Short Communication

The emerging causal understanding of institutional objects

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ABSTRACT

Institutional objects, such as money, drivers' licenses, and borders, have functions because of their social roles rather than their immediate physical properties. These objects are causally different than standard artifacts (e.g. hammers, chairs, and cars), sharing more commonality with other social roles. Thus, they inform psychological theories of human-made objects as well as children's emerging understanding of social reality. We examined whether children (N = 180, ages 4–9) differentiate institutional objects from standard artifacts. Specifically, we examine whether children understand that mutual intentions (i.e., the intentions of a social collective) underlie the functional affordances of institutional objects in ways that they do not for standard artifacts. We find that young children assimilate institutional objects into their intuitive theories of standard artifacts; children begin to differentiate between the domains in the elementary school years.

1. Introduction

Institutional objects, such as money, drivers' licenses, and borders have functions because of the roles they are assigned. An extensive body of research has examined how children conceptualize human-made objects (e.g., Gelman, 2003; Keil, 1989; Margolis & Laurence, 2007; Matan & Carey, 2001), but this work has focused on *standard artifacts*, such as simple tools and household objects. Because institutional objects operate by different causal processes, they warrant further investigation. We examine here whether and when these sets of human-made objects are conceptualized differently in children's causal theories.

Standard artifacts have functional affordances that stem from their physical structure, such as the way a hammer's form allows it to deliver force. The functions of institutional objects, by contrast, emerge from the social norms and institutions they are embedded in (Lewis, 1969; Roversi, Borghi, & Tummolini, 2013; Searle, 1995; Searle, 2010). To illustrate, take the example of money. Money's value is not determined by the paper it is printed on. Rather, people cooperatively assign dollar bills their value; known as a *status function* (Searle, 1995, 2010), dollar bills attain value by being collectively recognized as valuable. Status functions confer social powers to their rightful owners. In the case of money, it confers the right to engage in exchange within an economic community. Broadly then, institutional objects seem to comprise a distinct class of objects.

All human-made objects require human beings to come into existence; they do not exist naturally. For standard artifacts, humans *cause* them to exist and *cause* them to have the properties they possess through an intentional design process, but the role of intentions is *historical* (Bloom, 1996; Diaz-Leon, 2015; Matan & Carey, 2001). That is, once created, the functions they afford stem from their physical structure and so no longer directly depend on human intention. For example, after a hammer has been created, its ability to deliver blows is not affected by its intended use within a cultural context.

Institutional objects, on the other hand, are socially constructed in a more sustained manner (Diaz-Leon, 2015). Their functional properties are constituted by a community's *ongoing* mutual intentions. If the community changes its intentions, the object no longer affords the same function. When, in late 2016, India's government elected to invalidate 500 and 1000 rupee notes as a hedge against corruption, the former money became mere paper – even though nothing had changed about its physical form or historical origins.

Theories developed to account for standard artifacts are insufficient to explain the causal processes that govern institutional objects. Previous theories emphasize original intended kind (Bloom, 1996, 1998), design (Kelemen & Carey, 2007), physical structure (Keil, 1989; Malt & Johnson, 1992; Nelson, Frankenfield, Morris, & Blair, 2000), or some combination of the above (Chaigneau, Barsalou, & Sloman, 2004). All fail to capture the unique dynamics of institutional objects. Here we take a developmental approach, exploring children's intuitions about institutional objects. For children to have a mature sense of institutional objects, they need to understand that their functions are based in mutual intentions: a community's intention to assign an object a social role (Searle, 1995).
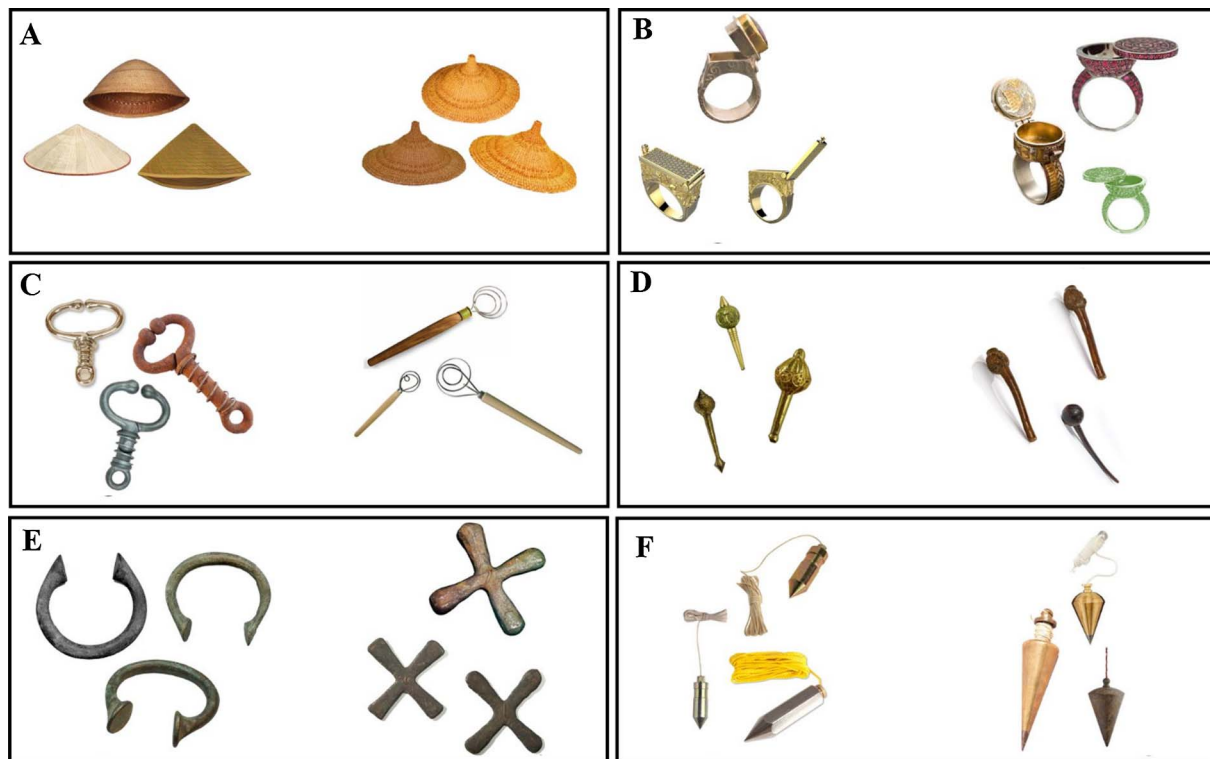

Fig. 1. Novel objects that children were presented with. Each panel (e.g. A) represents an object class (e.g., yukku) and its two subsets.

Some evidence suggests children recognize that mutual intentions constitute social reality early on. For example, young children understand how pretense works, which has many of the properties of mutual intentions: pretend statuses, like institutional statuses, are applied to objects via ongoing, cooperative intentions (Rakoczy, 2008; Rakoczy, Tomasello, & Striano, 2004; Wyman, Rakoczy, & Tomasello, 2009). Children also understand that mutual intentions underlie arbitrary rules (Schmidt, Rakoczy, Mietzsch, & Tomasello, 2016). Children often participate in the creation of pretense and game rules. It has been suggested that the more active role they play in this domain might lead to early competency in recognizing the causal underpinnings of games and rules (Kalish, 2005). Supporting this, young (5-year-olds) children understood that rules were changeable when they helped to create them but not when they were only taught the rules (Hardecker, Schmidt, & Tomasello, 2017). Older children (7-year-olds), however, understood that both types of rules were changeable. Thus, children's early competency with pretense and rules may not generalize to other types of social facts.

Children also recognize the role of mutual intentions in creating social groups (Noyes & Dunham, 2017). Children's insight here may be supported by early emerging beliefs about groups. Social groups are composed of human beings, which children understand as intentional agents early on (Wellman & Gelman, 1992). Young children also believe that group members cooperate and form allegiances (Rhodes, 2013; Shutts, Roben, & Spelke, 2013), and believe that social groups mark obligations (Kalish & Lawson, 2008; Rhodes & Chalik, 2013). Thus, special insight into the intentional and normative structure of groups may help them recognize that groups are based in human intentions. Again, this competency may or may not generalize to other domains that lack the support of human- and group-specific beliefs.

We suspected institutional objects would be more challenging to grasp. Children do not participate in the construction of institutional objects. Objects like money are based in complex institutional channels (e.g., dollar bills are assigned legal status by the U.S. Federal Reserve, which gains its authority from congressional legislation, and so on). Second, institutional objects are assigned to physical tokens (e.g., coins)

that generally resemble standard artifacts. Children encounter far more standard artifacts in their daily life (e.g., tools, toys, furniture, etc.), which might encourage them to over-generalize their normal understanding of standard artifacts to institutional objects.

We hypothesized that young children would treat institutional objects like standard artifacts. We expected their ability to distinguish the domains to emerge slowly over development. Specifically, we expected this intuition to emerge among school age children, in accordance with prior research on children's beliefs about the flexibility of rules (Hardecker et al., 2017). To assess children's intuitions, we employ a novel adaptation of the classic transformation paradigm (Keil, 1989). We present children with vignettes where a community changes its intentions about a set of objects and asked children whether the object's functional affordances changed (Study 1 and 2).

2. Study 1

2.1. Method

2.1.1. Participants

90 children (female = 58, male = 32; White = 73%, multi-racial/other = 13%, Black = 10%, Asian = 4%) participated, evenly split across three age ranges: 4–5, 6–7, and 8–9. An additional six children were excluded: 5 failed to pay attention or were disrupted; one because of experimenter error.

2.1.2. Design, stimuli and procedure

2.1.2.1. Design. We employed a within-subject design, presenting children with objects from two domains: institutional objects and standard artifacts. For each object, children were asked to provide a *function assignment*, i.e. to say whether the object's functional affordances changed after the community changed its intentions about the artifact's status. As a secondary measure, we elicited *categorization judgments,* i.e. judgments about whether the object's category changed after a community changed its intentions about its status. Because possible ambiguities with this question were noted
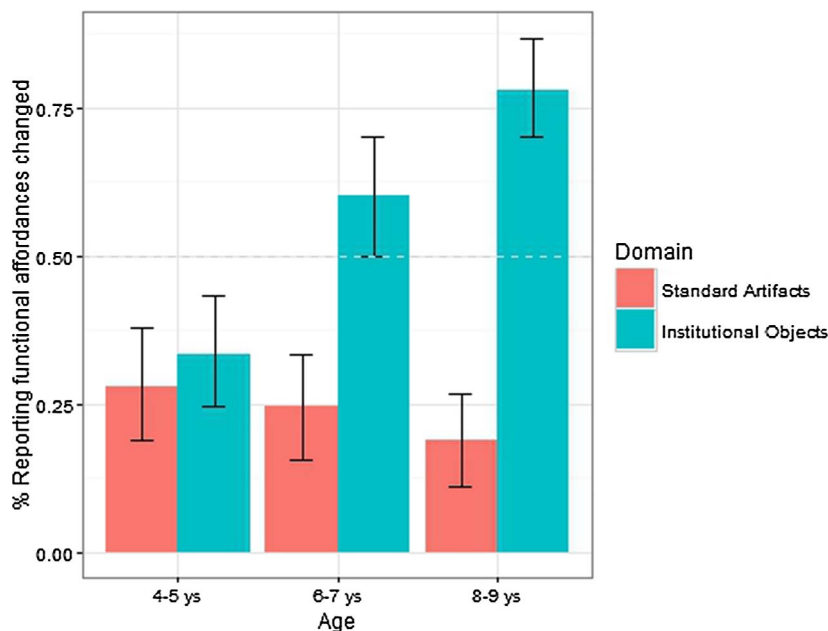
Fig. 2. Children's report of whether an object's functional affordances changed after the mutual intentions of the community changed. Error bars are bootstrapped 95% confidence intervals; they are informative relative to chance (0.5) and across age ranges. Bars next to each other are within-subject. Age was analyzed continuously, but is presented discretely (n = 30/age bracket) for clarity.

during the review process, the results for this measure are provided in the online supplement; this question was removed from the design of Study 2.

2.1.2.2. Stimuli. We created six sets of novel objects (Fig. 1A–F). Each set was comprised of two subsets. Objects in the full set shared similarities in their basic shape and structure; however, subsets had higher internal familiar resemblance and were different from each other in form and superficial features. Each set of objects was paired with an unfamiliar name: yukku (A), zynyll (B), wurgu (C), gada (D), kaya (E), and plumbo (F).

There were three functional descriptions from each domain: *standard artifact functions*, storing/carrying (A and B), cracking/grinding (C and D), throwing/dislodging (E and F); and *institutional functions*, access/membership (A and B), turn-taking/speaking privileges (C and D), value/exchange (E and F). Each function description was paired with two sets of objects (listed above in parantheses); which description children heard was randomized. Each object set randomly appeared as either a standard artifact or an institutional object; i.e., if A, C, and E was presented as standard artifacts, then object B, D, and F appeared as institutional objects, and vice versa.

Each function description was paired with a description of the community's (the Vawnsies') practices: for example, the storing/carrying function was presented in the following manner:

"*Vawnsies love to snack on rice. They also love to always have snacks on them wherever they go. These are Yukkus from Vawnsie island. When a Vawnsie has a yukku, they can put rice inside it and carry snacks with them!*"

For value/exchange, we presented children with the following vignette:

"*Vawnsies love to buy and sell things at markets. They have lots of stores all across the island. These are Plumbos from Vawnsie island. When a Vawnsie has plumbos, they can give them to workers at the store and buy things they need.*"

All descriptions followed this basic structure, and are comprehensively presented in the online supplement.

2.1.2.3. Procedure. Children were introduced to a novel island (Vawnsie Island) and told they would hear about things from there.

Children were then given six trials, each corresponding to one of the function-object pairs outlined above. Trial order was completely randomized (i.e., there was no blocking by domain).

For each trial, children were introduced to one of the novel object classes (as described above); children were first introduced to only one of the subsets. Then, children were shown both subsets of objects on the screen at the same time. Children were told that the Vawnsies decided that objects in the first subset were no longer members of the object category: e.g., "*one day all of the Vawnsies decide that these* [subset 1] *are not gadas anymore; they decide that only these* [subset 2] *are gadas now.*"

Children then answered (in randomized order) the primary dependent measure concerning function (e.g., "*A Vawnsie has one of these; do you think they can still use this to [previously described function]?*") as well as the secondary dependent measure concerning categorization (e.g., *do you think these are still gadas or not gadas anymore?*").

2.2. Results

We examined children's function judgments (1 = change, 0 = did not change) with a Domain by Age multilevel binomial logistic regression; participant was treated as a random effect. We centered and standardized age to maximize the interpretability of the regression slopes. There was a main effect of domain, $b = -4.36$, $SE = 0.65$, $p < 0.001$. There was no main effect of age, $b = 0.59$, $SE = 0.57$, $p = 0.300$. These effects were qualified by a two-way interaction between age and domain, $b = -3.54$, $SE = 0.642$, $p < 0.001$ (Fig. 2). Young children (4–5-year-olds) did not differentiate the domains, $b = -0.82$, $SE = 0.59$, $p = 0.17$. School age children did: 6–7-years-olds, $b = -3.52$, $SE = 0.78$, $p < 0.001$, and 8–9-year-olds, $b = -14.42$, $SE = 3.03$, $p < 0.001$.

2.2.1. Individual-level analyses

We next examined individual responses to capture participant-level trends (Table 1). We counted the number of children that believed functional affordances changed for institutional objects, standard artifacts, both, or neither. Reporting change on 0–1 of 3 trials was counted as 'no change,' reporting change on 2–3 trials was counted as 'change.' The majority of younger children thought neither function could change (N = 20 out of 30), χ^2 (1, N = 30) = 13.85, $p = 0.003$. This was also common for 6–7-year-olds (N = 16), with some making the mature distinction (N = 8), χ^2 (1, N = 30) = 10.76, $p = 0.013$. By

Table 1
Individual-level data: The effect of changes in mutual intentions by domain and question type.

	Both change	Neither change	Only IO change	Only SA change
Study 1				
4–5 years	7	20	2	1
6–7 years	6	16	8	0
8–9 years	6	5	19	0
Study 2				
4–5 years	2	23	2	3
6–7 years	5	19	5	1
8–9 years	5	5	20	0
Adults	0	3	25	2

Note. Reported are counts of children displaying each response pattern. Children were categorized into four categories, based on which types of objects they thought could change category (top) or function (bottom): both, neither, institutional objects (IO) only, and standard artifact (SA) only.

8–9-year-olds, most children believed only institutional functions changed (N = 19), χ^2 (1, N = 30) = 13.16, p = 0.004. Thus, individual-level data suggests the distinction is not robust until 8–9-years-old.

3. Study 2

In Study 2, we examined information about *conventional use* instead of *explicit category decisions*. This methodological change addresses a potential worry with the question prompt in Study 1. There we explained that conventional category judgments changed but we did not say anything about conventional use. Younger children may have had difficulty inferring functional properties from stories about conventional categories; if so, this would make younger children appear less competent than they actually are.

As an additional theoretical point, explicit agreement is often difficult or impossible for communities to reach; instead conventions are often based in coordinated behavior rather than explicit agreement *per se* (Lewis, 1969). Thus, coordinated social practice and explicit agreement are two independent pathways by which social reality can be created and changed. Therefore, Study 2 helps to ensure that our results are robust across critical methodological variation. Finally, we added adult participants to verify that the response pattern we considered "mature" in Study 1 was in fact typical of adults.

3.1. Method

3.1.1. Participants

90 children (female = 45, male = 44, 1 not recorded; White = 72, Asian = 10, multi-racial/other = 5, Black = 4) participated, evenly split across three age ranges: 4–5, 6–7, and 8–9. An additional 3 children were excluded for failing to pay attention or being disrupted during test taking. 30 adults were recruited from Amazon Mechanical Turk (female = 14, male = 16; White = 24, Asian = 2, Black = 2, Native American = 1, 1 not answered).

3.1.2. Design, stimuli and procedure

Stimuli were identical to Study 1. The design was altered so that only functional affordance questions were asked. We altered the script in two ways. First, we described changes in mutual intentions differently, saying (for example): "*One day though, all of the Vawnsies stopped using these* [left objects] *as gadas and started using these* [right objects] *as gadas.*" Second, we altered the test question, asking: "*A Vawnsie found one of these in his/her house; if he/she wants to, can he/she still use one of these to [previously described function]?*" The question was clarified to provide a more compelling cover story for why a Vawnsie still had an object that the community stopped using.

3.2. Results

3.2.1. Child data

We replicated the results of Study 1 (Fig. 3); data analysis was carried out as described in Study 1. There was a two-way interaction between domain and age, $b = -1.72$, $SE = 0.34$, $p < 0.001$. Young children (4–5-year-olds) did not distinguish between domain, $b = -0.54$, $SE = 0.47$, $p = 0.253$. School age children did: 6–7-year-olds, $b = -2.49$, $SE = 0.68$, $p < 0.001$, and 8–9-year-olds, $b = -5.74$, $SE = 1.15$, $p < 0.001$.

Coding children's individual performance revealed a more conservative estimate (Table 1). 4–5-year-olds said that neither type of functional affordance changed (N = 23 out of 30), χ^2 (1, N = 30) = 40.00, $p < 0.001$; which was also common for 6–7-year-olds (N = 19). Only a majority of 8–9-year-olds believed that only institutional functions changed (N = 20), χ^2 (1, N = 30) = 25.60, $p < 0.001$.

3.2.2. Adult data

We examined whether adults differentiated between domains using a multi-level linear model on average response scores (0 − 1) with domain as predictor and participant as random effect. Adults reported that institutional objects changed (M = 0.82, SD = 0.31) more often than standard artifacts (M = 0.09, SD = 0.19), $b = -0.73$, $SE = 0.07$, $p < 0.001$. The majority of adults (25 out 30) believed only institutional functions changed, χ^2 (1, N = 30) = 51.38, $p = < 0.001$.
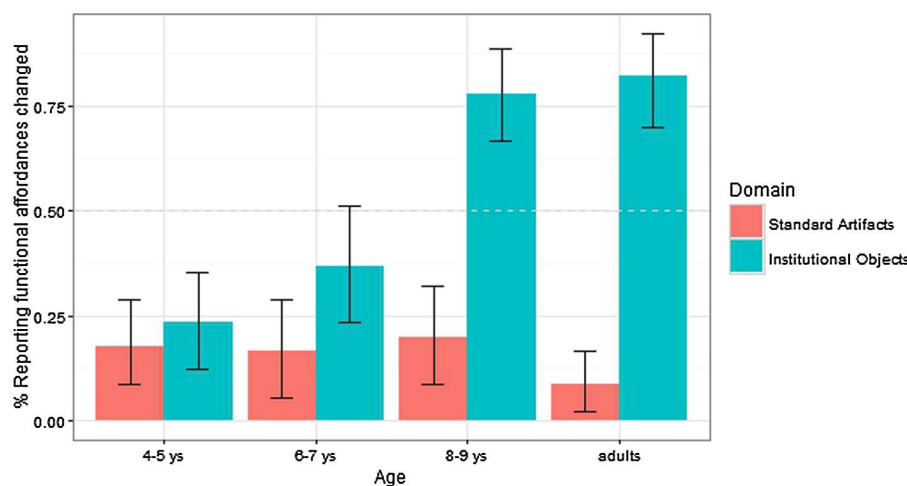

Fig. 3. Participants' report of whether an object's functional affordances changed after the mutual intentions of the community changed. Error bars are bootstrapped 95% confidence intervals; they are informative relative to chance (0.5) and across age ranges. Bars next to each other are within-subject. Child age was analyzed continuously, but is presented discretely (n = 30/age bracket) for clarity.

4. General discussion

We find strong support for the hypothesis that young children would treat institutional objects like standard artifacts. They believed functional affordances persisted after changes to the community's intentions. Children's recognition that institutional functions are based in mutual intentions developed slowly over the early school years, becoming robust only in older children (8–9 year-olds).

Institutional objects are part of a broader domain including arbitrary conventions and social roles. Notably, even preschool children recognize the causal role of mutual intentions for conventions and social groups (Noyes & Dunham, 2017; Schmidt et al., 2016), rendering the later emergence for institutional objects somewhat surprising. This may occur because children mis-apply a salient alternative to institutional objects, namely their theory of standard artifacts. This mis-application is supported by the causal opacity of institutional objects, which tend to be created through complex institutional channels to which children are not privy. Thus, children slowly recognized that institutional objects fall within the purview of their *naïve sociology* (Kalish, 2005; Rhodes, 2013).

Children treated the three institutional objects similarly across age (see online supplement). This is interesting because the three institutional objects presumably differ in the transparency of their underlying intentional infrastructure (Kalish & Sabbagh, 2007). For example, the money-like object was relatively opaque; even some adults believe money is still backed by a gold standard (Searle, 1995). The absence of substantial item differences suggests that whatever cognitive change precipitates children's insight is probably not strongly object-specific.

Debates concerning the nature of object mental representations have continued for decades (Carrara & Mingardo, 2013). Focusing on large-scale distinctions between institutional objects and standard artifacts may reveal differences in how human-made objects are conceptualized (Roversi et al., 2013). Developmentally, institutional objects demonstrate that children's naïve sociology can look sophisticated in some contexts but crude in others. The findings here highlight the need to qualify children's insight into the construction of social reality (Kalish, 2005).

Supplementary material

Please see https://osf.io/3jns8/ for data files, materials, and annotated results.

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