). Children from more religious backgrounds are indeed more likely to treat the properties of social categories as inherited (Chalik et al., 2017; Diesendruck & Haber, 2009); taking those findings together with the present results suggests that perhaps such effects depend on more sustained exposure to creationist origin stories over time, or on other aspects of religious upbringing. To illustrate the distinction between explaining with an intrinsic cause (as found on the explanation measure) and thinking of something as *innate* (as tested with the switched-at-birth measure) with an everyday example, the present findings suggest that relatively brief exposure to the idea that girls were purposefully created to be distinct from boys (as an example) would be sufficient to lead young children to think that the stereotypical features of girls are caused by intrinsic mechanisms (e.g., that a girl wears pink because girls just love this color rather than because of an idiosyncratic, personal preference), but that additional input would be needed to lead to a stronger and more specific version of this belief—that the feature is biologically determined (e.g., that girls *are born* with a love for this color). While leaving open the question of what additional input leads to these stronger forms of essentialist beliefs, the present findings indicate that causal explanations about category origins—one form of testimony that children receive throughout development—shape how children use categories to explain the behavior of the people around them. In the present study, we did not predict differences across these different facets of essentialist thought in advance, so future research will need to explore how and when information about a category’s origins might shape these features of children’s beliefs in different ways.

Study 2

The goal of Study 2 was to begin to address *how* stories about category origins have these effects on children's explanations of people. Do they do so particularly because they include information about the design goals of an intentional and powerful creator, or more generally by signaling that the categories children see in the world are not arbitrary?

Viewing category membership as determined by either quasi-scientific causes (e.g., genes, blood) or supernatural causes (e.g., God) entails viewing categories as non-arbitrary and fixed. However, only beliefs in supernatural causes also rely on the intention of a powerful creator that categories *should* be the way that they are. Creator's intentions are a fundamental aspect of how people reason about artifact categories (Bloom, 1995; Diesendruck, Markson, & Bloom, 2003; Lombrozo, 2010) but have received little attention as a potential feature of people's beliefs about the social world. In Studies 2 and 3, we explore the role of these two underlying causal mechanisms in shaping essentialist beliefs about social categories: (1) cues that category membership is non-arbitrary, and (2) beliefs that category membership reflects the intentions of a creator.

Given the importance of cultural cues in shaping beliefs about categories of people (Diesendruck et al., 2013; Liberman, Woodward, & Kinzler, 2017; Rhodes & Gelman, 2009; Taylor, Rhodes, & Gelman, 2009), here we focus exclusively on causal reasoning about the origins of social categories. Just as adults defer to experts to know the "true" status of natural kind categories (e.g., deferring to a biologist to determine whether or not a particular animal is a bird; Malt, 1990), children rely on the experts in their environments (i.e., adults) to learn how to divide up the social world (Danovich & Keil, 2004; Gelman & Markman, 1986; Jaswal, 2010; Jaswal, Lima, & Small, 2009; Noyes & Keil, 2017; VanderBorghet & Jaswal, 2009; Wilson & Keil, 1998). Thus, causal explanations about category origins—one form of testimony that children receive throughout development—could be particularly important in shaping whether children use categories to predict and explain the behavior of the people around them.

Method

Participants

Participants in Study 2 were 71 4- to 5-year-old children ($M_{\text{age}} = 4$ years, 11 months; 43 male; 28 female). Of our sample of children whose parents reported demographic information (13% chose not to), 28% were White, 25% were Hispanic or Latino, 17% were Black, 7% were Asian, 1% were American Indian or Alaskan Native, 1% were Middle Eastern or North African, and 13% were more than one race. Participants were recruited and tested in the same manner as in Study 1.

Materials and Procedure

Children first completed the same warm-up activity as in Study 1, and the condition manipulation was again presented in the form of a colorful storybook read to children by a trained experimenter. Next, children were randomly assigned to one of two origin conditions (discovered, created). In the created condition, children learned that a powerful being had created a whole new world, as in Study 1. However, whereas the found condition in Study 1 did not provide any explicit information about the origins of the category Modies, in Study 2 we used a narrative describing the category Modies as based on explicitly quasi-scientific criteria to compare against beliefs about supernatural causes. That is, in the discovered condition, children learned about “a very good scientist” who visited a whole new world. Thus, both origin conditions described causal reasons for categorizing some people as Modies, but only the created condition also entailed a powerful creator’s intention that the category *should* be a certain way.

In order to examine the role of origin explanations in marking categories as non-arbitrary, each child was also randomly assigned to one of two grouping conditions (arbitrary, non-arbitrary) in a 2 x 2 between-participants design. First, we introduced the creator’s or scientist’s goal for categorization: Children learned that the powerful being [scientist] had a special tool that she wanted to use to make some people different from everyone else [to use to look inside all the people in the world to see if some of them were different from everyone else].

Grouping entities together into categories based on supernatural and quasi-scientific goals both entail that the grouping reflects a non-arbitrary delineation between different kinds of people. Thus, in the non-arbitrary conditions, the powerful being [scientist] successfully used the tool to make some people different [to look inside to see if people were different] and then decided to call some people Modies.

In the arbitrary condition, however, the special tool “broke,” so the powerful being [scientist] could not use it to accomplish her goal; some people were called Modies arbitrarily (“just for fun”). Labels mark categories as distinct kinds of things and can facilitate categorization (Ferry, Hespos, & Waxman, 2010, Fulkerson & Waxman, 2007; Kripke, 1972, Putnam, 1975; Waxman & Hall, 1993; Xu, 2002). However, people view many labelled categories as non-essential kinds (e.g., chairs, coffeepots) and labels alone are not sufficient to elicit essentialist beliefs about novel social categories (Rhodes, Leslie, Bianchi, & Chalik, 2017; Rhodes, Leslie, & Tworek, 2012). For this reason, we did not expect that calling some people Modies “just for fun” would be sufficient for young children to view the categorization as marking people as distinct kinds, and we described the category using a noun label in both the arbitrary and non-arbitrary condition manipulations in order to hold this feature constant. In this way, the created conditions described the intention of a powerful creator that the category *should* be a certain way. Thus, Study 2 contrasted beliefs that categories are non-arbitrary (vs. arbitrary) with beliefs about different types of causes for how Modies came to be (quasi-scientific, supernatural), in order to examine the role of these two aspects of causal origin beliefs in shaping children’s person judgments.

As in Study 1, after reading the storybook from start to finish once, the experimenter read it a second time and asked the child to fill in details about the story on each page to ensure that they understood. After the condition manipulation phase, the experimenter moved on to the test phase, which consisted of open-ended explanations and inheritance items, as in Study 1. For inheritance items in Study 2, children were asked whether the baby could change to

displaying the unselected feature if it wanted to on all questions (not just on the first question);
test items were otherwise the same as in Study 1.

Results

Explanations

Children's open-ended explanations were analyzed as in Study 1, with origin (discovered, created) and grouping (arbitrary, non-arbitrary) included as predictors and random intercepts for each item. Consistent with our predictions, children's explanations differed by grouping (LR $\chi^2(1) = 3.91, p = .048$; Figure 3): Children who heard the grouping described as non-arbitrary were more likely to refer to the category and stable, intrinsic causes in their explanations ($M = 0.43$, CI: [0.36, 0.50]) than children who heard the grouping was arbitrary ($M = 0.31$, CI: [0.25, 0.38]). The pattern of means was similar for both scope (non-arbitrary: $M = 0.17$, CI: [0.10, 0.24]; arbitrary: $M = 0.07$, CI: [0.02, 0.12]) and content (non-arbitrary: $M = 0.69$, CI: [0.61, 0.78]; arbitrary: $M = 0.56$, CI: [0.47, 0.66]). The odds of using a category-based explanation were 2.36 as high in non-arbitrary conditions than arbitrary conditions (95% CI [0.87, 6.38]). Children's explanations also differed by age, with children referring to the category and stable, intrinsic causes less often across age ($\beta = -0.87$, $SE = 0.33$, $z = -2.62$, $p = .009$). There were no main or interactive effects of origin condition (e.g., whether the non-arbitrary structure was created by supernatural or quasi-scientific mechanisms) on explanations.

Figure 3

Probabilities with Wald 95% confidence intervals of explaining the features of Modies by referring to stable, intrinsic causes, by grouping, Study 2. Large shapes represent group means, small lines show average responses per participant.

Inheritance

Children's responses to the switched-at-birth story were also coded and analyzed as in Study 1. As in Study 1, there were no main or interactive effects of our predictor variables on children's responses.

Discussion

The results of Study 2 show that stories about both quasi-scientific and supernatural causes shape children's use of social categories to explain the behavior of other people via a similar mechanism: They mark categories as non-arbitrary. We did not find an effect of whether the non-arbitrary structure was created by an intentional being created or discovered by a smart scientist, suggesting that what mattered was whether children had specific reasons to believe

that the categories reflected real, non-arbitrary structure, and not particularly the intentions of a powerful creator. Thus, perhaps stories about category origins (including creationist origin stories) serve as one type of general signal that the categories children see around them are non-arbitrary. As in Study 1, we again found effects of whether categories were described as arbitrary or not on how children used those categories to explain behavior, but no effects of this information, or of information about the specific origin story, on children's beliefs about whether category-related features would be inherited and stable (as assessed by the switched-at-birth measure).

Beliefs that categories arise from supernatural causes are an important feature of many of the world's religions (Evans, 2001; Numbers, 1995). Beliefs about quasi-scientific causal criteria for categories, like blood and genes, are also widespread across cultures (Cramer & Imai, 2002; Dar-Nimrod & Heine, 2011; Gil-White, 2005; Heine et al., 2017; Waxman et al., 2007). The prevalence of these forms of reasoning about how things in the world came to be has led some researchers to propose that they might both arise due to a common cognitive mechanism, as products of the domain-general human capacity for causal explanation (Barrett, 2000; Kelemen, 2004). Although Study 2 provided explicit information about the creator's or scientist's goals for category membership, people's beliefs about causes are often vague at best—they may expect that something caused the world to be structured as it is, even if they do not know exactly what that cause is. For example, when asked where genes are located, only about a third of adults were able to identify that they are located in cells—and nearly as many believed that genes are only located in the mind or brain, highlighting people's tendency use quasi-scientific causes to explain the behavior of others (Lanier et al., 2004).

Given the prevalence of both of these types of beliefs, and their unspecified nature, it is unclear how explicit stories about quasi-scientific or supernatural causes might differ from children's baseline beliefs about category structure. That is, how might children's beliefs in the found condition in Study 1 compare to those in the discovered condition in Study 2? In the

discovered condition in Study 2, children heard about explicitly quasi-scientific causes for forming a social category; in the found condition in Study 1, in contrast, children did not hear any explicit information about the origins of the category Modies. Thus, it is unclear whether children in Study 1 may have interpreted this ambiguous causal information as indicating an arbitrary grouping, or whether they might have expected the grouping to be non-arbitrary even if they did not have any specified notion of why it was such.

To address this issue, in Study 3 we included a baseline condition, in which the grouping is explicitly described as arbitrary, and compared responses in this condition to conditions that present (non-arbitrary) quasi-scientific or supernatural causal origin explanations. Thus, we directly test how different types of non-arbitrary causal explanations shape children's social judgments in comparison to an arbitrary baseline condition.

Study 3

Method

Participants

Participants in Study 3 were 64 4- to 5-year-old children ($M_{\text{age}} = 5$ years, 2 months; 35 male; 29 female). Of our sample of children whose parents reported demographic information (20% chose not to), 38% were White, 17% were Hispanic or Latino, 8% were Black, 14% were Asian, 2% were American Indian or Alaskan Native, 3% were Middle Eastern or North African, and 8% were more than one race. Participants were recruited and tested in the same manner as in Studies 1 and 2.

Materials and Procedure

As in Studies 1 and 2, children first completed the warm-up activity and then heard the condition manipulation in the form of a colorful storybook read to them by a trained experimenter. Children were randomly assigned to one of three creation conditions (traveler, discovered, created). The discovered and created conditions were similar to the non-arbitrary conditions in Study 2 (in which the "special tool" worked), so in both conditions the category

Modies marked a non-arbitrary division. The traveler condition was designed to provide a baseline against which to compare the other two conditions, by describing a person “just like you and me” who liked to take trips, and who went on a trip to visit a whole new world, similar to the found condition in Study 1. The traveler used the “special tool” to say hello to the people in the world and ask if they had exciting stories to share. However, in this condition the category was described as explicitly arbitrary, with some people called Modies “just for fun,” as in the arbitrary conditions in Study 2. Thus, this condition provided a baseline in which Modies were neither described as intentionally created, nor were they discovered based on quasi-scientific criteria. As in Studies 1 and 2, the experimenter first read the storybook from start to finish once and then read it a second time with “help” from the child.

After the condition manipulation phase, the experimenter moved on to the test phase. An important consequence of using categories to predict and explain what their members is believing that category members are deeply similar to each other (Gelman, 2003; Rhodes & Mandalaywala, 2017). Therefore, in addition to open-ended explanation questions as in Studies 1 and 2, we also asked children in Study 3 a series of induction questions in order to explore how causal reasoning about the origins of a social category shape beliefs about homogeneity. First, children were trained to use a 5-point scale with different numbers of dots to depict different numbers of Modies (“all,” “most,” “some,” “a few,” and “just one”; Rhodes & Liebenson, 2015). Children answered a series of practice questions to become familiar with the scale (e.g., “How many kids have birthdays? Right, all kids have birthdays! So let’s point to the picture that’s all filled up with dots, because that means all.”). Children then were shown a series of pictures of Modies (as silhouettes) displaying specific features and were asked how many other Modies also displayed those features (e.g., “This Modie can bounce a ball on his head. How many other Modies do you think can bounce a ball on their heads too?”). After each induction decision, children were asked whether the Modie could change to not displaying the feature if it wanted to

(1 = no, 0 = yes). Children answered induction questions first, followed by open-ended explanation questions, which were the same as those in Studies 1 and 2.

For exploratory purposes, we also probed children's beliefs about the boundaries of the category Modies using two other new tasks. These included a visitor task, in which children met a visitor from another planet who did a lot of things differently from us. They were told that some things the visitor and his friends from the other planet did were wrong (e.g., saying that a dog in a pumpkin costume is actually a pumpkin), but others were just different (e.g., saying a cup with a flower growing in it is a flowerpot). Children were then told that the visitor was looking at a picture of a Modie like the ones in the book, but that the visitor and his friends said it was not a Modie, it was something else; they were asked whether the visitor was "maybe right" (1 = no, 0 = yes; Rhodes & Gelman, 2009). We also included a deference to experts task (Gelman & Coley, 1990; Kalish, 1998; Jaswal & Markman, 2002), in which we asked children whether or not, if they were unsure about whether someone was a Modie, they could just decide on their own or if they needed to ask someone (1 = ask someone, 0 = decide on their own). We included these tasks in Study 3 to further explore how origin stories shape various facets of category beliefs.

Results

Explanations

Children's open-ended explanations were coded and analyzed as in Studies 1 and 2, with condition (traveler, discovered, created) included as a predictor. We report unstandardized regression coefficients, with the baseline (traveler) condition coded as the intercept, as well as the results of likelihood ratio tests of overall main and interactive effects. Children in the created condition referred to the category and stable, intrinsic causes the most often ($M = 0.37$, CI: [0.28, 0.45]; effect of created condition compared with baseline, $\beta = 0.79$, $SE = 0.39$, $z = 2.03$, $p = .04$), followed by children in the discovered condition ($M = 0.30$, CI: [0.22, 0.37]; effect of discovered condition compared with baseline, $\beta = 0.4$, $SE = 0.39$, $z = 1.02$, $p = .31$). Children in

the traveler condition referred to the category and stable, intrinsic causes the least often ($M = 0.25$, CI: [0.18, 0.33]). The odds of a category-based explanation were 2.21 times as high for children in the created condition compared with baseline (95% CI [1.03, 4.76]). Although responses in the created and baseline (traveler) condition differed from one another, the overall effect of condition did not improve model fit as indicated by the Likelihood Ratio Test ($X^2(2) = 4.02$, $p = .13$). Responses also did not differ by age (LR $X^2(1) = 0.84$, $p = .36$). The pattern of means was similar for both explanation codes, although children across conditions generated few explanations that referred to the category in scope (traveler: $M = 0.02$, CI: [-0.02, 0.05]; discovered: $M = 0.07$, CI: [0.01, 0.14]; created: $M = 0.08$, CI: [0.01, 0.16]); their explanations more often referred to intrinsic content (traveler: $M = 0.49$, CI: [0.37, 0.62]; discovered: $M = 0.52$, CI: [0.40, 0.64]; created: $M = 0.65$, CI: [0.53, 0.77]).

Figure 4

Probabilities with Wald 95% confidence intervals of explaining the features of Modies by referring to stable, intrinsic causes, by condition, Study 3. Large shapes represent group means, small lines show average responses per participant.

Induction

We analyzed children's induction decisions using an ordinal logistic regression model with the Ordinal package; means are reported as the average response on the 0-4 scale (0 = "just one"; 1 = "a few," 2 = "some," 3 = "most," 4 = "all") with 95% confidence intervals (CIs). We again report unstandardized regression coefficients, with the baseline condition coded as the intercept, as well as the results of likelihood ratio tests of overall main and interactive effects. Children in the created condition generalized the most broadly ($M = 2.91$, CI: [2.59, 3.24]; effect of created condition compared with baseline, $\beta = 0.69$, $SE = 0.35$, $z = 1.99$, $p = .047$), followed by children in the discovered condition ($M = 2.77$, CI: [2.47, 3.08]; effect of discovered condition compared with baseline, $\beta = 0.43$, $SE = 0.34$, $z = 1.24$, $p = .21$). Children in the traveler condition generalized properties to the fewest Modies ($M = 2.40$, CI: [2.12, 2.68]). As in the analysis of explanations, although responses in the created and baseline (traveler) condition differed from one another, the overall effect of condition did not improve model fit as indicated by the Likelihood Ratio Test ($\chi^2(2) = 4.07$, $p = .13$). Responses also did not vary by age.

Figure 5

Average responses on the induction task with Wald 95% confidence intervals, by grouping, in Study 3. Large shapes represent group means, and small lines show average responses per participant.

We found no main or interactive effects on children's binary flexibility responses asked after each induction item, or their responses in the exploratory visitor task or deference to experts task.

Discussion

In Study 3, causal information about the origins of a social category shaped children's decisions about whether or not to use a social category to predict and explain what its members are like. These effects were similar for both supernatural origin stories and those describing quasi-scientific causes; however, children's responses were also similar when they heard about quasi-scientific causes as when they heard that the category's origins were explicitly arbitrary. Thus, these results introduce the possibility that information about supernatural category origins

may present stronger cues to category structure than information about quasi-scientific category origins. To address this possibility, we subjected the results of all three studies to an omnibus analysis.

Omnibus Analysis

In order to provide an overall test of our hypothesis that beliefs about quasi-scientific and supernatural causal origins shape children's person judgments by marking categories as non-arbitrary, we combined data on children's open-ended explanations about people from Studies 1-3 into an omnibus analysis ($N = 171$). We focused on the roles of arbitrariness and origin condition in shaping children's explanations, as this measure was asked in a consistent manner across all three studies. For this analysis, we re-coded the conditions across studies for consistency (see Table 3). For Study 1, we included only responses about the social category Modies (i.e., no responses about animals). We then analyzed children's explanations across the three studies, with arbitrariness, origin, study, and age included as predictors in the model and random intercepts for each item.

<u>Study</u>	<u>Condition</u>	<u>Coded as</u>	
		<u>Grouping</u>	<u>Origin</u>
1	Found	Arbitrary	Not created
	Created	Non-arbitrary	Created
2	Discovered	Arbitrary	Not created
	Discovered	Non-arbitrary	Not created
	Created	Arbitrary	Created
	Created	Non-arbitrary	Created
3	Traveler	Arbitrary	Not created
	Discovered	Non-arbitrary	Not created
	Created	Non-arbitrary	Created

Table 1

Re-coded conditions in Studies 1-3 for omnibus analysis.

This omnibus analysis was consistent with our primary findings in each study: children who learned that a novel category reflected a non-arbitrary means of dividing up the social world

were more likely to use the category to explain the traits of people who were its members (main effect of arbitrariness, $LR\ X^2(1) = 8.83, p = .003$). Compared to arbitrary groupings, children who learned about non-arbitrary category groupings were 1.62 times as likely to refer to the category and a stable, intrinsic cause to explain people's behavior (95% CI [0.68, 3.87]). These beliefs did not differ for quasi-scientific causes and supernatural ones (main effect of origin, $LR\ X^2(1) = 0.05, p = .83$). Thus, causal origin stories shape children category beliefs by marking non-arbitrary ways of dividing up the social world. A creator's intention when designing a particular category did not play a crucial role in shaping these beliefs. As in Study 2, children's use of the category to explain people's traits and behaviors overall decreased with age (main effect of age, $\beta = -0.6, SE = 0.22, z = -2.68, p = .007$). There were no significant interactions of these factors, nor were there any main or interactive effects of study (all $ps > .10$).

General Discussion

From infancy, people simplify their worlds by dividing up their experiences into categories—dogs and cats, apples and oranges, boys and girls. Reasoning based on categories is central to human cognition, and categories provide a powerful lens through which we can understand the people we meet every day. Yet our reliance on any particular social category to predict and explain why those around us do what they do varies depending on the importance of that category within our cultural environment. For example, essentialist beliefs about race and ethnicity differ along with people's political views (Mandalaywala, Amodio, & Rhodes, 2017) or those of their parents (for children; Rhodes & Gelman, 2009a). These beliefs also differ depending on the diversity of people's local environment (Deeb, Segall, Birnbaum, Ben-Eliyahu, & Diesendruck, 2011; Mandalaywala, Ranger-Murdock, Amodio, & Rhodes, 2018) and their own minority group membership (Kinzler & Dautel, 2011; Mandalaywala et al., 2018; Roberts & Gelman, 2016). Similarly, people's essentialist beliefs about religion categories depend on their own religious upbringing (Chalik, Leslie, & Rhodes, 2017; Diesendruck & Haber, 2009) and whether religion is associated with social and political conflict in their environment (Diesendruck,

Goldfein-Elbaz, Rhodes, Gelman, & Neumark, 2013; Smyth et al., 2017). Even essentialist beliefs about gender, which emerge early and are particularly ubiquitous across cultures (Rothbart & Taylor, 1992; Prentice & Miller, 2007; Taylor, 1996; Taylor, Rhodes & Gelman, 2009), vary depending on people's values and experiences (Eidson & Coley, 2013; Fast & Olson, 2018; Rhodes & Gelman, 2009a).

Across cultures, young children likely use a range of cues to determine which kinds constitute meaningful distinctions—from subtle cues like the kinds of language adults use to talk about categories (Diesendruck & Haber, 2009; Gelman et al., 2010; Rhodes et al., 2012; Segall et al., 2014), to explicit causal explanations about the underlying structure of categories (Chalik et al., 2017; Diesendruck & Haber, 2009). The current results suggest that these cues may all share an important characteristic—they all communicate adults' beliefs that the category in question is a non-arbitrary way of dividing up the social world. By explaining a category as based on non-arbitrary causes—whether supernatural or quasi-scientific—adults signal to children that they view the category as reflecting the objectively true structure of the social world. In this way, perhaps the fact that a particular category *is* marked as a meaningful distinction in children's environment matters more than precisely *why* that category is viewed as such.

While we found consistent results regarding children's open-ended explanations across studies, we found somewhat mixed patterns of results across various other measures of children's beliefs. For example, information about category origins did not shape children's beliefs about whether properties were heritable, as assessed by the switched-at-birth tasks in Studies 1 and 2. We also found no effect of condition on children's responses in the exploratory visitor task or deference to experts task in Study 3. Finally, although only arbitrariness—and not information about the intentions of a powerful creator—shaped children's explanations in Study 2 and in the omnibus analysis across studies, there did appear to be some effects of information about intentionality in Study 3. In this study, children appealed to intrinsic causes and

generalized the features of one category member to more other members of the kind more often in the created condition than the traveler condition, whereas children in the discovered condition (in which categories were described as non-arbitrary but no information was given about intentionality) did not differ from either of these two conditions. While these findings are consistent with the possibility that information about an intentional creator uniquely influenced children's beliefs, these effects were small and found only in Study 3. Also, in Study 3, although the created and baseline conditions differed from one another, the overall effect of condition did not improve the model fits (unlike in Studies 1-2), suggesting perhaps that the traveler condition, which was intended as a baseline, did not effectively induce strong beliefs that the categories were created arbitrarily.

Indeed, it is possible that children in the present studies may have interpreted *all* of the categories of Modies as intentionally created by a powerful agent, varying only in whether the origin was known or unknown. The propensity to construe categories in terms of an agent's purposeful action persists into adulthood, even for those who do not endorse religious creationist beliefs (Järnefelt et al., 2015; see also Banerjee & Bloom, 2014; Heywood & Bering, 2014; Kelemen & Rosset, 2009; Kelemen et al., 2013) and even in secular cultural environments (Järnefelt et al., 2019; Rottman et al., 2017). These tendencies are particularly common in young children (Evans, 2001; Kelemen, 2004; Kelemen & DiYanni, 2005). While the discovered conditions in Studies 2 and 3 provided quasi-scientific criteria for classification of the category, they did not provide an explicitly non-creationist explanation about the origins of the category, such as a description of its evolution. In the absence of a scientific descriptions of how the category came to be, it is possible that children interpreted even quasi-scientific causes as products of an intentional creator, and that we would have found more pronounced effects of our manipulations (including on additional indicators of essentialist thought) if we had included these stronger comparisons.

It is also possible that some children are more receptive to supernatural causal origin stories than others. As described above in the Discussion of Study 1, children from more religious backgrounds are more likely to treat the properties of social categories as inherited (Chalik et al., 2017; Diesendruck & Haber, 2009), but such effects might depend on sustained exposure to creationist origin stories over time, or on other aspects of children's religious upbringing. Although the parents of roughly half of our total sample of children provided information about religiosity, and this factor did not significantly predict children's response ($ps > .10$), our convenience sample of children recruited and tested in New York City likely presented a high level of variation in cultural and religious backgrounds, which these studies were not designed to test for. Future research should directly examine how and when quasi-scientific and supernatural origin stories shape the various facets of essentialist beliefs across cultural and religious communities.

Future research should also examine the developmental trajectory of how arbitrariness and creator's intent shape people's use of categories to reason about what people are like. Children use intuitive theories to make sense of the world around them (Wellman & Gelman, 1998; Gopnik & Wellman, 2012), and they quickly develop category beliefs similar to those held by the adults in their communities. Young children are also more likely than adults to view a range of categories as homogenous (Emmons & Kelemen, 2015; Shtulman & Shulz, 2008), and they tend to think of many categories, including natural kinds, and intentionally created for some purpose (Kelemen, 2004). Thus, it is possible that young children hold an early-emerging bias to expect some categories to be essentialized kinds that reflect objectively true divisions between different types of people, even if they are unsure *which* categories they are (Gelman, 2003). Given children's readiness to view kinds as non-arbitrary, it is possible that stories communicating beliefs about category origins might be particularly influential in early childhood. However, it is also possible that adults, who have more nuanced category knowledge, might use origin stories to reason about category structure differently than young children. Adults who

explicitly endorse a creationist world view differ in their beliefs about how categories constrain the behavior of their members (Robinson & Semtana, 2019). Further, scientific and supernatural causal explanatory frameworks often coexist with each other, and reliance on supernatural causes to explain events may even increase, rather than decrease, across the lifespan (Legare, Evans, Rosengren, & Harris, 2018). Finally, there is also significant cross-cultural variation in the details of creationist origin stories people use in their daily lives (Chalik et al., 2017). While the specific categories about which people hold essentialist beliefs may vary across cultures, people hold these beliefs about *some* categories in every culture studied so far (e.g., Astuti, Solomon, & Carey, 2004; Gil-White, 2002; Sousa, Atran, & Medin, 2002). Thus, future work should also examine how reasoning about the origins of social categories may differ—or remain the same—across cultural contexts.

The current findings have implications for education, particularly how we teach children and adolescents about the biological bases of people's traits. Beliefs that categories are non-arbitrary, such as viewing traits as determined by genes, shape how we explain human behavior—from predicting what someone would like as a birthday present (Taylor, 1996; Taylor, Rhodes & Gelman, 2009), to predicting whether they will cheat on their partners (Garcia et al., 2010). These beliefs can also have pernicious consequences. For example, believing that racial categories reflect genetic distinctions leads people to endorse more racial stereotypes and view racial categories as more distinct, homogenous, and predictive (Donovan, 2014; Keller, 2005; Haslam, 2011; Parrott, Kahl, Ndiaye, & Traeder, 2012; Tenenbaum & Davidman, 2016). Thus, educators should carefully consider the role of scientific explanations (and students' quasi-scientific understanding of them) in shaping how people reason about the social world, for example by explicitly teaching students that racial groups are not defined by genetic differences. Given the possibility that people, especially children, posit an intentional creator even in the absence of explicit creationist input, these scientific explanations should also incorporate instruction about evolution and human origins.

Future work should also examine other aspects of category use that may be shaped differently by quasi-scientific and supernatural causal origin explanations. For example, while young children's prescriptive knowledge of categories (i.e., beliefs about how useful categories are for judging what individual people are like) may be similar for different types of causal origin explanations, their prescriptive judgements (i.e., beliefs about what category members *should* be like) may well differ. That is, while children may reason that any cue to non-arbitrary structure marks a category as useful for predicting what people *are* like, reasoning that an omniscient creator intended categories to be a certain way (with potential ramifications if the creator's will is questioned) could lead children to expect that people *should* conform to their categories. Thus, future research should examine whether supernatural origin stories might play a more prominent role in shaping normative beliefs about members of categories.

Categories provide an incredibly powerful shortcut for reasoning about the many people we meet each day—by grouping our experiences into categories, we can make broad inferences based on limited experience. One important factor people consider when deciding whether or not to base their judgments of people on category membership is intuitions about how the category came to be. When we view categories as reflecting non-arbitrary divisions between fundamentally different kind of people, we expect the traits and behaviors of category members to be stable and intrinsic, rather than individual and idiosyncratic. Thus, beliefs about *why* categories are the way they are shape how people use them in their daily lives.

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