The Cognitive Precursors of Early Developing Essentialist Beliefs

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Abstract

Essentialist beliefs about categories (e.g., intuitions that categories like "girl" or "tiger" reflect real natural structure in the world) emerge early in development across diverse cultural contexts, but the processes by which they develop have rarely been examined. We tested if the basic conceptual and explanatory biases that children rely on to build intuitive theories of the world contribute to the emergence of essentialism across early childhood. Consistent with this possibility, children who deferred to experts regarding category labels, endorsed single and intrinsic causes for object functions, and generated over-hypotheses about structure based on limited evidence developed more essentialist beliefs across childhood (with some variation across domains of thought). Together, these data reveal that the development of essentialist beliefs is shaped by basic conceptual biases that underlie how children construct intuitive theories about the world.

Keywords: essentialism; cognitive biases; cognitive development; concepts and categories; longitudinal research

The beliefs that a baby tiger will grow up to be ferocious, that you either are a "math person" or you are not, that scientists are fundamentally different people from artists, and that a baby boy will inevitably prefer blue to pink all reflect essentialist beliefs about the world (Gelman, 2003; 2004; Hirschfeld, 1996; Medin & Ortony, 1989; Rothbart & Taylor, 1992). Essentialism entails a series of interrelated beliefs about categories and category features, including that (a) categories are stable and fixed-at-birth (e.g., a baby tiger will grow up to be ferocious, even if raised by a community of peaceful sheep), (b) category boundaries are inflexible (e.g., an animal either is a tiger or it is not), (c) categories reflect natural and objective distinctions (e.g., classifying some animals as tigers and others as sheep is a reflection of the natural and objective structures of the world, not an arbitrary decision), and (d) category membership is causally explanatory of behavior (e.g., the reason that a sheep is gentle is simply *because* it is a sheep; Rhodes & Moty, 2020).

Although essentialist intuitions can sometimes promote positive attitudes towards members of certain social categories (e.g., those based on sexual orientation, disability, and weight; Bogart et al., 2018; Haslam et al., 2002; Haslam & Levy, 2006; Jayaratne et al., 2006; Pearl & Lebowitz, 2014), more often, they lead to pernicious and problematic consequences. For example, essentialist beliefs about social categories (e.g., those based on gender, race, ethnicity, nationality, religion, etc.) tend to exaggerate between-group differences, ignore within-group variation, and deny the role of social construction, thus leading to increased levels of social stereotyping, prejudice, and resistance towards intergroup contact (Bastian & Haslam, 2006; Haslam, 2017; Hodson & Skorska, 2015; Mandalaywala et al., 2017; Pehrson et al., 2009; Roberts et al., 2017; Yzerbyt et al., 2001; Zagefka et al., 2013). As an example, one who endorses essentialist beliefs about gender may be more inclined to believe that boys are naturally more agentic than girls or that gender disparities are due to intrinsic differences in aptitude rather than sociocultural factors.

Similarly, although some essentialist inferences about animal categories may be warranted (e.g., that wolves will give birth to a baby wolf rather than a baby sheep), essentialist beliefs about animal categories can also reflect an inaccurate and biased perception of the natural world and impede scientific understanding (Gelman & Marchak, 2019; Gelman & Rhodes, 2012; Leslie, 2013; Mayr, 1982). For example, essentialism implies that species have fixed and unchanging essences (e.g., a cheetah has a "cheetah essence" that makes it fast) and that all members of an animal category share the same characteristics and features (e.g., all cheetahs possess exceptional speed), which is inconsistent with a scientific understanding of metamorphosis, speciation, and natural selection (Gelman & Marchak, 2019; Gelman & Rhodes, 2012; Leslie, 2013; Mayr, 1982).

Essentialist beliefs about animal and social categories emerge early in development and are widespread across cultures. Children as young as age three, including those from diverse cultural contexts with limited or no exposure to Western education (e.g., Madagascar, Yukatek Maya villages in Mexico, Menominee Native Indian tribes in the United States) endorse essentialist beliefs about animal and (certain) social categories (Astuti et al., 2004; Atran et al., 2001; Birnbaum et al., 2010; Davoodi et al., 2020; Hirschfeld, 1995; Medin & Atran, 2004; Rhodes & Gelman, 2009; Sousa et al., 2002; Taylor et al., 2009). For example, even before they begin formal schooling, young children expect that animal categories reflect natural and objective distinctions, remain stable across development, and are determined by parental lineage (Gelman & Markman, 1986; Gelman & Wellman, 1991; Rhodes et al., 2014; Waxman et al., 2007). While essentialist beliefs about animal categories are rather consistent across cultures, children's essentialist beliefs about social categories show greater variation, specifically in terms of *which* social categories they essentialize (e.g., children exposed to greater racial diversity report lower levels of racial essentialism; Deeb et al., 2011; Diesendruck et al., 2013; Giles et al., 2008; Pauker et al., 2016; 2018; Rhodes & Gelman, 2009; Smyth et al., 2017; Xu et al., 2022).

Although essentialist beliefs have been widely documented among young children, the processes by which they arise in early childhood have rarely been tested directly. One

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theoretical account suggests that essentialist thought is the product of a folk biological module, which is then triggered for both animal species and some social kinds (e.g., gender, race, ethnicity; Atran, 1998). Another view suggests that essentialism arises as children construct intuitive theories to make sense of the world (Gelman et al., 2010; Gelman & Roberts, 2017; Rhodes & Moty, 2020). On this second account, essentialism results from the domain-general conceptual and explanatory processes and biases that children rely on to make sense of the environment that they encounter.

For example, children may observe (or hear described in language) that girls wear pink, have long hair, play with dolls, etc. more than boys do. As children try to make sense of such regularities (Gopnik & Wellman, 2012; Xu, 2019), they can interpret them in either more *essentialist* terms (e.g., girls naturally prefer pink) or not (e.g., that people just buy more pink things for girls). Here, we tested if several conceptual and explanatory biases lead children to develop essentialist beliefs in response to such patterns.

First, we considered children's interpretation of language that describes categories (Gelman & Roberts, 2017). Language transmits essentialist beliefs via noun labels (e.g., "This is a scary tiger!") and generic statements (e.g., "Tigers have stripes"), which children recognize as referring to abstract kinds by at least age 2.5 years (Gelman & Raman, 2003). Young children often assume that adult speakers are knowledgeable experts who know the right way to talk about categories (Gelman & Markman, 1986; Jaswal, 2004; 2007); therefore, we propose that from frequent exposure to generic descriptions of categories, children assume that the referenced kinds exist in a real (objective and natural) way in the world *because* linguistic experts refer to them as if they do. If this is the case, children who are more likely to defer to adult linguistic experts may develop more essentialist views about categories in domains where such descriptions are common.

Second, we considered biases that shape causal reasoning. Starting from infancy, young children expect the *insides* of objects to be causally powerful. For example, 14-month-olds tend to attribute a novel animate object's behavior (e.g., movement, sound) to internal (e.g., their stomach) rather than external features (e.g., their hat; Newman et al., 2008). Children who more readily refer to internal and intrinsic causes may also be more likely to rely on intrinsic causes to explain observed regularities (e.g., many cheetahs are fast *because* something inside of them makes them run fast; many girls wear pink *because* pink is an inherently feminine color); this cognitive tendency to refer to internal causes could contribute to the foundation of essentialist beliefs.

Third, once children develop a set of essentialist-like intuitions (e.g., a cheetah is fast because something inside it makes it run fast; a cheetah is spotted because of something special about its fur; a cheetah is a natural kind that is objectively distinct from jaguars), their tendency to form over-hypotheses (i.e., higher-order generalizations; Goodman, 1955; Macario et al., 1990) may then help them build a conceptual framework that is consistent with an essentialist representation of categories (Rhodes & Moty, 2020). For instance, by assuming that something inside cheetahs makes them run fast and have spotted fur, they may form the over-hypothesis that an unknown "essence" is responsible for all these observed similarities and others yet-to-be-discovered (Brandone, 2017; Gelman et al., 1986). As another example, as children learn labels of different animals (e.g., dogs, goldfish, snakes), they may form over-hypotheses about how physical features of animals (e.g., body coverings) mark naturally distinct kinds. Therefore, children who are more inclined to generate over-hypotheses may more readily build a conceptual framework consistent with essentialist thought.

Fourth, children from Western cultures often refer to single, object-based causes over more complex, relational ones (Carstensen et al., 2019; Rhodes & Moty, 2020; Walker & Gopnik, 2014). For example, when presented with different combinations of blocks that make a toy play music, English-speaking three-year-olds prioritize single, object-matched evidence (e.g., a single blue block makes the toy play music) over relation-based evidence (e.g., two *different* blocks make the toy play music; Carstensen et al., 2019). We considered whether children who readily refer to single, object-based mechanisms may be more likely to rely on a single, object-based "essence" to explain category-based regularities; conversely, children who instead refer to more complex, relational mechanisms may be less likely to formulate essentialist intuitions about categories.

In the present study, we tested whether the four hypothesized cognitive precursors of essentialism (deference to expert, intrinsic bias, over-hypothesis, relational thinking) would predict young children's essentialist beliefs about animal and social categories over time. By doing so, we sought to understand the developmental origins of biological and social essentialism.

Methods

Participants

Participants (N = 262; 137 girls, 125 boys; M_{Age} = 4.64 years, SD = 0.90, 3-5.98 years) were randomly assigned to one of two conditions (Animal Condition: n = 137; Human Condition: n = 125) and were tested in October to November 2021. Of those participants, 194 (Animal Condition: n = 105; Human Condition: n = 89) were tested a second time in February to April 2022 (i.e., approximately five months later). All participants were recruited and tested via a remote unmoderated research platform (Rhodes et al., 2020) and came from 34 states across the United States. Parental consent and child assent were obtained from all participants. All study procedures were approved by the Institutional Review Board of New York University.

Procedures

The longitudinal study consisted of two waves of data collection. In the first wave, participants completed four

measures that assessed their essentialist beliefs about animal or human categories (i.e., that categories and their features are a) fixed-at-birth, b) inflexible, c) objective, and d) explanatory), as well as four tasks that assessed their general cognitive tendencies (i.e., children's general tendency to a) defer to linguistic experts in category labeling, b) infer intrinsic over extrinsic causes, c) draw over-hypotheses based on limited patterns of evidence, and d) infer relational over object-based causes). The cognitive tasks were only administered at the first time point, while the essentialism measures were administered at both; participants' condition assignments for the essentialism measures were consistent across time.

Measures

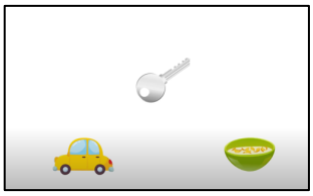
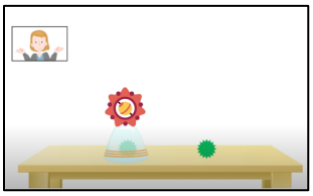
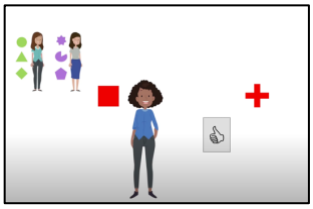
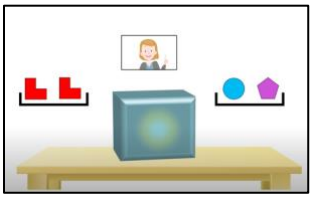
Cognitive Measures We included a total of four general cognitive biases that we theorized might contribute to the development of essentialism in early childhood (see Table 1 for example trials for each task). The order of the four cognitive tasks was consistent across participants (Deference to Expert, Over-Hypothesis, Relational Thinking, Intrinsic Bias), but the order of the trials presented within tasks was randomized.

Children's tendency to defer to linguistic experts in category labeling (i.e., **Deference to Expert**) was tested by showing participants a perceptually ambiguous object (e.g., an object similar to both a spoon and a key) and then asking them where to place the object (with the narrator referring to the object with a particular category label; e.g., "Where does this *spoon* go? In a bowl or with a car?"; Jaswal, 2004). Responses consistent with the label provided were coded as 1, and those inconsistent with the label provided were coded as 0. This task included one trial.

Children's tendency to infer intrinsic over extrinsic causes (i.e., **Intrinsic Bias**) was tested by asking participants if they thought that a toy was started by an internal (coded as 1) or external (coded as 0) causal factor (Cimpian & Salomon, 2014; Walker & Gopnik, 2014). This task included one trial.

Children's tendency to draw over-hypotheses based on limited patterns of evidence (i.e., **Over-Hypothesis**) was tested by showing participants examples of people's favorite toys; the first individual liked to play with three green objects in various shapes, the second individual liked to play with three purple objects in various shapes, and the third individual liked to play with a red square (Macario et al., 1990). Participants were then shown a series of shapes in different colors and asked if the third individual would like to play with each object. Responses consistent with the participant generating a higher-order abstract rule (e.g., everyone likes to play with toys of the same color) were coded as 1 (i.e., accepting red shapes or rejecting shapes in other colors), and those inconsistent with this tendency were coded as 0 (i.e., rejecting red shapes or accepting shapes in other colors). This task included eight trials.

Table 1: Example trials for each cognitive task.

 **Deference to Expert** **Q**: Where does this *spoon* go? (bowl = 1, car = 0)	 **Intrinsic Bias** **Q**: Do you think the one *inside* the toy turned it on? Or do you think the one *outside* of the toy turned it on? (inside = 1, outside = 0)
 **Over-Hypothesis** Children were shown a first individual who liked to play with three green objects in various shapes, a second individual who liked to play with three purple objects in various shapes, and a third individual (Razzle) who liked to play with a red square. **Q**: Does Razzle like to build with this one? Yes, or no? (accepting red objects/rejecting other objects = 1, other choices = 0)	 **Relational Thinking** Children observed a musical toy that could be turned on with two different sets of blocks (one red, one blue; or one red, one purple) but not two blocks of the same color (two yellow or two green). **Q**: Only one of these trays has the things that would make my toy play music. Can you point to the tray that has the things that would make my toy play music? (blue and purple = 1, two red = 0)

Children's tendency to infer relational over object-based causes (i.e., **Relational Thinking**) was tested by showing participants a musical toy that could be turned on with two different sets of blocks (one red, one blue; or one red, one purple); therefore, children could either assume that an individual block (e.g., the red block) or a relational pattern (e.g., two different blocks) caused the effect (Carstensen et al., 2019). Participants were then asked if the toy could be turned on by two red blocks (reflecting object-based

reasoning; coded as 0) or one blue and one purple block (reflecting relational reasoning; coded as 1). This task included one trial.

Essentialism Measures We included four measures of children's essentialist beliefs about animals and humans. In both conditions, children indicated their beliefs about a novel category ("Zarpies"). The script for the two conditions was identical; the only difference was whether children were presented with novel animal or human categories.

To assess whether participants endorsed beliefs that categories are fixed-at-birth, we showed children a baby (animal or human) who was born to a Zarpie mom but grew up with a mom who was not a Zarpie (Gelman & Wellman, 1991; Rhodes et al., 2012; Taylor, 1996) and asked them if the baby would grow up to share features and category membership with the Zarpie mom (coded as 1) or the other mom (coded as 0). This measure included three trials.

To assess whether participants endorsed beliefs that category boundaries are inflexible, we told children about a trait that Zarpies shared and another trait that non-Zarpies shared and asked whether an individual Zarpie (animal or human) could only have the same-category trait (coded as 1) or could also have the other-category trait (coded as 0; Rhodes & Mandalaywala, 2017; Taylor et al., 2009). This measure included two trials.

To assess whether participants endorsed beliefs that categories reflect objective distinctions in nature, we showed children an exemplar "Zarpie" (animal or human) and asked them to indicate whether a series of exemplars were "the same kind" (Kalish, 1998; Rhodes et al., 2014; Rhodes & Gelman, 2009). Responses that accepted other Zarpies as the same kind but not other more superordinate categories (e.g., another human) were coded as 1; other responses were coded as 0. This measure included three trials.

To assess whether participants endorsed beliefs that categories are causally explanatory, we showed children a Zarpie (animal or human) engaging in a type of behavior and asked them to choose if their behavior was based on category membership (coded as 1) or context (coded as 0; Gelman et al., 2010; Rhodes et al., 2012). This measure included two trials.

Therefore, children completed a total of ten questions that assessed their essentialist beliefs about categories.

Analytic Strategy

To examine the effects of general cognitive tendencies, age, condition, and time on participants' essentialism beliefs, we conducted separate generalized linear models with a binomial distribution (using the package *lme4*; Bates et al., 2015) for each cognitive measure (deference to expert, intrinsic bias, over-hypothesis, and relational thinking), respectively, with cognitive bias, participant age (centered), participant condition (Animal, Human), time wave (1, 2), and their interactions as fixed effects, participant ID, item, and time wave as random effects, and whether participants indicated an essentialist response as the dependent variable (which included participants' responses from the four essentialism tasks, with each item response scored as 1 = essentialist, 0 = non-essentialist; item was included as a random intercept).

Results

Overall, children's general cognitive tendencies predicted the development of essentialism, with some variation across domains.

Children who deferred to experts, by accepting a counter-intuitive label given by an adult, generally expressed more essentialist beliefs than those who did not (main effect of deference to expert: X^2 (1) = 4.14, p = .042; see Fig. 1A). This effect held across domains (for both animal and social categories), as well as across age and time wave (ps > .20).

The remainder of the cognitive tendencies related to essentialism in a domain-dependent manner. In particular, children who endorsed intrinsic over extrinsic causes, and more readily formed over-hypotheses based on limited evidence, expressed more essentialist beliefs about animal categories, but these cognitive tendencies did not relate to essentialism for social categories (two-way interaction between intrinsic bias and domain: X^2 (1) = 5.32, p = .021; see Fig. 1B; two-way interaction between over-hypothesis and domain: X^2 (1) = 4.43, p = .035; see Fig. 1C).

On the other hand, for relational thinking, children who inferred relational causes over object-based causes developed less essentialist beliefs over time for social categories (three-way interaction among relational thinking, condition, and time wave: X^2 (1) = 6.27, p = .012; see Fig. 1D); relational thinking did not relate to essentialism for animal categories.

Discussion

Together, these data shed novel light on the developmental origins of biological and social essentialism. Specifically, 3-to-5-year-old children's general cognitive tendencies (including their tendency to defer to linguistic experts, infer intrinsic causes, generate over-hypotheses, and refer to relational evidence) predicted the developmental trajectory of their essentialist beliefs about animal and social categories. Whereas previous research on children's essentialist thought has focused on documenting its early emergence and pernicious consequences, the present study is the first, to our knowledge, to show that the early development of biological and social essentialism is shaped by the conceptual biases that children rely on to build intuitive theories about the world.

Critically, none of the cognitive measures in the present study were based on animal or social categories; instead, they tested children's basic, object-based cognitive tendencies (e.g., whether something inside a *toy* made it go, whether the relation between two *blocks* turned on a toy; Carstensen et al., 2019; Walker & Gopnik, 2014). Therefore, the cognitive measures here were not intended to test biases that may reflect or precede essentialist-consistent intuitions (e.g., an inherence bias; Cimpian & Salomon, 2014), but rather general conceptual tendencies that we hypothesized would interact with children's experiences and observations as they build intuitive theories about the world.

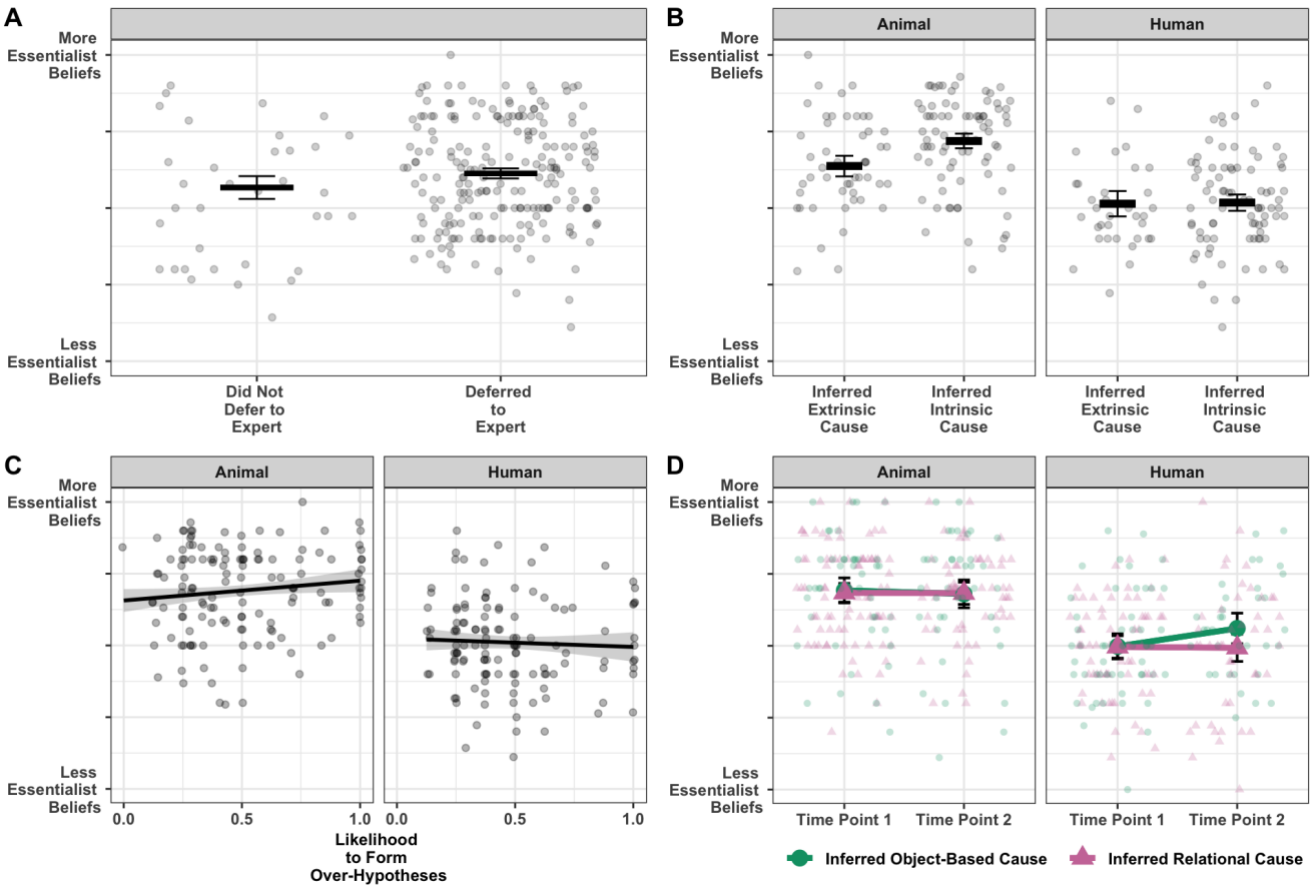


Figure 1: (**A**) Probability of participants giving an essentialist response by their tendency to defer to a linguistic expert when labeling an object. (**B**) Probability of participants giving an essentialist response by their tendency to infer intrinsic over extrinsic causes and assigned condition (intrinsic bias contrast for animal categories: b = .43, SE = .15, z = 2.92, p = .004; human categories: b = -.07, SE = .16, z = -.43, p = .668). (**C**) Probability of participants giving an essentialist response by their tendency to form over-hypotheses based on limited patterns of evidence and assigned condition (over-hypothesis slope for animal categories: b = .35, SE = .27, z = 1.31, p = .190; human categories: b = -.14, SE = .31, z = -.46, p = .645). (**D**) Probability of participants giving an essentialist response by their tendency to infer relational over object-based causes, assigned condition, and time wave (contrast for children's social essentialist beliefs at the second time point between those who inferred relational vs. object-based causes: b = -.53, SE = .21, z = -2.56, p = .011; other contrasts: ps > .25). *Note*: Small shapes reflect individual averages, and large shapes/lines reflect group averages. Error bars and bands reflect 95% CIs.

Due to the constructive nature of children's theory building process, these basic cognitive tendencies could determine the extent to which children develop essentialist beliefs in response to their observations. For example, children who are more likely to generalize over-hypotheses could infer from several observations (e.g., differences between boys and girls that are observed directly or described in language) that there are many other between-category differences and within-category similarities. Similarly, children who are more likely to refer to intrinsic and object-based causes might infer that these regularities arise from inherent differences, whereas those who refer to more external, relational causes might reason that socialization processes and historical factors play an important role in forming these differences (Cimpian & Salomon, 2014; Rhodes & Moty, 2020). From this perspective (and as the present data suggest), the development of essentialism reflects less of a domain-specific cognitive module (Atran, 1998; Gil-White, 2001; Pinker, 1994), but more of a constructive process that depends on the interplay of children's basic cognitive tendencies with the evidence they encounter in the world (Rhodes & Moty, 2020).

While the constructive process described so far is domain-general, the way children's cognitive tendencies predicted their essentialist beliefs showed some variation by domain (animal vs. human). Why might have some conceptual biases related more to their essentialist beliefs about animal than social categories? We suggest this has to do with the hierarchical conceptual structures of each domain that children brought into the task.

Consider how children learn about animals. For example, as they learn about the category *dogs*, they will likely hear adults refer to them with that specific category label and describe them with generic statements (e.g., "Dogs wag their tails when they're happy"; "This is a big dog!"), which may prompt them to view dogs as a natural, distinct category in which category members share features with one another (Gelman et al., 2010; Gelman & Heyman, 1999; Rhodes et al., 2012; Waxman, 2010). More so, their experiences with dogs may further contribute to an essentialist representation of the category dogs, wherein they assume that puppies will grow up to be dogs and not cats, that there is an absolute and natural boundary between dogs and cats, and that the reason a dog barks is *because* they are a dog. These beliefs are all consistent with an integrated essentialist representation of dogs (e.g., that a "dog" essence gives rise to these properties; Rhodes & Moty, 2020).

Critically, children will likely go through a similar learning process for other animal categories (e.g., lions, hamsters, cats, goldfish). From these experiences, children can abstract a set of higher order regularities not for each animal category, but for the *domain* animals in general: that the domain of animals consists of various naturally distinct categories, where each kind of animal shares intrinsic essences with other category members and is separated from other animal kinds with absolute boundaries. We suggest that the extent to which children form over-hypotheses based on limited evidence and appeal to intrinsic causes will shape the extent to which they bring such beliefs about the structure of the animal domain into the task, and thus the likelihood of essentializing a new animal category when they encounter it.

In comparison, children's learning of social categories might vary considerably depending on the specific social category at play. Whereas children may endorse certain essentialist beliefs about some categories (e.g., that gender is stable across time, so a boy is likely to grow up to be a man; Gelman & Taylor, 2014), they might be less likely to do so for other social categories (e.g., those based on team memberships, age, or interests). The boundaries that separate different social categories and the similarities that bind category members together are more context-dependent than they are for animal categories; for example, gender might be more predictive of children's social interactions at school than at home, and children's team affiliations might change from year to year. This variability within the domain of social categories predicts a less uniformly integrated set of essentialist theories about social categories compared to animal categories. Indeed, unlike for animal categories, children tend to treat new social categories as candidates for essentialism and then develop essentialist beliefs (or not) for each category one at a time (Chalik et al., 2017; Rhodes et al., 2012; 2018), rather than apply a set of higher order expectations for the entire domain.

Considering the results in the present study, these domain-specific structures may explain the variation in how children's cognitive tendencies shaped their essentialist beliefs about animal and social categories. For animal categories (more than social categories), children's abstraction of a set of higher order regularities at the domain level may rely more on their general tendency to assume intrinsic mechanisms (e.g., to infer that a single, unseen essence gives rise to a set of correlated essentialist intuitions about a specific animal category) and to generate over-hypotheses (e.g., to apply this integrated set of essentialist intuitions at the higher domain level). In comparison, both animal and social categories are highly marked in language (Gelman et al., 2010; Gelman & Heyman, 1999; Rhodes et al., 2012; Waxman, 2010), so the general tendency to defer to adult linguistic experts may contribute to their view of both categories as being objectively determined. Finally, the tendency to focus on complex, relation-based evidence may be especially crucial to developing anti-essentialist views of social categories, given how the socially constructed nature of social categories is often defined by complex sociocultural processes (Cimpian & Salomon, 2014).

The participants included in the present study were all English-speaking children recruited from the United States. This limitation not only constrains the generalizability of the present findings (Cheon et al., 2020; Roberts et al., 2020), but also poses a set of important questions about the role of culture for future research. The set of conceptual biases tested here are widely held, but not culturally invariant. For example, people from more collectivist cultures are more likely to defer to authority (Li et al., 2019) but also less likely to infer to a single intrinsic, object-based cause (Carstensen et al., 2019). Therefore, future cross-cultural research could further illuminate how essentialist beliefs may develop from an interplay of developmental, cognitive, and cultural processes. In addition, in future work, it will be helpful to pinpoint if these cognitive biases predict variation in essentialism, even accounting for individual variation in verbal abilities, executive functions, or other more domain-general cognitive capacities. Until then, the present study reveals four cognitive precursors that predict the early trajectory of biological and social essentialist beliefs, thus providing support for a constructivist account of the development of essentialism.

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