Received Date: 09-Jun-2015
Revised Date: 18-Jun-2016
Accepted Date: 20-Jun-2016
Article Type: Regular Article
Running Head: CHILDREN'S ESSENTIALIST BELIEFS

My Heart Made Me Do It: Children's Essentialist Beliefs About Heart Transplants

Meredith Meyer
Otterbein University
Susan A. Gelman and Steven Othello Roberts
University of Michigan
Sarah-Jane Leslie
Princeton University

Author Note

Meredith Meyer, Department of Psychology, Otterbein University; Susan A. Gelman, Department of Psychology, University of Michigan; Steven O. Roberts, Department of Psychology, University of Michigan; Sarah-Jane Leslie, Department of Philosophy, Princeton University.

This research was supported by NICHD grant HD-36043 to S. A. Gelman and NSF grants BCS-1226942 and BCS-1530669 to Leslie. We gratefully acknowledge the research assistance of Elizabeth Anastasia, Chhavi Chaudhry, and Alexandra M. Was.

Correspondence concerning this article should be addressed to Meredith Meyer, Department of Psychology, 1 S. Grove St., Westerville, OH 43081.
Phone: (614) 823-1581
E-mail: mmeyer@otterbein.edu

Keywords: Causal reasoning, concepts, children, psychology, psychological essentialism

Abstract

Psychological essentialism is a folk theory characterized by the belief that a causal internal essence or force gives rise to the common outward behaviors or attributes of a category's members. In two studies, we investigated whether 4- to 7-year-old children evidenced essentialist reasoning about heart transplants by asking them to predict whether trading hearts with an individual would cause them to take on the donor's attributes. Control conditions asked children to consider the effects of trading money with an individual. Results indicated that children reasoned according to essentialism, predicting more transfer of attributes in the transplant condition vs. the non-bodily money control. Children also endorsed essentialist transfer of attributes even when they did not believe that a transplant would change the recipient's category membership (e.g., endorsing the idea that a recipient of a pig's heart would act pig-like, but denying that the recipient would *become* a pig). This finding runs counter to predictions from a strong interpretation of the "minimalist" position, an alternative to essentialism.

My Heart Made Me Do It: Children's Essentialist Beliefs About Heart Transplants

> The third surgeon fixed the pig's heart firm in the place where his own had been. In the morning he did not stay with the others at all, but wherever there was a corner he ran to it, and rooted about in it with his nose as pigs do. The others wanted to hold him back by the tail of his coat, but that did no good; he tore himself loose, and ran wherever the dirt was thickest.
> ("The Three Army Surgeons," The Brothers Grimm)

Psychological essentialism is a folk theory with two primary assumptions. First, certain categories are believed to be richly-structured natural kinds whose members share many features, including deep and non-obvious ones. Second, the members of such categories are assumed to possess an underlying causal essence that is responsible for their shared features (Gelman, 2003; Medin & Ortony, 1989). Much work suggests that essentialism is an early-developing bias that guides how children construct and think about certain categories. Children often view these categories as sharply-bounded, natural, and immutable, as opposed to graded, invented, and fluid

(Rhodes & Gelman, 2009; Taylor, Rhodes, & Gelman, 2009). Children are also capable of attending to internal and inborn aspects of individuals in determining category membership (Gelman & Wellman, 1991; Newman & Keil, 2008; Setoh, Baillargeon, & Gelman, 2013), and they often privilege category membership over outward perceptual attributes as the basis on which to extend novel properties and make predictions about future behavior (Dewar & Xu, 2009; Gelman, 2003; Gelman & Coley, 1990; Gelman & Markman, 1986, 1987; Gelman & Wellman, 1991; Graham, Kilbreath, & Welder, 2004; Keil, 1989). These findings are all consistent with the idea that children attribute essences to natural kind categories, and expect such essences to be causally responsible for the category-typical features that emerge.

However, the majority of past studies of essentialism have focused on how children expect certain categories to have rich, nonobvious structure and how they use this expectation to license inductive inferences, leaving open questions about children's beliefs in the causal scope and power of essences. The current study addresses this issue by asking children about the consequences of an organ donation. If children believe that essences reside within internal parts, and that essences have causal powers, then transferring parts from a donor to a recipient may also be believed to cause the recipient to take on some of the donor's characteristics. (This sort of prediction is precisely the premise behind the Grimm tale about the pig-like surgeon, quoted at the beginning.) The current study focuses on this pattern of essentialist thinking, asking whether young children systematically believe that the transfer of an internal bodily element--the heart--could cause recipients to take on aspects of their donors.

Prior research suggests that, for adults, organ transplants are essentialized in this fashion. People dislike the idea of receiving transplants from morally objectionable individuals (Hood, Gjersoe, Donnelly, Byers, & Itajkura, 2011), a preference that could be attributed to people's expectations that such transplants may confer an immoral essence. Even more tellingly, both transplant patients and members of the general public often explicitly endorse the possibility of taking on attributes of organ donors, including personality traits and preferences (Inspector, Kutz, & David, 2004; Sanner, 2001a, 2001b). A recent study elaborated on these findings by asking adults, in both the United States and India, directly about causal essentialist beliefs regarding heart, blood, and DNA transplants from a wide range of donor types (including humans and non-human animals) (Meyer, Leslie, Gelman, & Stilwell, 2013). Consistent with

essentialism, people often reported that an organ donation (but not a non-bodily money transfer) could confer donors' traits to recipients (both themselves and another individual).

The patterns of thinking observed in the above studies are particularly interesting in light of the lack of scientific basis or empirical evidence for predicting that an organ donation has the power to transfer a donor's attributes. In other words, adults possess a belief that runs counter to evidence or teaching. In contrast, many past studies of essentialism tap into intuitions about natural kinds that, ultimately, are empirically supported or have some basis in truth; for instance, it is consistent with empirical observation that inborn species membership typically remains constant despite outward changes, and is often a reliable basis for drawing inductive inferences. In contrast, there is no scientific evidence to support essentialist intuitions in the context of an organ transplant. The fact that adults nevertheless often endorse the causal powers of a transplanted essence speaks to the strength of an essentialist bias.

The current studies turn the focus to children's beliefs, asking whether children, too, show evidence of such an empirically unsupported essentialist bias regarding the causal powers of an internal bodily part. Specifically, we asked whether young children believe that getting a heart transplant could cause properties to be transferred from the donor to themselves. The heart was selected for study because it is a plausible locus of an individual's essence (as it is bodily, inherent, and internal), because it is familiar to children, and because prior research examining adults' transplant beliefs included the heart (e.g., Meyer et al., 2013). There is also preliminary evidence that children ascribe causal properties to the heart. By early elementary school age, children report that trading hearts with someone has the power to cause the recipient to take on the donor's traits of kindness (and meanness), as well as emotions including happiness, sadness, and love (Johnson, 1990; Winer, Cottrell, & Bica, 2009). Though results from these studies appear consistent with essentialism, they are limited in that they are focused exclusively on traits and features that are metaphorically or culturally associated with the heart--emotions and kindness (along with other non-emotional attributes and psychological processes unique to the individual, such as specific knowledge and identity). Children may have thus been responding based on their belief that hearts function to determine certain specific emotions and feelings, rather than believing more broadly that essences determine individuals' behaviors and trait-like features. Furthermore, prior studies were not designed to test children's essentialist intuitions, but rather compared children's beliefs about the causal powers of the heart to predictions regarding a

brain transplant.

The current studies directly tested children's essentialist beliefs regarding a wider range of human and non-human animal trait-like attributes, asking children whether their personality or behavior would change to be more like that of the donor after a transplant. Posing the scenario as a transplant/donation to the children themselves--rather than an unknown or fictional individual--was designed to maximally appeal to children's intuitive folk beliefs regarding essences, and to make the scenario simple to understand. For the human trials, we asked not only about the traits of kindness and meanness, which are traditionally associated with the heart, but also about the extent to which a heart transplant would confer the donor's intelligence on the recipient. This served as an especially stringent test of essentialism, as it is highly unlikely that children have ever been exposed to idioms or cultural messages implying that the heart is responsible for this attribute. For the non-human trials, we presented scenarios involving donations from a pig and a monkey, in order to test children's intuitions regarding the causal powers of transplants from different species. We also selected these traits and non-human animals because they were investigated in a similar context in adult work (Meyer et al., 2013) and are familiar even to young children (Heyman & Gelman, 1999, 2000). Finally, we also included children younger than those in prior studies concerning transplants; previous studies of essentialism in children have suggested that it is present in the preschool years (e.g., Gelman, 2003), yet previous investigations of children's beliefs about transplants have focused only on children of elementary school age or older.

Our studies also included a control condition that described trading either money (Studies 1 and 2) or a collar (Study 2) in order to allow for comparisons between beliefs about the causal powers of an internal, biological element--the heart--and an external, non-biological possession. If children reported more transfer of traits in the heart vs. the money/collar trade, this would provide evidence in favor of essentialism, as it would suggest that the causal force was construed as being internal and bodily. If this pattern were to be obtained, it would also rule out the possibility that children's predictions of trait transfer after a heart transplant were due to (1) a simple positive response bias or task demands or (2) a broader style of magical thinking related to generalized contagion effects (the idea that direct or indirect physical contact can transmit aspects of an individual; Johnson & Jacobs, 2001; Nemeroff & Rozin, 1994). Either of these

alternative interpretations would result in children reporting that both heart and money/collar exchanges result equally in transfer of attributes.

In addition to examining children's beliefs about the causal powers of a transplant, a second focus of our study was to address a theoretical criticism of essentialism known as "minimalism" (Strevens, 2000). On its strongest reading (see Meyer et al., 2013, for discussion of other readings), the minimalist approach holds that when people seek to explain outward category-typical features, they appeal directly to category membership as the basis for their explanations, rather than representing essences as intervening causal forces. More specifically, the minimalist position describes both children and adults as expecting the operation of a "K-law" (K standing for "kind"), according to which they believe there is *something* about being a member of a kind that leads to the possession of a category-typical feature. Importantly, that "something" need not be an essence (i.e., a category-specific, internal, innate causal force), but rather may be left wholly unspecified; it is just a “brute fact” (Strevens, 2000, p. 154) that a category and a feature are linked. For instance, rather than attributing a pig's properties to the presence of a pig’s essence, minimalism claims that people instead need only appeal to the pig's category membership; so long as an individual is a pig, then that individual will display pig-like behavior, and no causal intervening essence is considered at all.

The minimalist position reinterprets data traditionally used to support psychological essentialism, arguing that children's and adults' well-documented tendency to assume the existence of richly structured natural kinds, and to infer properties on the basis of category membership, can be explained more parsimoniously through K-laws (Strevens, 2000, 2001). Although minimalism was proposed as a challenge to essentialism over fifteen years ago, it continues to be debated (e.g., Houkes & Vermaas, 2013; Leslie, 2013; Sloman & Malt, 2003; Smith, 2014; Weisberg, 2007), and only one empirical study has been designed to directly pit its predictions against those from psychological essentialism. Meyer et al. (2013) did this in their study of adults' essentialist intuitions regarding transplants. As described above, that set of studies asked adult subjects to report on the likelihood that traits would transfer to an individual who received an organ from one of a variety of donors. Some of these donors belonged to a different species, namely a pig and a chimpanzee. For these non-human donors, an additional question was included that asked subjects to report whether recipients' category membership would change after receiving a donation from these animals. If adults appealed simply to

category membership as the license to form predictions about attributes (the reasoning process proposed by minimalism), one would then predict that attribute change (e.g., acting more pig-like) would only be predicted in cases when the respondent also endorsed some degree of category change. Yet results indicated that adults readily provided predictions of trait transfer, while simultaneously *denying* that recipients' category membership would change (e.g., they often reported that the recipient of a pig's heart might act more pig-like, but uniformly denied that the recipient would *become* a pig). This pattern of responding provided clear support in an adult sample against the predictions of minimalism, and instead supported the predictions of essentialism (also see Ahn et al., 2001; Strevens, 2001).

Questions remain, however, regarding whether children also appeal to essences. Because psychological essentialism is claimed to be an early-developing bias, it is important to again test minimalist predictions, this time in a developmental sample. The current studies accomplish this, asking whether young children believe that the transfer of an internal biological part is capable of exerting effects independent of the recipient's category membership. Specifically, for the two non-human donors in our transplant scenarios (the pig and the monkey), we asked children not just whether getting a heart from these animals would result in a transfer of pig or monkey attributes, but also whether the child would *become* a pig or a monkey (i.e., change category membership). If children engage in essentialist reasoning, we would expect them to report that the transfer of a heart can have causal effects *even if* category membership of the recipient does not change. This would imply that children were not simply basing their predictions of category-typical behavior on an individual's category membership, but rather on a belief in the causal powers of a transferred essence.

To summarize, our studies were designed to address several unresolved issues regarding children's essentialist intuitions by (1) asking children to consider how heart transplants might affect a range of attributes, including ones not traditionally associated with the heart, including those associated with different non-human kinds, and (2) providing a test of strongly minimalist accounts by focusing on the potential causal power of an essence independent of category membership. Study 1 explored children's beliefs about transplants in a between-subjects design, in which children reported their predictions of change after either a heart transplant, or the exchange of a quarter. Study 2 extended findings from Study 1, in a within-subjects design in

which children provided predictions of change after either a heart transplant or an exchange of money (this time a dollar).

Study 1

Method

Participants

The final sample included 72 children in two age groups (4- and 5-year-olds: n=36, referred to as "younger children"; 6- and 7-year-olds: n=36, referred to as "older children"). An equal number of children in each age group (n=18) participated in the heart transplant and the non-bodily money control conditions (Heart: younger children M_{age}=5.00 yrs., SD=0.64; older children M_{age}=6.77 yrs., SD=0.69; Money: younger children, M_{age}=5.50 yrs., SD=0.56; older children, M_{age}=6.75 yrs., SD=0.55). Data from two additional children were excluded due to experimenter error.

Materials

Heart transplant vignettes described trading hearts with one of six donors (nice child, mean child, smart child, not-smart child, pig, and monkey) (Appendix). Each human donor vignette had a male and female version, matched to the participant's sex. Pictures accompanied each vignette depicting the donor engaging in behaviors characteristic of the relevant trait (for human donors) or category (for animal donors) (Table 1). Money Control vignettes described trading a quarter with each character and included only the four human donors, as animals do not possess money. Picture content and vignette text were otherwise identical to heart transplant vignettes.

For both the Heart and Money conditions, donors were grouped into pairs (for Heart, pairs were smart + not-smart, nice + mean, pig + monkey; for Money, pairs were smart + not-smart and nice + mean). We ordered pairs in all possible combinations, creating six orders for the Heart condition and two orders for the Money condition. The number of orders for each condition was then doubled by reversing the order of the members within pairs. Heart vs. money was a between-subjects factor. An equal number of children within each condition participated in the twelve heart transplant orders or the four money control orders.

Procedure

Vignettes were read aloud with accompanying pictures. For each character, three sample behaviors were provided that supported the character's trait or species identity. Children then

heard a brief description of either the heart or money exchange and were asked an initial forced-choice test question assessing predictions of attribute change: "If you got [Donor's] heart/quarter, would you end up [acquiring Donor's attribute], or would you stay the same?" (e.g., for the male "smart" heart donor named Sam, the test question was, "If you got Sam's heart, would you end up being smarter, like Sam, or would you stay the same?") If children responded with "stay the same," the trial ended. If children responded with endorsement of change, five circles of increasing size were shown, and the experimenter asked the child to point to the circle representing the amount of change the child predicted, ranging from "just a little bit" (smallest circle) to "a whole lot" (largest circle). For the animal donors, the attribute change question was phrased similarly to the attribute question for human donors: "If you got the pig's/monkey's heart, would you end up acting and feeling more like a pig/monkey, or would you stay the same?" An additional question assessing category change was then asked: "If you got the pig's/monkey's heart, would you end up being a pig/monkey, or would you still be a person?" If a child answered "still be a person," the trial ended. If a child endorsed category change, he/she was asked, "How much would you be a pig/monkey?" with the same pictorial Likert scale as before. We used the same scale for the category membership question as for the property inference question, in order to be able to compare responses across the two measures.

----------Table 1 appears about here ----------

Results and Discussion

Predictions of attribute change

Scores for predicted attribute change could range from 0 ("stay the same") to 5 (indicating the greatest degree of change). A summary score was calculated for attribute change by averaging across human donors (excluding animal donors, as they were not featured in the money condition, and were designed to test the predictions of minimalism). A 2 (age group: younger vs. older) x 2 (condition: heart vs. money) x2 (valence: positive [smart, nice] vs. negative [not-smart, mean]) mixed between-within ANOVA for attribute change revealed a main effect for condition, $F(1,68) = 12.86$, $p < .01$, $\eta_p^2 = .16$, with scores higher for heart transplants ($M = 2.26$, $SD = 1.84$) than money transfers ($M = 0.93$, $SD = 1.37$). There was also an age group x condition interaction, $F(1,68) = 6.17$, $p = .02$, $\eta_p^2 = .08$. To explore this interaction, we again examined condition-based differences within each age group. The condition effect was significant in older children, $t(34) = 4.73$, $p < .001$, but not in younger children, $t(34) = 0.72$, $p =$

.48 (Figure 1). (The pairwise comparisons in this follow-up, and all subsequent ones, were uncorrected.) Comparison of heart and money scores between age groups indicated it was specifically younger children's money scores (M = 1.38, SD = 1.63) that were significantly higher than older children's (M = 0.47, SD = 0.86), $t(34) = 2.09$, $p = .04$; in contrast, scores for heart were not different between younger and older children ($p = .13$). Individual response patterns were consistent with the mean comparisons indicating that older, but not younger, children differentiated between heart and money; whereas 14/18 older children in the heart condition endorsed attribute change at least once for human donors, only 5/18 older children in the money condition did the same; this difference was significant (Fisher's exact test, $p < .01$). In contrast, approximately equal numbers of younger children in the heart and money conditions endorsed change (11 in heart, and 10 in money); this was non-significant, $p > .10$. Thus, there was clear evidence that older children endorsed the transfer of traits via heart transplants, though younger children did not differentiate between the heart and money conditions.

There was additionally a main effect of valence, $F(1,68) = 14.03$, $p < .001$, $\eta_p^2 = .17$, with positive traits (M = 1.97, SD = 2.04) receiving higher endorsements of change than negative traits (M = 1.22, SD = 1.80). This effect was qualified by a valence x age group interaction, $F(1,68) = 9.34$, $\eta_p^2 = .12$; whereas younger children showed a pronounced preference for endorsing transfer of positive traits (M = 2.27, SD = 2.16) over negative traits (M = 1.67, SD = 1.89), $t(35) = 4.71$, $p < .001$, this difference was not significant in older children (positive M = 1.67, SD = 1.90; negative M = 1.53, SD = 2.08; $t(35) = 0.51$, $p = .62$). No other main effects or interactions were observed, all ps > .44. The valence effect in younger children suggests that, regardless of condition, they may have been reluctant to endorse negative attributes in themselves.

Finally, to test whether effects for older children were solely driven by endorsement of attribute change for aspects traditionally associated with the heart (meanness and niceness), we examined scores for the heart and money conditions for the smart/not-smart trials alone. Here again, consistent with analyses of the summary score, children were significantly more likely to endorse change in the heart condition (M = 2.39, SD = 2.13) than the money condition (M = 0.42, SD = 0.85), $t(34) = 3.67$, $p < .01$. Individual response patterns were consistent with this analysis; 12/18 children gave at least one prediction of attribute change in the smart/not-smart

trials for the heart condition, whereas only 4/18 did so in the money condition, $p = .02$ by Fisher's exact test.

----------Figure 1 appears about here----------

Test of Minimalism

Summary change scores were calculated by averaging across the animal donors (featured only in the Heart condition) for the attribute change and category change questions separately; as before, scores for attribute change could range from 0 (no change) to 5 ("a whole lot" of change), and scores for category change could range from 0 (corresponding to no category change, or "stay a person") to 5 (corresponding to "a whole lot" of being a non-human animal). A 2 (age group: younger vs. older) x 2 (question: attribute vs. category) ANOVA was conducted, with question as a within-subjects variable. Supporting our prediction that endorsement of attribute change would be higher than endorsement of category change, there was a main effect for question, $F(1,34) = 31.75$, $p < .001$, $\eta_p^2 = .48$, with significantly higher scores on the attribute change questions ($M = 2.52$, $SD = 1.82$) than the category change questions ($M = 0.69$, $SD = 1.60$). There was also a main effect for age group, $F(1,34) = 7.72$, $p < .01$, $\eta_p^2 = .19$, whereby older children were overall more likely to endorse change of any type ($M = 2.21$, $SD = 1.45$) than younger children ($M = 1.01$, $SD = 1.13$). Finally, there was no age group x question interaction. Although the interaction was not significant, we nevertheless examined the effect of question within each age group to determine whether this effect held for both older and younger children; differences were indeed significant for both age groups according to t–tests, ps < .01 (older children's attribute change $M = 3.25$, $SD = 1.59$, category change $M = 1.17$, $SD = 1.98$; younger children's attribute change $M = 1.79$, $SD = 1.78$, category change $M = 0.22$, $SD = 0.94$). Individual response patterns were consistent with the main effect observed for question (see Table 2); whereas 27/36 children endorsed attribute change at least once on the pig or monkey trials, only 6/36 children endorsed category change on these same trials at least once, Fisher's exact $p < .001$. Moreover, of the 30 children who uniformly denied category change, 21 (70%) endorsed attribute change at least once. Thus, children often endorsed attribute change as resulting from a heart exchange, while simultaneously denying that the recipient's category membership would change.

----------Table 2 appears about here.----------

In summary, six- and seven-year-old children showed clear evidence for essentialism, predicting that heart transplants would transfer donors' attributes. They were also significantly more likely to make such causal predictions for this scenario than for a non-bodily money transfer, indicating that they were representing essences as bodily and internal, and ensuring that effects were not simply due to a positive response bias, or to a broader belief in magical contagion. Furthermore, they predicted attribute transfer even for traits not traditionally associated with the heart (smart and not-smart), suggesting they were not simply basing their responses off of a common cultural metaphor.

As well, when transplants were described as coming from non-human animals, children of both age groups more often endorsed that they would feel or act like the animal than that they would become a member of that animal category. Moreover, a majority of children who denied that they would change categories still endorsed some degree of attribute transfer. These patterns are inconsistent with a strongly minimalist account, which claims that people appeal to category membership as the basis for predicting outward features. Instead, the findings support essentialism; children expect transfer of an internal, bodily essence to cause the emergence of features, independent of category change. These results are consistent with past research indicating that children expect internal features to determine category-typical attributes (Gelman & Wellman, 1991; Newman, Herrmann, Wynn, & Keil, 2008; Newman & Keil, 2008), but go beyond past studies by finding that these internal elements can be represented as a transferrable and causal source of attributes.

Younger children (4- and 5-year-olds) did not distinguish between heart and money transfers, instead predicting that both exchanges would cause themselves to become more like their donors. One possible explanation for this finding is that younger children were reluctant to attribute negative properties (mean, not-smart) to themselves. Another (non-competing) possibility is suggested by the spontaneous comments from a couple of the younger participants, who remarked that they did not know what a quarter was (the specific amount of money described in the money exchange scenario). Thus, some children, particularly ones in the younger group who have less direct contact with money, may have been uncertain about what a quarter was, leading to confusion about the task. This is especially likely given that children were never shown pictures of either hearts or quarters, and thus if they did not know what a quarter was, they would have had no basis for making an informed decision.

Study 2 was developed to address this possibility. As in Study 1, we asked children to make predictions about attribute change after either receiving hearts or money from a series of people and animals. However, for the money exchange scenarios, we used a dollar rather than a quarter, as we expected that children of all ages would be more familiar with this unit of money.[1] We also added a non-bodily transfer control scenario for the two animals to parallel the money control trials for the human characters and to include trials that were not as clearly valenced as the original human donor trials. In Study 1, recall that we simply omitted the money control items for the animals due to animals not possessing money, but in Study 2 we provided questions about transfer of a collar. We selected a collar as the animal "control" condition because we wanted an object that an animal had with it for an extended period of time (like money). Finally, in order for each participant to serve as their own control, Study 2 included heart vs. dollar/collar transfer as a within-subjects factor.

Study 2

Method

Participants

The sample (n = 50) included two age groups: 4- and 5-year-olds (n = 24, M_{age} = 5.05 years, SD = 0.62, again referred to as “younger children”) and 6- to 7-year-olds, (n = 26, M_{age} = 6.99 years, SD = 0.56, again referred to as “older children”). Children were recruited in the Midwest at a university-affiliated children's museum study site.

Materials

As in Study 1, heart transplant vignettes described trading hearts with a total of six donors (nice child, mean child, smart child, not-smart child, pig, and monkey), and each human donor vignette had a male and female version, matched to the participant’s sex. Behaviors provided as evidence of the character's trait or identity were identical to those used in Study 1, as were the pictures depicting the characters (except that animal donors were depicted as wearing collars around their necks). Control questions described trading a dollar with each of the four human characters, or receiving and wearing the collar of each of the two animal characters. For

[1] Prior research in which children were asked to provide monetary values for items indicated that children 4-5 years of age nearly always reported amounts in whole dollars, even for low-value items, such as a single crayon, or a cookie with a bite taken out of it (Gelman, Frazier, Noles, Manczak, & Stilwell, 2015).

both human and animal trials, picture content and vignette text for the control trials were otherwise identical to heart transplant vignettes.

Donors were grouped into pairs (not smart + smart, nice + mean, pig + monkey). The order of the pairs was counterbalanced across participants, as was the order of the donors within each pair. Each participant responded to questions about both heart and dollar/collar transfers. The order of the test questions was counterbalanced across participants, such that within each age group, half of the children were first asked the dollar/collar control questions, and the other half were first asked the heart questions. For animal donors only, a third question asked about category change (identical to those used in Study 1).

Procedure

The procedure for Study 2 was identical to that of Study 1, except that each item had both a heart question and a control (money/collar) question, and condition was a within-subject factor, such that each child responded to questions about both heart and money/collar transfers.

Results and Discussion

Test of Attribute Change

Scores for predicted attribute change could again range from 0 ("stay the same") to 5 ("a whole lot" of change). A summary score was calculated for attribute change by averaging across all donors (humans and animals, because unlike Study 1, the animals were included in both conditions). A 2 (age group: younger vs. older) x 2 (condition: heart vs. money) x 2 (order: heart question first vs. dollar/collar question first) mixed between-within ANOVA indicated the predicted main effect for condition, $F(1,46) = 33.23$, $p < .001$, $\eta_p^2 = .42$, with scores higher for heart transplants ($M = 1.59$, $SD = 1.70$) than money/collar transfers ($M = 0.30$, $SD = 0.69$). There was also an age group x condition interaction, $F(1,46) = 6.06$, $p = .02$, $\eta_p^2 = .12$, indicating a larger effect among older than younger children (Figure 2). Importantly, however, the condition effect was significant in both age groups: older children, $t(25) = 5.73$, $p < .001$; younger children, $t(23) = 2.09$, $p = .048$. Individual response patterns indicate that for both age groups, the most common response pattern was to have heart scores higher than money scores, consistent with essentialism. However, when comparing the number of children whose heart scores were greater than their money scores (vs. the opposite pattern, money greater than heart), this was not significant for younger children according to a binomial test ($p = .30$), whereas it was significant for older children ($p < .01$).

There was additionally a condition x order interaction, $F(1,46) = 8.13$, $p = .01$, $\eta_p^2 = .15$. This interaction appeared to be due to heart scores being attenuated in instances when the dollar/collar question was asked first. To test whether condition differences remained significant despite this attenuation, we examined condition-based differences within condition order. The condition effect was significant both when children received a heart question prior to a dollar/collar question (Heart $M = 2.11$, $SD = 1.83$; Dollar/Collar $M = 0.19$, $SD = 0.39$), $t(24) = 4.96$, $p < .001$, and when they received a dollar/collar question prior to a heart question (Heart $M = 1.08$, $SD = 1.43$; Dollar/Collar $M = 0.42$, $SD = 0.89$), $t(24) = 2.68$, $p = .01$. No other main effects or interactions were significant.

We additionally conducted a targeted 2 (age group: younger vs. older) x 2 (condition: heart vs. money) x 2 (order: heart question first vs. dollar/collar question first) mixed between-within ANOVA, this time examining scores only on trials that did not ask about niceness or meanness (i.e., the smart/not-smart and pig/monkey trials), to determine whether children expected traits to transfer even when they were not metaphorically or idiomatically associated with the heart. The same main effects and interactions from the analysis of all trials reported above were obtained. Scores were higher in the heart condition ($M = 1.57$, $SD = 1.75$) vs. the money condition ($M = 0.27$, $SD = 0.70$), $F(1,46) = 35.19$, $\eta_p^2 = .43$. There was also a significant condition x age interaction, $F(1,46) = 4.98$, $\eta_p^2 = .10$, indicating that effects were larger among older than younger children. Nonetheless, condition differences were significant both in age groups: younger children (Heart $M = 1.04$, $SD = 1.59$; Money/Collar $M = 0.24$, $SD = 0.26$), $t(23) = 2.33$, $p = .03$, and older children (Heart $M = 1.42$, $SD = 1.83$; Money/Collar $M = 0.29$, $SD = 0.81$), $t(25) = 5.71$, $p < .001$. Finally, there was also a significant condition x order interaction, $F(1,46) = 8.42$, $\eta_p^2 = .15$. Again, condition differences were attenuated when the dollar/collar question was presented first, but condition effects were still significant both when children received a heart question prior to a money/collar question (Heart $M = 2.13$, $SD = 1.83$; Money/Collar $M = 0.20$, $SD = 0.46$), $t(24) = 5.11$, $p < .001$, and when they received a money/collar question prior to a heart question (Heart $M = 1.01$, $SD = 1.50$; Money/Collar $M = 0.33$, $SD = 0.88$), $t(24) = 2.84$, $p < .01$. Individual response patterns were consistent with the overall condition effect of interest, indicating that children were more likely to endorse attribute change in the heart vs. money/collar condition; 30/50 children gave at least one prediction of

attribute change in the smart/not-smart/pig/monkey trials for the heart condition, whereas only 10/50 did so in the money/collar condition, $p < .001$ by Fisher's exact test.

Lastly, we conducted a second more targeted ANOVA to assess valence effects. Recall that results from Study 1 suggested that younger children, but not older children, were more likely to endorse the transfer of positive vs. negative traits. To assess this possibility in the current analysis, we additionally included condition (heart vs. money) to assess if valence effects varied not just according to age (as in Study 1), but also interacted with condition. For this analysis, we focused only on the human traits that were clearly valenced (smart and not smart, nice and mean), consistent with analyses from Study 1, and we report only effects including valence, the factor of interest. The 2 (age group: younger vs. older) x 2 (condition: heart vs. money) x 2 (valence: positive vs. negative) ANOVA revealed only a main effect of valence, $F(1, 48) = 5.29$, $p = .03$, $\eta_p^2 = .10$, with transfer of positive traits more likely to be endorsed ($M = 1.13$, $SD = 1.14$) than negative traits ($M = .85$, $SD = 1.10$). However, valence did not participate in any significant two- or three-way interactions (all $ps \geq .30$). Thus, unlike in Study 1, the valence effect was observed in both younger and older children.

----------Figure 2 appears about here----------

Test of Minimalism

Summary change scores were again calculated by averaging across the animal donors for the attribute change and category change questions separately. As before, scores could range from 0-5 for both traits and category change. A 2 (age group: younger vs. older) x 2 (question: attribute vs. category) ANOVA was conducted, with question as a within-subjects variable. There was a main effect for question, $F(1,48) = 25.09$, $p < .001$, $\eta_p^2 = .34$, with significantly higher scores on the personality/behavior change questions ($M = 1.50$, $SD = 1.81$) than the category change questions ($M = 0.29$, $SD = 1.07$). There was also a main effect for age group, $F(1,48) = 4.12$, $p < .05$, $\eta_p^2 = .08$, whereby older children were overall more likely to endorse change in general ($M = 1.22$, $SD = 1.40$) than younger children ($M = 0.54$, $SD = .63$). Finally, there was no significant age group x question interaction, $p = .18$. Nevertheless, we examined the effect of question within each age group to determine if this effect held for both older and younger children. Differences were indeed significant for both age groups according to t–tests, $ps \leq .01$ (older children's attribute change $M = 1.98$, $SD = 1.73$, category change $M = 0.46$, $SD = 1.39$; younger children's attribute change $M = 0.98$, $SD = 1.78$, category change $M = 0.10$, $SD =$

0.51). Individual response patterns (see Table 2) were consistent with the main effect observed for question; whereas 25/50 children endorsed personality/behavior change at least once on the pig/monkey heart transplant trials, only 4/50 children endorsed category change at least once, Fisher's exact $p < .001$. Furthermore, of the 46 children who denied category change, 21 (or 46%) endorsed attribute change at least once. Thus, replicating results from Study 1, children were often willing to endorse personality/behavior change as resulting from a heart exchange while simultaneously denying that the recipient's category membership would change.

General Discussion

Psychological essentialism can be thought of as consisting of two major beliefs: first, certain categories are construed as richly-structured natural kinds, and second, these categories are assumed to have an underlying causal essence responsible for category-typical outward features (Gelman, 2003). The current studies examined this second assumption, asking whether children 4 through 7 years of age expect the transfer of an internal bodily element (the heart) to result in the transfer of a donor's attributes. Children frequently predicted that receiving a heart from another individual would transfer the personality, feelings, or behaviors of the donor, including characteristics that are not traditionally associated with the heart (e.g., intelligence [from a smart person's heart]; acting like a pig [from a pig's heart]). Importantly, children's expectations of change were higher when considering a heart transplant than when considering the transfer of money. This condition difference indicates that the effects were not simply due to a response bias to report that change took place, nor did they reflect belief in magical contagion, such that mere association with an individual can pass along that individual's qualities (e.g., Nemeroff & Rozin, 1994).

These findings interacted with age. Whereas the older children (6- to 7-year-olds) differentiated between a heart transplant and money transfer in both studies, the younger children (4- to 5-year-olds) did so only in Study 2. However, the younger children's difficulty in Study 1 appeared to reflect both a reluctance to attribute negative properties to themselves and uncertainty about what a quarter is. In Study 2, when a familiar unit of currency was used (dollar instead of quarter), the younger children also indicated that a heart transplant would yield attribute changes that money transfer would not (i.e., the younger children showed the same patterns of results as the older children). Overall, the findings thus indicate that by preschool age, children treat an internal bodily part as having causal consequences. This finding is in keeping

with past studies that point to children's focus on internal aspects in forming category judgments and drawing inductive inferences (e.g., Graham et al., 2004; Newman et al., 2008; Newman & Keil, 2008; Setoh et al., 2013), but goes beyond them to demonstrate the causal aspect of essentialist beliefs--the idea that something inside *gives rise* to outward features. This finding is also particularly striking because children appear to believe in a causal essence that exists in a body part that scientists would argue is not, in fact, causally involved in outward traits, abilities, or personalities. The presence of these essentialist beliefs, then, exist despite a lack of empirical support, and suggests that essentialism operates as a powerful bias relatively early in development.

Our findings also speak to an unresolved theoretical debate regarding children's representation of essences. In particular, the strongest minimalist alternative to essentialism claims that children, when explaining category-typical outward features, appeal only to category membership and K-laws (natural laws linking categories to features). Minimalism denies that children systematically represent causal essences as an intervening force (Strevens, 2000, 2001). Children in our studies, however, frequently endorsed the possibility of their characteristics changing upon receiving a pig or a monkey heart, while simultaneously denying that they would *become* a pig or a monkey. This result held equally for younger and older children in both studies. Thus, by 4-5 years of age, children appeared not to rely on category membership and K-laws as a basis for predicting outward features; instead, they expected causal effects even if they (the recipient) stayed a member of a contrasting category (namely, human). These findings are inconsistent with strong minimalism and are instead in keeping with predictions of essentialism; children appeal to an internal causal essence when making predictions about outward features. (See Meyer et al. (2013) for discussion of weaker interpretations of minimalism; briefly, the authors argue that weaker interpretations of the minimalist thesis do not constitute substantive empirical alternatives to essentialism.)

The present investigation still leaves several issues unaddressed. In particular, it will be important in the future to present additional transfer scenarios beyond those used in the current study, in order to refine our understanding of exactly what sorts of donations are essentialized by children. For instance, in our study, we did not control (across the heart vs. money/collar conditions) approximate value or duration of possession (hearts are arguably more valuable and owned for a longer period of time than quarters, dollars, or collars). Essentialism predicts that

these dimensions would not matter, and that it is a donation's status as innate, biological, and internal that would drive expectations of trait transfer. However, this is an empirical question yet to be resolved. Moreover, it will be useful to examine children's essentialist intuitions regarding donations that meet only one, two, or all of the criteria claimed to be important for construing something as a vehicle for essence; for instance, would children expect skin or hair (innate, biological, but non-internal) to transfer attributes? What of a pacemaker (non-innate, non-biological, but internal)? Varying these dimensions in future investigations will allow us to better understand what exactly is interpreted as containing essences.

Another unresolved issue is how precisely essentialism changes across development. The current data clearly indicate that young children demonstrate causal essentialist expectations in the context of reasoning about heart transplants. However, results are not definitive regarding change across development within the age groups under investigation (four- to seven-year-olds), in light of the complicating valence effects observed in younger children in both studies. And similar work in adults (Meyer et al., 2013) used non-parallel measures of essentialist predictions, disallowing direct comparison of children's and adults' essentialism. Future work can expand the age ranges that are examined, and also examine how cultural upbringing interacts with the trait under investigation (e.g., see Rhodes & Gelman, 2009; Diesendruck, 2013). Relatedly, work can directly target how children and adults integrate acquired scientific knowledge with their essentialist expectations. Psychological essentialism is often described as involving a placeholder notion of essence; one need not know the precise nature or structure of an essence in order to believe that it exists (Medin & Ortony, 1989). Instead, essentialism can be reflected by the belief that *something* internal, innate, and bodily is responsible for the emergence of a category's features. However, adults--at least adults in many cultures with formal education--often seem to attribute essence-like powers to genes; that is, they appear to fill in an essence placeholder with their understanding of how genes function to determine species identity, physical make-up, and category-typical behaviors.

The tendency to combine essentialist expectations with predictions drawn from biological knowledge has consequences for how people attribute and explain the behaviors of others. For instance, assuming that genes have essence-like powers often results in over-attributing many behaviors and characteristics to innate, stable, and internal elements of people. These patterns of thinking are particularly interesting in the social realm, where genetic essentialism is often

associated with stereotyping, prejudice, and the exaggeration of inter-group differences (Dar-Nimrod & Heine, 2011; Keller, 2005; Kvaale, Haslam, & Gottdiener, 2013). It will be important in future work to establish the precise developmental pathway by which people come to fill in their placeholder notion of essence with their understanding of genes. Moreover, it will be useful to examine the factors that contribute to such beliefs (e.g., educational experience, family beliefs, cultural background), as there are substantial individual differences in the extent to which adults form genetic essentialist predictions, and the types of categories to which they apply these explanations (e.g., non-human animal vs. social groups).

In sum, the current studies are the first to provide direct evidence that children attribute causal powers to an inherent, internal force: children expect the transfer of such a force, via a heart transplant, to confer a donor's attributes on the recipient. Our findings thus provide support for the idea that children are psychological essentialists, and suggest that such a bias is both early-developing and strong, existing independent of empirical support for its predictions.

References

Ahn, W., Kalish, C., Gelman, S. A., Medin, D. L., Luhmann, C., Atran, S., ... Shafto, P. (2001). Why essences are essential in the psychology of concepts. *Cognition, 82*, 59-69.

Dar-Nimrod, I., & Heine, S. J. (2011). Genetic essentialism: On the deceptive determinism of DNA. *Psychological Bulletin, 137,* 800-818.

Dewar, K., & Xu, F. (2009). Do early nouns refer to kinds or distinct shapes? *Psychological Science, 20,* 252-257.

Gelman, S. A. (2003). *The essential child: Origins of essentialism in everyday thought*. New York: Oxford University Press.

Gelman, S. A., & Coley, J. D. (1990). The importance of knowing a dodo is a bird: Categories and inferences in 2-year-old children. *Developmental Psychology, 26*, 796-804.

Gelman, S. A., Frazier, B. N., Noles, N. S., Manczak, E. M., & Stilwell, S. M. (2015). How much are Harry Potter's glasses worth? Children's monetary evaluation of authentic objects. *Journal of Cognition and Development, 16*, 97-117.

Gelman, S.A., & Markman, E. M. (1986). Categories and induction in young children. *Cognition, 23,* 183-209.

Gelman, S. A., & Markman, E. M. (1987). Young children's inductions from natural kinds: The role of categories and appearances. *Child Development, 58,* 1532-1541.

Gelman, S. A., & Wellman, H. M. (1991). Insides and essences: Early understandings of the nonobvious. *Cognition*, *38*, 213-244.

Graham, S. A., Kilbreath, C. S., & Welder, A. N. (2004). Thirteen-month-olds rely on shared labels and shape similarity for inductive inferences. *Child Development, 75*, 409-427.

Hood, B. M., Gjersoe, N. L., Donnelly, K., Byers, A., & Itajkura S. (2011). Moral contagion attitudes towards potential organ transplants in British and Japanese adults. *Journal of Culture and Cognition, 11,* 269-286.

Houkes, W., & Vermaas, P. E. (2013). Pluralism on artefact categories: A philosophical defence. *Review of Philosophy and Psychology*, *4*, 543-557.

Inspector, I., Kutz, Y., & David, D. (2004). Another person's heart: Magical and rational thinking in the psychological adaptation to heart transplantation. *The Israeli Journal of Psychiatry and Related Sciences, 41,* 161-173.

Johnson, C. N. (1990). If you had my brain, where would I be? Children's understanding of the brain and identity. *Child Development, 61,* 962-972.

Johnson, C. N., & Jacobs, M. G. (2001, April). *Enchanted objects: How positive connections transform thinking about the very nature of things*. Poster presented at the Society for Research in Child Development, Minneapolis, MN.

Keil, F. C. (1989). *Concepts, kinds, and cognitive development*. Cambridge, MA: MIT Press.

Keller, J. (2005). In genes we trust: The biological component of psychological essentialism and its relationship to mechanisms of motivated social cognition. *Journal of Personality and Social Psychology, 88*, 686–702.

Kvaale, E., Haslam, N., & Gottdiener, W. (2013). The 'side effects' of medicalization: A meta-analytic review of how biogenetic explanations affect stigma. *Clinical Psychology Review, 33,* 782-794.

Leslie, S.-J. (2013). Essence and natural kinds: when science meets preschooler intuition. In T. S. Gendler and J. Hawthorn (Eds.), *Oxford Studies in Epistemology*, *Vol. 4.* (pp. 108-165). New York: Oxford University Press, pp. 108–165.

Medin, D. L., & Ortony, A. (1989). Psychological essentialism. In S. Vosniadou & A. Ortony (Eds.) *Similarity and analogical reasoning* (pp. 179-196). New York, NY: Cambridge

University Press.

Meyer, M., Leslie. S. J., Gelman, S. A., & Stilwell, S. M. (2013). Essentialist beliefs about bodily transplants in the United States and India. *Cognitive Science, 34,* 668-719.

Nemeroff, C., & Rozin, P. (1994). The contagion concept in adult thinking in the United States: Transmission of germs and interpersonal influence. *Ethos, 22,* 158–186.

Newman, G. E., Herrmann, P., Wynn, K., & Keil, F. C. (2008). Biases towards internal features in infants' reasoning about objects. *Cognition, 107,* 420-432.

Newman, G. E., & Keil, F. C. (2008). Where's the essence? Developmental shifts in children's beliefs about internal features. *Child Development, 79,* 1344-1356.

Rhodes, M., & Gelman, S. A. (2009). A developmental examination of the conceptual structure of animal, artifact, and human social categories across two cultural contexts. *Cognitive Psychology, 59,* 244-274.

Sanner, M. A. (2001a). Exchanging spare parts or becoming a new person? People's attitudes toward receiving and donating organs. *Social Science and Medicine, 52,* 1491-1499.

Sanner, M. A. (2001b). People's feelings and beliefs about receiving transplants of different origins--questions of life and death, identity, and nature's border. *Clinical Transplantation, 15,* 19-27.

Seitoh, P., Wu, D., Baillargeon, R., & Gelman, R. (2013). Young infants have biological expectations about animals. *Proceedings of the National Academy of Sciences, 110,* 15937-15942.

Sloman, S., & Malt, B. (2003). Artifacts are not ascribed essences, nor are they treated as belonging to kinds. *Language and Cognitive Processes, 18,* 563-582.

Smith, D. L. (2014). Dehumanization, essentialism, and moral psychology. *Philosophy Compass, 9,* 814-824.

Strevens, M. (2000). The essentialist aspect of naive theories. *Cognition, 74,* 149-175.

Strevens, M. (2001). Only causation matters: Reply to Ahn et al.. *Cognition, 82,* 71-76.

Taylor, M. G., Rhodes, M., & Gelman, S. A. (2009). Boys will be boys; cows will be cows: Children's essentialist reasoning about gender categories and animal species. *Child Development, 80,* 461-481.

Weisberg, M. (2007). Three kinds of idealization. *The Journal of Philosophy,* 639-659.

Winer, G. A., Cottrell, J. E., & Bica, L. A. (2009). When hearts, hands, and feet trump brains: Centralist versus peripheralist responses in children and adults. *British Journal of Developmental Psychology, 27, 343-364.*

Appendix: Story text from the Heart and Money Conditions in Studies 1 and 2. Text in brackets varied according to the character described (see Table 1); provided sample text is for the "mean" female character.

Heart Story Text: This is [Mia], and [Mia] is really [mean]. Look, when [Mia] is [drawing pictures, she never shares crayons with the other kids. When someone in her class dropped a toy and it broke, Mia just laughed. And yesterday, Mia pushed someone when everyone else was playing tag.] So [Mia] is really [mean]. Now imagine that you and [Mia] traded hearts, so you ended up with [Mia's] heart inside your body. It doesn't hurt; you just end up with [Mia's] heart inside you. If you got [Mia's] heart, would you end up being [meaner], like [Mia], or would you stay the same?

A "stay same" response ended the trial. A response of attribute change was followed by:

How much [meaner]? Just a little bit like this (*point to small circle)*, a whole lot like this (*point to largest circle),* or somewhere in between *(sweeping point to middle three circles)?*

Money Story Text: This is [Mia], and [Mia] is really [mean]. Look, when [Mia] is [drawing pictures, she never shares crayons with the other kids. When someone in her class dropped a toy and it broke, Mia just laughed. And yesterday, Mia pushed someone when everyone else was playing tag.] So [Mia] is really [mean]. Now imagine that you and [Mia] both have quarters/dollars*, and you and [Mia] traded quarters/dollars, so you ended up with [Mia's] quarter/dollar. If you got [Mia's] quarter/dollar, would you end up being [meaner], like [Mia], or would you stay the same?

A "stay same" response ended the trial. A response of attribute change was followed by:

How much [meaner]? Just a little bit like this (*point to small circle)*, a whole lot like this (*point to largest circle),* or somewhere in between *(sweeping point to middle three circles)?*

* *Quarter* was used in Study 1, and *Dollar* was used in Study 2.

Table 1

Characters and Behaviors from Studies 1 and 2

Character Attribute/ Identity	Name (female/male version)	Behaviors
nice	Nellie/Neil	shares crayons
		helps fix a classmate's broken toy
		holds the door open for others
mean	Mia/Max	never shares crayons
		laughed when a classmate's toy breaks
		pushes a classmate at recess
smart	Samantha/Sam	gets all the math problems right
		doesn't say anything wrong when reading aloud
		thinks complicated homework is easy
not-smart	Victoria/Victor	gets a lot of math problems wrong
		gets stuck on easy words when reading aloud
		thinks easy homework is hard
pig	na	eats a bunch of mushed-up food
		lives outside in a pen with other pigs
		rolls around in the mud to stay cool
monkey	na	eats bananas
		lives with other monkeys in the tall trees
		swings from tree to tree to look for food

Table 2

Individual Response Patterns on Test of Minimalism in Studies 1 and 2

Study 1		Attribute Change Endorsed	
		Yes	No
Category Change Endorsed	Yes	6	0
	No	21	9

Study 2		Attribute Change Endorsed	
		Yes	No
Category Change Endorsed	Yes	4	0
	No	21	25

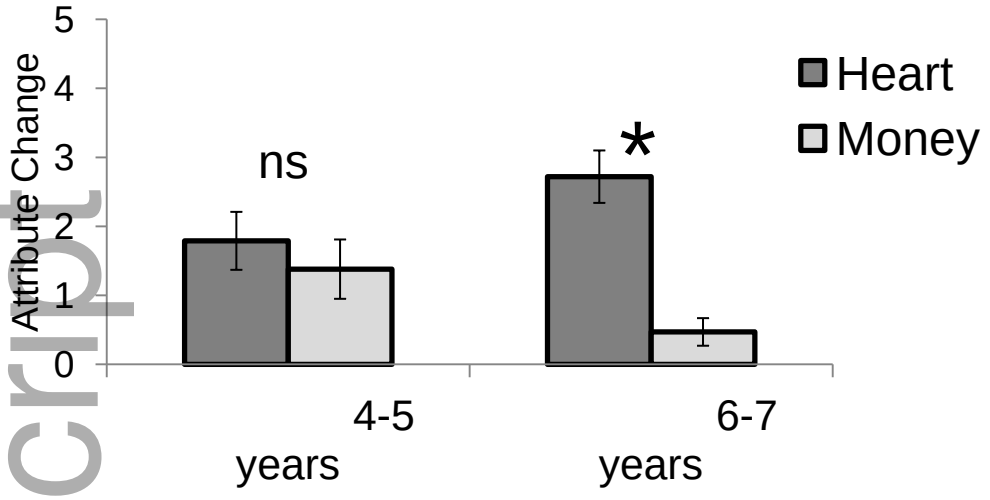

Figure 1. Mean endorsement of attribute change for human donor trials in Heart and Money conditions, Study 1. Error bars represent ± 1 standard error of the mean.

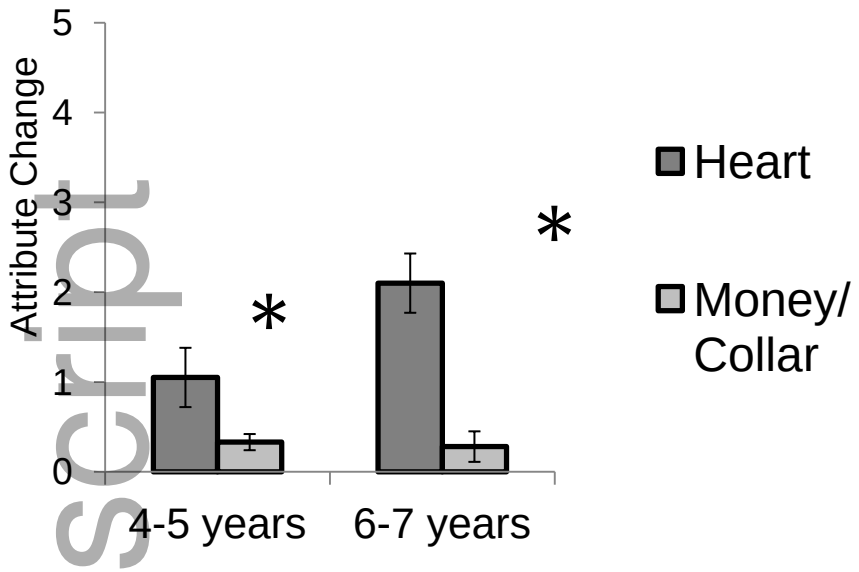

Figure 2. Mean endorsement of attribute change for Heart and Money/Collar conditions, Study 2. Error bars represent ± 1 standard error of the mean.