Teleological essentialism in development

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Abstract

Overcoming appearances in categorizing is an important intellectual achievement. But children often rely heavily on appearances, as classic shape similarity (Landau, Smith, & Jones, 1988) and perceptual transformation tasks (Keil, 1989) show. We propose that children can rely on purposes to overcome appearances when categorizing not only artifacts, but biological kinds as well. Across three experiments, with 570 US based children, we find support for this. Children successfully categorized dissimilar-looking objects together based on shared purposes, both at basic (Experiment 1) and superordinate levels (Experiment 2). Children also used an object's purpose to judge that it maintained its identity in the face of radical perceptual transformations (Experiment 3). We discuss our results in the context of essentialism. Some have proposed that scientific essences—placeholders for what gives something its identity that science fills out—might help children overcome appearances, but this requires a protracted development since scientific elaboration is challenging and rare (Gelman, 2003). Instead, we suggest that children can readily treat purposes as essences. That children can elaborate placeholders with purposes for biological kinds suggests a reorientation of essentialism.

Keywords: categorization; teleology; essentialism; development; perceptual features.

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Introduction

It's a significant intellectual achievement that humans can categorize things in ways that go beyond perceptual similarities—grouping things that look different into the same category and things that look alike into different categories. When perceptually dissimilar things are united into a single category that includes perceptually typical and atypical members, new inductive generalizations are enabled, and advances in knowledge can be achieved. Such is the case in moving whales from the fish to mammal category, which took most of scientific history (Romero, 2012).

Going beyond perceptual similarity in categorization is crucial even in ordinary classification. Consider the large variety of superordinate categories, from vegetables to furniture, that people form (e.g., Rosch & Mervis, 1975). It would be nearly impossible to form these superordinate categories by relying only on appearances. Nevertheless, perceptual features are immediately available. And they play an important role in early word learning and categorization (e.g., Baldwin, 1989; Booth, Waxman, & Huang, 2005; Diesendruck & Bloom, 2003; Gershkoff-Stowe & Smith, 2004; Graham & Diesendruck, 2010; Jara-Ettinger, Levy, Sakel, Huanca, & Gibson, 2022; Jones & Smith, 1993; Landau et al., 1988; Macario, 1991; Peretz-Lange & Kibbe, 2024; Samuelson & Smith, 2005; Smith, Jones, Landau, Gershkoff-Stowe, & Samuelson, 2002). Two classic sets of findings well illustrate the difficulty that children have in overcoming a reliance on appearances in categorization: shape similarity and transformation tasks.

Shape similarity plays a powerful role in early word learning and categorization. If, for instance, children are taught a new word in "dinosaur language", shown an apple and told it's a "dax", a shape match, such as a tennis ball, and a category match that is perceptually dissimilar, like a banana, when asked to find another dax, preschoolers select the shape match (e.g., Baldwin, 1992; Gentner & Namy, 1999; Imai, Gentner, & Uchida, 1994; Landau et al., 1988). Labels can help children overcome a reliance on perceptual similarity (e.g., Cimpian & Markman, 2005; Gelman & Markman, 1986; Markman, 1989; Waxman, 1990) for basic-level categories, such as clocks, cookies and flowers (Cimpian & Markman, 2005), and help children generalize properties of perceptually dissimilar basic-level category members (e.g., Gelman & Markman, 1986, 1987). Labels are less effective at the superordinate level (e.g., Cimpian & Markman, 2005).

Children also struggle to overcome appearances when categorizing things that undergo radical perceptual transformation. If children are shown a raccoon that is made to look like a skunk, they show a protracted developmental pattern before they come to think that undergoing perceptual transformation doesn't actually make it a skunk (Keil, 1989). In fact, it isn't until children are around 9 that they overcome a reliance on perceptual features in radical transformation tasks.

Much of the time children and adults alike determine what something is by consulting its perceptual features. But solely relying on appearances poses serious limitations. How might we overcome them? Sometimes we need to consider what makes something the kind of thing it is. We propose that children can treat purposes, or what something is for, as determining what makes it the kind of thing that it is. And we show that children can leverage purposes to overcome a reliance on appearances in classic cases involving shape similarity and radical perceptual transformation. Importantly, we argue that children can rely on purposes to overcome appearances not only when categorizing artifacts, but also when categorizing *biological kinds*.

We begin by setting out our proposal that children might be able to rely on what something is for to overcome a reliance on appearances. Then we test whether children categorize dissimilar-looking objects together based on shared purposes, both at the basic (Experiment 1) and superordinate level (Experiment 2), and whether children can use an object's purpose to judge that it maintains its identity in the face of radical perceptual transformations (Experiment 3). We conclude by discussing our findings in the context of essentialism.

Purposes and categorization

Both children and adults can override perceptual similarity by relying on purposes in artifact categorization (e.g., Nelson, Frankenfield, Morris, & Blair, 2000; Rips, 1989; Rose & Schaffer, 2017). For instance, Rips (1989) found that adults judge that an object that looks like a lampshade is actually an umbrella when they are told that it was originally designed to protect people from rain. Work on artifact categorization often focuses on two central factors that play a role in determining what something is for—intended function and current use (Joo, Yousif, & Knobe, 2023; Prinzing et al., 2024). And developmental research has mostly centered on whether there are developmental changes in the role of intended function and current use in categorizing artifacts (e.g., Asher & Nelson, 2008; Defeyter & German, 2003; Defeyter, Hearing, & German, 2009; Diesendruck, Markson, & Bloom, 2003; Gelman & Bloom, 2000; German & Johnson, 2002; Jaswal, 2006; Matan & Carey, 2001; Prinzing et al., 2024; Rips, 1989). For instance, adults tend to think that an artifact designed for making tea but currently used for watering flowers is a teapot (Matan and Carey 2001; though see Joo et al. 2023). So do 6-year-old children. However, 4-year-old children weigh current over intended function. Nonetheless, even 4-year-old children rely on current use to determine what something is for and thus what is. Children and adults can use what an artifact is for to determine what it is (see also Prinzing et al., 2024). But what about *biological kinds*?

Kelemen et al. (2003) examined whether children generalize animal behavior based on category membership. Children were introduced to two perceptually dissimilar animals, for instance, a shrew and a duck. For each, they were told about a behavior the animal engages in. The shrew tries to find insects and the duck tries to find weeds. Then children were shown the test animal, a platypus, that was overall perceptually similar to the shrew. While the platypus was perceptually dissimilar to the duck, it shared a functionally adaptive characteristic with it: a bill. The key question was whether children would think that the platypus tries to find insects or weeds. 4- to 5-year-old children were inclined to think that the platypus would try to find weeds. This suggests that children can generalize behavior based on shared functionally adaptive features. Might children also rely on functions when *categorizing* biological kinds?

Rose and Nichols (2019) found that if a bee is made to look like a spider but preserves the purpose of bees, making honey, adults categorize it as a bee. What something is for can play a role in categorizing biological kinds, even in the face of conflicting perceptual appearances. Perhaps children can also rely on what something is for to determine what it is—even in the face of conflicting perceptual appearances—when categorizing biological kinds as well as artifacts. If children are subtly prompted to think about something's purpose, will that lead them to override perceptual similarity? Our proposal is that what something is for might be readily accessible to children (e.g., Butler & Markman, 2014; Deák, Ray, & Pick, 2002; Diesendruck & Bloom, 2003; Kelemen, 1999; Kemler Nelson, Russell, Duke, & Jones, 2000; Zhu, Goddu, Zhu, & Gopnik, 2024) and as such aid children in going beyond perceptual appearances when categorizing both biological kinds and artifacts.

Our question

Our central question is whether in classic cases documenting the powerful role of perceptual appearances in categorizing—those involving striking shape similarities (e.g., Landau et al., 1988) and those involving complete and radical perceptual transformations (e.g., Keil, 1989)—teleological considerations lead children to overcome their reliance on appearances. In asking whether providing information about purposes will lead children to overcome a reliance on appearances, we recognize that it would hardly be surprising if children categorized *artifacts* based on purposes. What is yet to be explored is whether children can use what something is for to overcome appearances when categorizing *biological kinds* as well as artifacts. Will giving children information about what something is for help them override perceptual similarity when categorizing both biological kinds and artifacts?

Experiments

For all results reported in this paper, we fit Bayesian logistic mixed effects models. We will refer to a statistical result of interest as "credible" when the 95% credible interval excludes 0, except when reporting odds ratios, which we will interpret as credible when the credible interval excludes 1.

All materials, data, analyses, and links to pre-registrations are available here: `https://github.com/davdrose/teleological_essentialism_development`

Experiment 1: Shape and purpose at the basic-level

We begin by asking whether providing information about purposes will lead children to overcome a reliance on appearances when categorizing biological kinds and artifacts at the basic-level. So, for instance, if children are shown a wolf spider and told what it is for, what other objects will they think are members of the same category? Will they think a different basic-level category member, a different shaped spider, such as a spiny orb weaver that has the same purpose, is a member of the same category? Or will they think that a member from a contrasting category that has the same shape as a wolf spider but a different purpose, a crab, is a member of the same category?

Methods

Participants

We recruited 180 participants through Lookit (Scott & Schulz, 2017) who were between the ages of 3 and 4 and met our pre-registered inclusion criteria (*gender*: 86 female, 93 male, 1 no response/other; *language*: 172 English, 8 no response/other). Each age group included 90 participants. Families were compensated $5 for their participation.

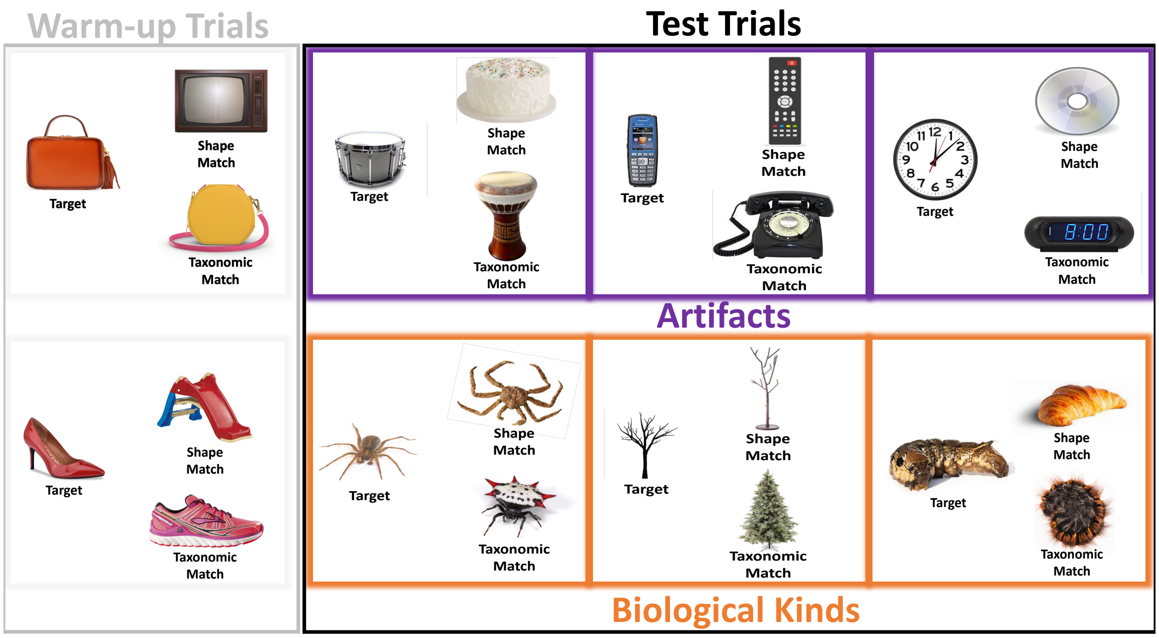

Figure 1

***Experiment 1 items**: Items for the warm-up (left box in gray) and test trials (right box in black). The test trials included three artifacts (purple boxes) and three biological kinds (orange boxes). Each trial included a target item and a shape and taxonomic match to the target item.*

Materials

To determine whether giving children information about what things are for would lead them to be less likely to categorize objects at the basic level on the basis of their shape, we created eight trials pitting shape against purpose, where six were test trials and two were warm-up trials. The test trials included three artifacts and three biological kinds. In all trials, children saw a target item, a shape and a taxonomic match to the target. The full set of materials is shown in Figure 1

Procedure

The experiment was programmed using Lookit (Scott & Schulz, 2017), and children were tested asynchronously. Participants were first introduced to a puppet named Maggie. They were told that Maggie is learning puppet language and were asked if they wanted to help teach her puppet language. Once they agreed, participants then proceeded to the two warm-up trials. They were first shown, by itself, the target item, which was given a novel label (e.g., “See this? This is a zulu.”). Then participants saw the shape match and the taxonomic match. On the final screen, participants saw all of the items. The target item wiggled and participants heard, “See this zulu?”. Then they were asked, “Can you find another zulu? Is it the one on the top or the one on the bottom?”. The objects in the top and bottom position on the screen wiggled when they were referred to. Children made

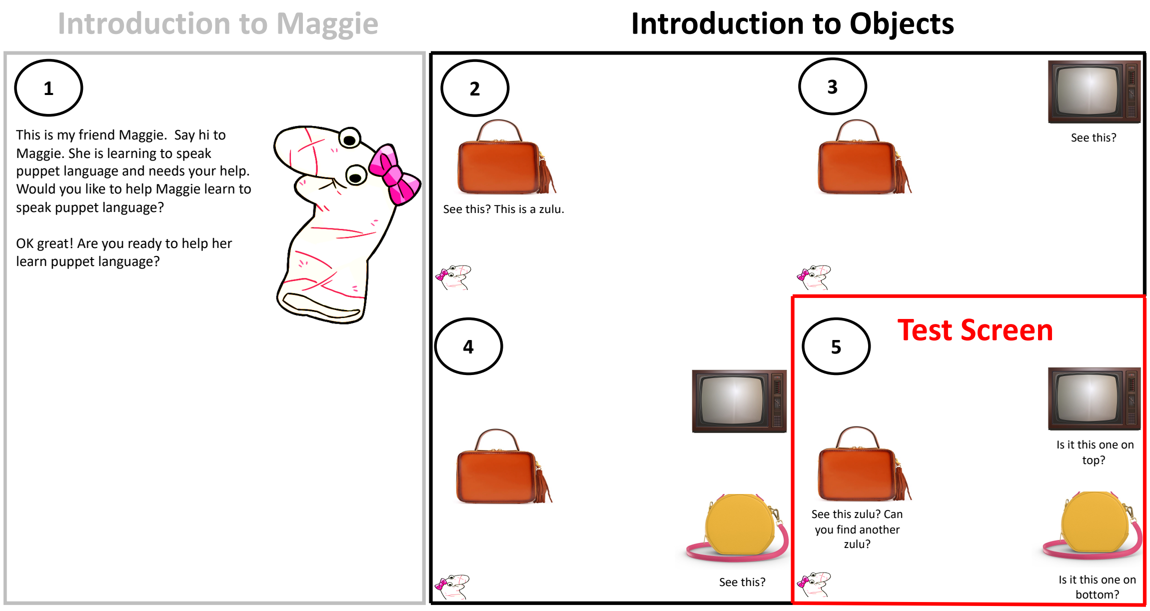

Figure 2

Experiment 1 procedure*: Overview of experimental procedure. Children were (1) first introduced to Maggie, then (2) introduced to the target object, (3) shown a shape match, (4) a taxonomic match and (5) asked whether the shape or taxonomic match was a member of the target object's category. Text was shown on the slides to participants.*

their "top" or "bottom" responses out loud.

The test trials were presented in the same way as the warm-up trials. An example of the procedure is shown in Figure 2.

Design

Participants were randomly assigned to one of three conditions: a *label only*, *category neutral* or *purpose* condition. Participants were also randomly assigned to one of three orders of the test items. These three orders were the same in each of our three conditions. Across the three orders, each test trial had the taxonomic match appear either below or above the shape match.

In the *label only* condition, a name was only given to the target item (e.g., "This is a Wubble"). In the *purpose* condition, in addition to a novel name, a purpose was given (e.g., "Wubbles are for making webs"). The category neutral condition was inspired by Gelman and Markman (1986, Study 3). Here the features ascribed to the objects are shared by many different kinds of objects (e.g., "Wubbles get wet when it rains"). An example of the kind of information provided in the different conditions is shown in Figure 3.

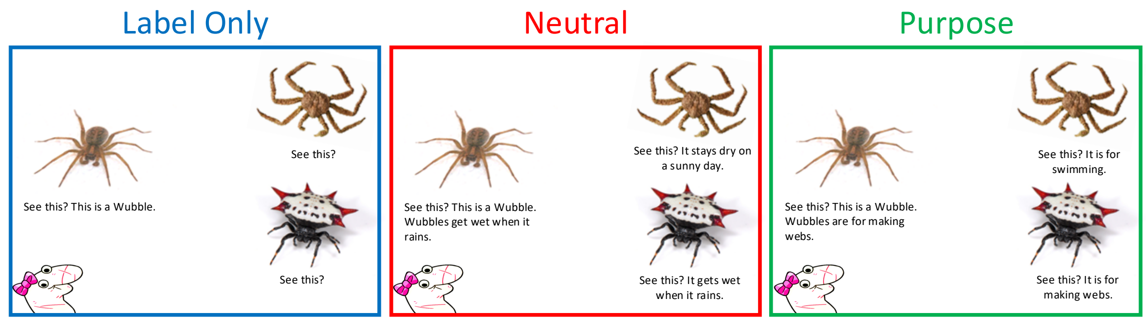

Figure 3

Experiment 1 conditions*: Overview of experiment conditions. An example trial is shown for each condition: Label Only (blue), Neutral (red) and Purpose (green). In each, the standard, the "Wubble", is shown on the left and the shape match, the crab, and taxonomic match, spiny orb weaver, are shown on the top and bottom respectively. After seeing all of the objects, children were asked if they can find another Wubble and asked if it was the one on the top or bottom.*

Results

The results are shown in Figure 4. Our pre-registered hypothesis was that children would be more inclined to engage in taxonomic categorization in the purpose condition in comparison to either the label only or neutral conditions. This is what we found. 70% (95% confidence interval (CI) = $[66\%, 75\%]$) of responses were taxonomic in the purpose condition, with only 45% (95% CI = $[41\%, 51\%]$) categorizing taxonomically in the neutral condition, and 39% (95% CI = $[34\%, 45\%]$) in the label only condition. Children were more inclined to categorize taxonomically when given a purpose compared to when they were only given a label (odds ratio: 4.21, 95% credible interval (CrI) = $[2.65, 6.26]$) or category neutral properties (odds ratio: 3.19, 95% CrI = $[2.04, 4.77]$). We didn't make any predictions about whether the label only and category neutral conditions would differ, but found that there was no credible difference in taxonomic responding between the label only and category neutral conditions (odds ratio: 0.76, 95% CrI = $[0.49, 1.10]$).

We also pre-registered the hypothesis that rates of taxonomic responding in the purpose condition would be greater than chance. This is what we found (95% CrI = $[65\%, 80\%]$). Though we didn't make any predictions about whether rates of taxonomic responding in the label only and neutral condition would differ from chance, we found that they were credibly lower than chance in the label only condition (95% CrI = $[30\%, 47\%]$) and not credibly different from chance in the neutral condition (95% CrI = $[36\%, 55\%]$). Lastly, as a pre-registered exploratory analysis, we examined whether there were differences between artifacts and biological kinds. We found that these didn't credibly differ ($\beta = 0.16$, 95% CrI = $[-0.10, 0.42]$).

Discussion

When 3- to 4-year-old children were given purposes for the objects, they no longer categorized based on shape: 70% of their responses were taxonomic. This isn't explained

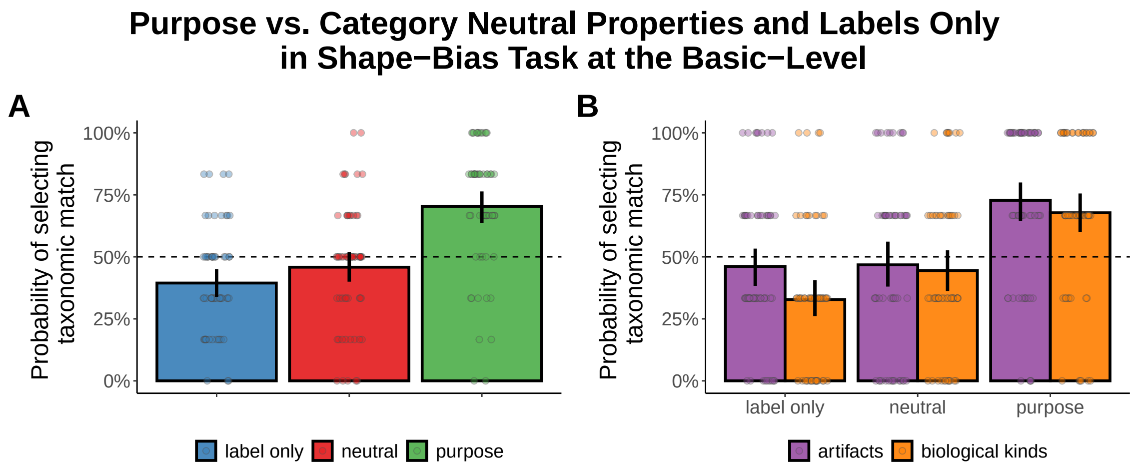

Figure 4

***Experiment 1 results**: (**A**) The mean probability, shown for each bar, of selecting the taxonomic match in each condition: label only (blue), neutral (red) and purpose (green). Black lines for each bar are bootstrapped 95% confidence intervals. Small dots are average taxonomic responses for individual participants. (**B**) The mean probability, shown for each bar, of selecting the taxonomic match for artifacts (purple) and biological kinds (orange) in each condition: label only, neutral and purpose. Black lines for each bar are bootstrapped 95% confidence intervals. Small dots are average taxonomic responses for individual participants for the artifact (purple) and biological kinds (orange).*

by a simple informational matching strategy since when given category neutral properties, only 46% of responses were taxonomic, which didn't differ from providing children with only a label, where 39% of responses were taxonomic.

Not only did providing purpose information lead children to overcome a reliance on shape, it was just as effective for *biological kinds* as for artifacts. We next ask whether the benefits of teleology in overcoming a reliance on shape extends to the superordinate-level.

Experiment 2: Shape and purpose at the superordinate-level

Here we ask whether information about purposes will lead children to overcome a reliance on appearance when categorizing biological kinds and artifacts at the superordinate-level. The superordinate-level is more abstract than the basic-level: category members have fewer features in common than at the basic-level. For instance, the superordinate category *fruit* includes a motley: apples, bananas, pineapples and star fruit, to name a few. Members of superordinate categories can look very different from one another. Even though it is harder to rely on perceptual similarity to categorize at the superordinate-level— there is little perceptual similarity to rely on—children nonetheless rely on shape to categorize at the superordinate-level (Cimpian & Markman, 2005). Will providing children with information about the purposes of biological kinds and artifacts help them overcome a reliance on appearances at the more abstract and challenging superordinate-level?

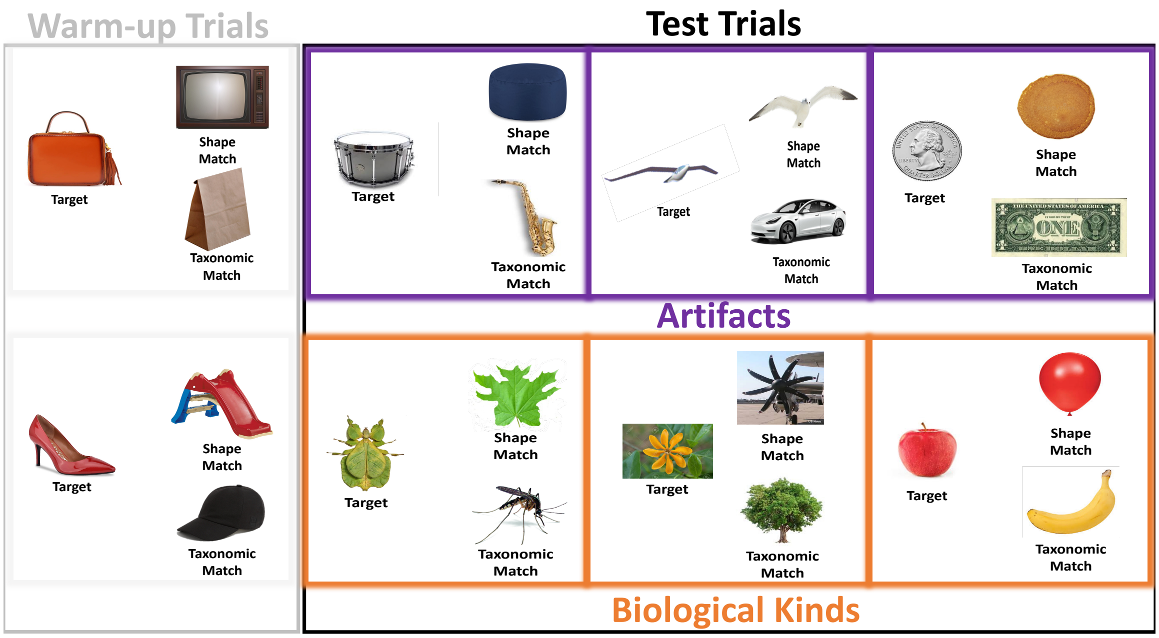

Figure 5

Experiment 2 items: *Items for the warm-up (left box in gray) and test trials (right box in black). The test trials included three artifacts (purple boxes) and three biological kinds (orange boxes). Each trial included a target item and a shape and taxonomic match to the target item.*

Methods

Participants

We recruited 90 participants through Children Helping Science who were between the ages of 3 and 4 and met our pre-registered inclusion criteria (*gender*: 46 female, 38 male, 6 no response/other; *language*: 78 English, 12 no response/other). Each age group included 45 participants. Families were compensated $5 for their participation.

Materials

To determine whether giving children information about what things are for would override their tendency to categorize objects at the superordinate-level on the basis of their shape, we created eight trials pitting shape against purpose, where six were test trials and two were warm-up trials. The test trials included three artifacts and three biological kinds. In all trials, children saw a target item, a shape and a taxonomic match to the target. The full set of materials is shown in Figure 5.

Procedure

The procedure was the same as in Experiment 1, except that children were tested synchronously over Zoom.

Design

The design was the same as in Experiment 1.

Results

The results are shown in Figure 6. Our pre-registered hypothesis was that children would be more inclined to engage in taxonomic categorization in the purpose condition in comparison to either the label only or neutral conditions. This is what we found. 67% (95% CI = $[60\%, 74\%]$) of responses were taxonomic in the purpose condition, with 41% (95% CI = $[34\%, 49\%]$) taxonomic responses in the label only condition, and 36% (95% CI = $[29\%, 43\%]$) in the neutral condition. Children were more inclined to categorize taxonomically when given a purpose compared to when they were only given a label (odds ratio: 3.41, 95% CrI = $[1.58, 6.12]$) or category neutral properties (odds ratio: 4.27, 95% CrI = $[2.04, 7.92]$). We also pre-registered that there would be no credible difference in taxonomic responding between the label only and category neutral property conditions. This is what we found (odds ratio: 1.28, 95% CrI = $[.60, 2.28]$).

We also pre-registered the prediction that rates of taxonomic responding in the purpose condition would be credibly greater than chance. This is what we found (95% CrI = $[57\%, 81\%]$). Our pre-registered prediction for the label only and neutral condition was that they would not credibly differ from chance. We found that they were credibly lower than chance in the neutral condition (95% CrI = $[21\%, 47\%]$) but not credibly different from chance in the label only condition (95% CrI = $[27\%, 54\%]$). Lastly, we preregistered that we would explore whether there were differences between artifacts and biological kinds. We found that they didn't credibly differ ($\beta = 0.23$, 95% CrI = $[-0.66, 0.20]$).

Discussion

Even at the superordinate-level, telling 3- to 4-year-old children the purposes of objects leads them to overcome a reliance on shape and categorize taxonomically instead. 67% of their responses were taxonomic when given a purpose. In contrast, only 36% were taxonomic when given category neutral properties and 41% of responses were taxonomic when given a label. Not only did providing purposes lead children to overcome a reliance on shape, it was, again, equally as effective for biological kinds as for artifacts.

We ask, in our final experiment, whether knowing that things preserve their purpose across radical perceptual transformations might help children override their reliance on appearances.

Experiment 3: Purposes and Radical Perceptual Transformations

Here we ask whether giving children information about what things are for will lead them to be less likely to categorize objects based on their appearance when they undergo radical changes in their perceptual features. Overcoming appearances in situations where things undergo radical transformation—like a bee being made to look like a spider—is incredibly challenging for children (Keil, 1989). But providing children information about the purposes of biological kinds as well as artifacts, and whether they are preserved across radical perceptual transformations, might help them override a reliance on appearances.

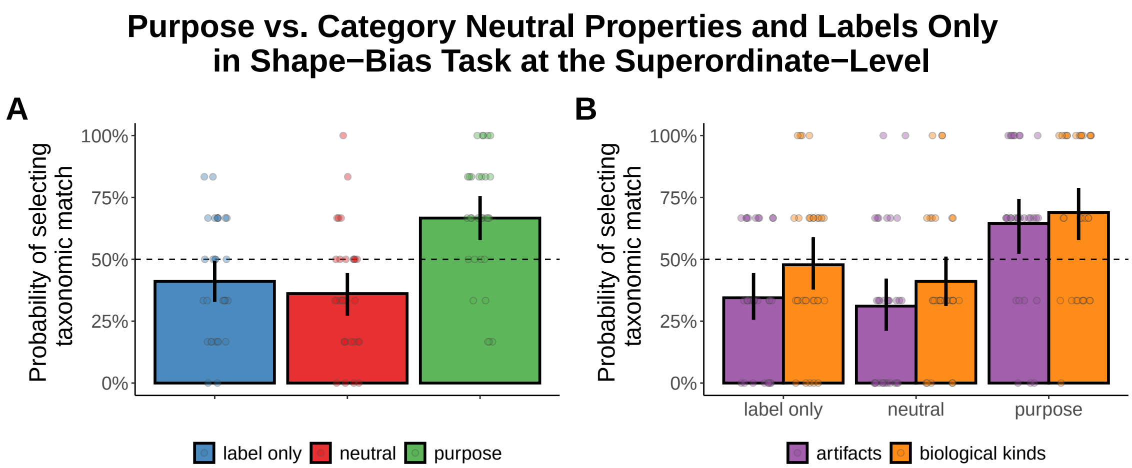

Figure 6

Experiment 2 results: *(**A**) The mean probability, shown for each bar, of selecting the taxonomic match in each condition: label only (blue), neutral (red) and purpose (green). Black lines for each bar are bootstrapped 95% confidence intervals. Small dots are average taxonomic responses for individual participants. (**B**) The mean probability, shown for each bar, of selecting the taxonomic match for artifacts (purple) and biological kinds (orange) in each condition: label only, neutral and purpose. Black lines for each bar are bootstrapped 95% confidence intervals. Small dots are average taxonomic responses for individual participants for the artifact (purple) and biological kinds (orange).*

Methods

Participants

We recruited 300 participants through Lookit who were between the ages of 5 and 9 and met our pre-registered inclusion criteria (*gender*: 156 female, 143 males , 1 no response/other; *language*: 274 English, 26 no response/other). Each age group included 60 participants. Families were compensated $5 for their participation.

Materials

To determine whether giving children information about what things are for would help them override their reliance on appearances when objects undergo radical perceptual transformation, we created 8 trials involving perceptual transformations on four pairs of artifacts and four pairs on biological kinds. The full set of item pairs is shown in Figure 7. These were selected based on a two-part norming study aimed at determining which purposes for different kinds were accessible to 4- to 6-year-old children (see Appendix). We selected some of the top artifacts and animals whose purpose children agreed on. Using those in the second part of our norming study, we gave 4- to 6-year-old children 14 artifact pairs and 14 animal pairs and asked which had that purpose. Children were overwhelmingly inclined to identify the correct items when asked which of two had some particular purpose. From these, we selected four artifact and four biological kind pairs to be used here

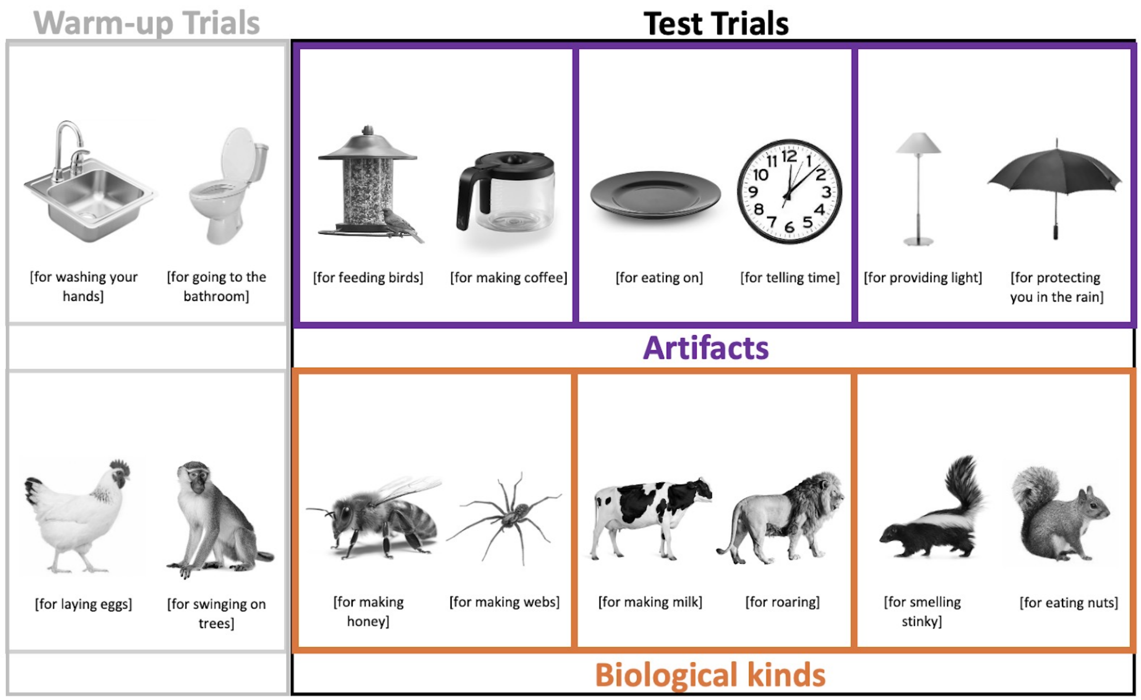

Figure 7

Experiment 3 items*: Item pairs for the warm-up (left box in gray) and test trials (right box in black). The test trials included three artifact pairs (purple boxes) and three biological kind pairs (orange boxes). Information included in the brackets was given only in the purpose condition.*

in Experiment 3 (see Figure 7).

Procedure

The experiment was programmed using Lookit (Scott & Schulz, 2017), and children were tested asynchronously. Each child was first introduced to Maggie and told that they, along with Maggie, would learn about Andy's projects. Next, they were introduced to Andy and shown his workshop. Children were told that Andy has various supplies for his projects including crayons, paper, tools, and a toolbox, and that he will use his supplies to change things.

Children began with two warm-up trials. They were shown an object (e.g., a sink) and told that Andy was going to use this for one of his projects. Maggie then identifies the item (e.g., "That's a sink.") and then children are told that Andy will change the object with his supplies. They are then given a description of how the object is changed (e.g., made rounder, given a handle and lid) and then shown, on a new screen, a different object (e.g., a toilet) and told that the thing Andy changed with his supplies now looks like this. Maggie then says what the item looks like (e.g., "That looks like a toilet."). Children are then reminded that the thing Andy changed now looks like what is shown on the screen (e.g., a toilet) and asked what the object is ("Do you think this is a sink or a toilet?").

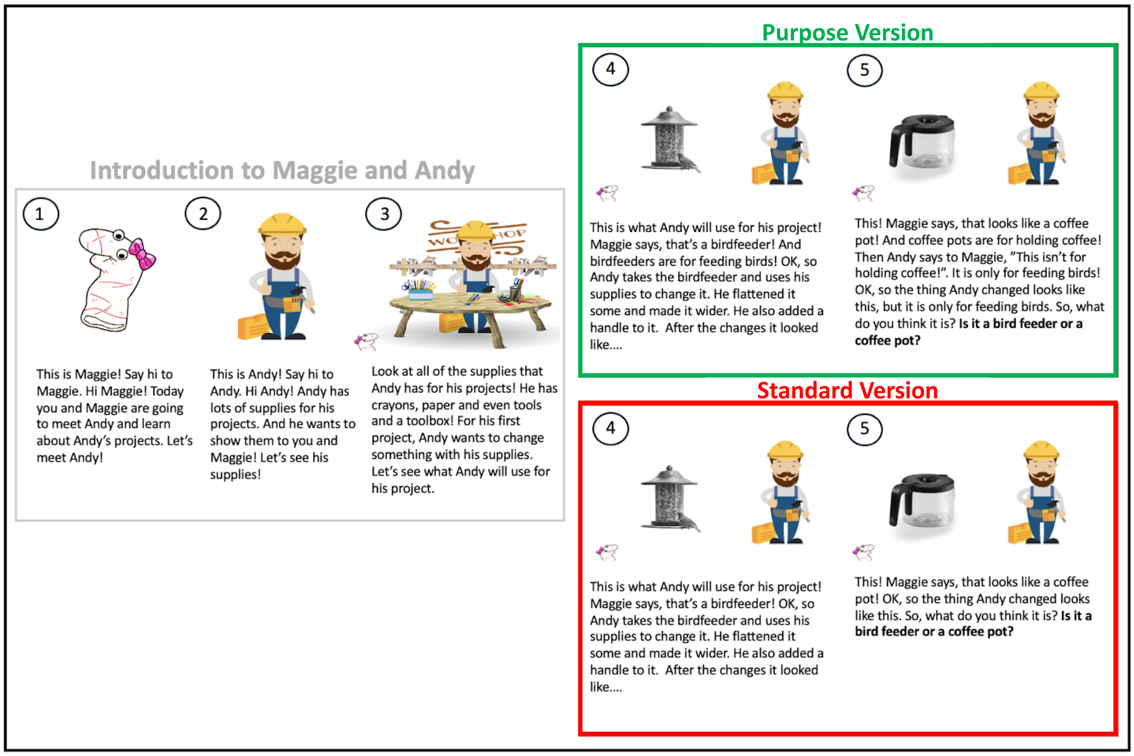

Figure 8

Experiment 3 procedure*: Overview of transformation experiment procedure. Children began by (1) being introduced to Maggie, (2) introduced to Andy and (3) shown the supplies that Andy uses to change things (left; gray). Children in the purpose version (top; green) were then (4) introduced to the object Andy is going to change with Maggie identifying what it is and what it is for. Then (5) children are shown what the object looks like after the change, Maggie says what it looks like and what it is for, while Andy says that it is for what the original object was for. Children are then asked what the object is. The standard version (bottom; red) is the same except Maggie doesn't mention a purpose when she sees the initial object (4) or when she sees the changed object (5). Text was not shown on the slides to participants.*

Children made their responses out loud. The procedure for the test trials was the same.

Design

Children were assigned to the purpose version or standard version. For each condition, there were three orders where the order of the warm-up trials was fixed but the order of the test trials varied. Due to a coding error, one of our three orders of trials had test trials randomized for each participant. The other two trial orders were fixed for each participant.

The standard version was based on Keil's (1989) original transformation task, and participants were told about the perceptual transformation an object underwent, such as

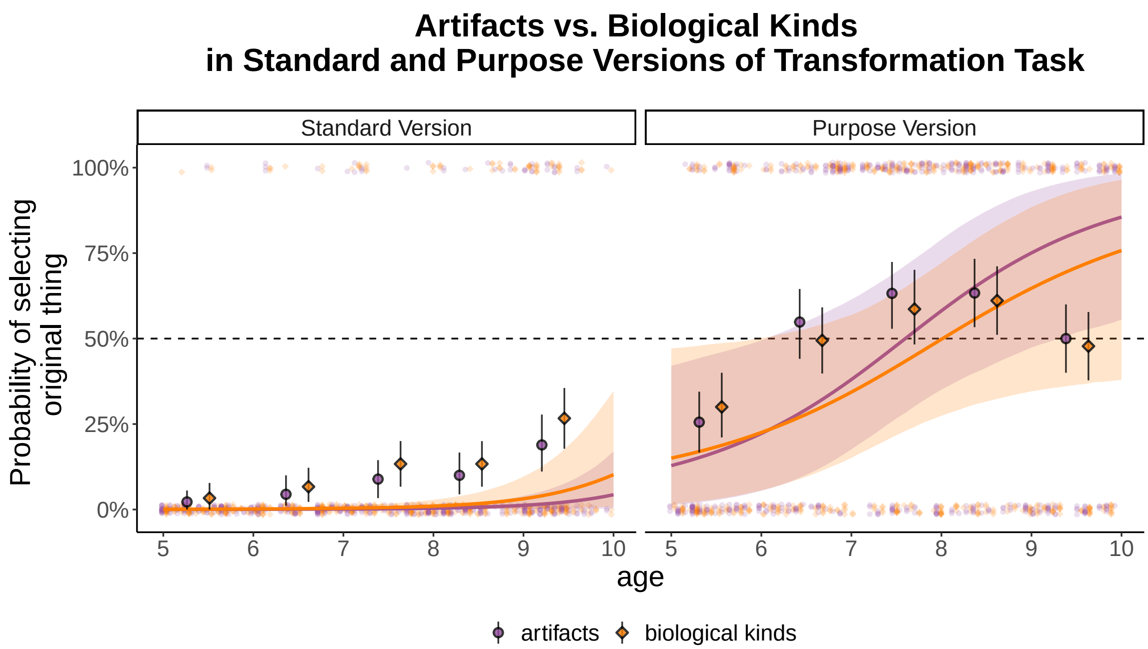

Figure 9

Experiment 3 results: *Probability of judging that the changed object was still a member of its original category in the standard (left panel) and purpose (right panel) conditions. For each condition, regression lines show the fits of Bayesian logistic mixed effects models with 95% credible intervals with model predictions for artifacts (purple) and biological kinds (orange) over age. Large dots are means for each age group for the artifact (purple) and biological kind (orange) items with bootstrapped 95% confidence intervals. Small dots are individual responses for artifacts (purple) and biological kinds (orange).*

a bee being made to look like a spider. The purpose version was based on Rose and Nichols (2019), and in addition to being told about the perceptual transformation the object underwent, children were also told the purpose of the object. For instance, when a bee was changed to look like a spider, children were told that it doesn't spin webs but only makes honey (see also e.g., Rose & Nichols, 2019).

Examples of the purpose and standard versions, along with the procedure, are shown Figure 8.

Results

The results are shown in Figure 9. We coded responses so that 1 = judging that the transformed object was still a member of its original category and 0 = judging that the transformed object changed categories. We first focus on the results comparing the standard and purpose versions that were predicted based on this manipulation.

In line with our pre-registered prediction, in contrast to the standard version, we found that children in the purpose version of the transformation task were more likely to think the object retained its original identity despite the radical transformation for both artifacts (purpose: 51%, 95% CI = $[47\%, 56\%]$, standard: 9%, 95% CI = $[6\%, 12\%]$, odds ratio: 752, 95% CrI = $[46, 5032]$) and biological kinds (purpose: 49%, 95% CI = $[45\%, 55\%]$, standard: 13%, 95% CI = $[10\%, 16\%]$, odds ratio: 500, 95% CrI = $[18.9, 3795]$). We also found, as predicted, that children were overall less likely to judge that the object changed categories as they got older (artifacts: $\beta = 1.05,\ 95\%\ \mathrm{CrI} = [0.53, 1.68]$; biological kinds: $\beta = 1.00,\ 95\%\ \mathrm{CrI} = [0.43, 1.67]$). We predicted that the difference between the purpose and standard versions in the extent to which children judged that the object retained its category membership after the transformation would increase with age, but we didn't find evidence of this (artifacts: $\beta = -0.53,\ 95\%\ \mathrm{CrI} = [-1.64, 0.52]$; biological kinds: $\beta = -0.59,\ 95\%\ \mathrm{CrI} = [-1.75, 0.58]$).

We also made specific pre-registered predictions for each condition. For the purpose version, we predicted that older children would be more likely to judge that the object didn't change its category after the transformation. We found evidence of this ($\beta = 0.77,\ 95\%\ \mathrm{CrI} = [0.14, 1.48]$). And for the standard version, we predicted, in line with Keil's original finding, that children would overall be more likely to think biological kinds didnt change their original category membership after the transformation. However, we didn't find evidence supporting this (odds ratio: $2.68,\ 95\%\ \mathrm{CrI} = [.25, 7.27]$). We did, however, and as predicted, find that older children in the standard version were more inclined to think that the objects overall, whether artifacts or biological kinds, didn't change their original category membership after being changed ($\beta = 1.14,\ 95\%\ \mathrm{CrI} = [.44, 2.07]$). Lastly, we predicted that in the standard version the difference between thinking biological kinds and artifacts retained their category membership would widen with age such that children, as they got older, would be more inclined to think biological kinds retained their category membership. But we didn't find evidence of this ($\beta = 0.01,\ 95\%\ \mathrm{CrI} = [-0.54, 0.59]$).

Discussion

Keil (1989) originally found that children categorized both artifacts and biological kinds based on their appearance, but that with increasing age they were less inclined to do so for biological kinds. In contrast to this standard transformation task, we found, unsurprisingly, that children used information about purposes to overcome appearances when categorizing artifacts. Artifacts serve as a useful comparison to biological kinds. Indeed, we found that not only did purposes help children overcome appearances in categorizing artifacts—they were also as effective in helping children overcome appearances when categorizing *biological kinds*.

General Discussion

We found that knowledge of a thing's purpose can play a powerful role in children's categorization and identity judgments. 3- and 4-year-old children used information about an object's purpose to override their strong reliance on shape. And they used purposes over shape for categorizing both biological kinds and artifacts, at both the basic (Experiment 1) and more challenging superordinate (Experiment 2) level. Purposes also helped children override their reliance on perceptual features in radical transformation tasks. When an object underwent radical changes in its perceptual features, children were more inclined to think the object retained its identity when it preserved its purpose (Experiment 3). In fact, telling five-year-old children the purposes of objects led them to be as likely as nine-year-old children, in the standard procedure with no purpose information, to think that an object that underwent radical perceptual transformation retained its identity. Together, this suggests that teleological information is readily accessible for determining category membership and identity. Why might children make use of what something is for to determine what it is, even for biological kinds? Our proposal is that children might treat what something is for as what makes it the kind of thing that it is—its essence.

Teleological essentialism is the view that people tacitly regard essences in terms of a telos (Rose & Nichols, 2019, 2020). What makes something the kind of thing that it is—its essence—is determined by its purpose. While most views of essentialism maintain that artifacts are not essentialized (e.g., Gelman, 2013; Keil, 1989), teleological essentialism instead suggests that they are. Their essence is determined by their purpose. But teleological essentialism suggests that it isn't only artifacts that are essentialized in terms of purposes. Instead, *biological kinds* are too.

Rose and Nichols (2019) found that across a range of standard tests of essentialist thinking, adults rely on teleological considerations. For instance, in a transformation task where a bee is made to look like a spider, if adults learn that it preserves the purpose of bees, making honey, adults say it is still a bee. But if the bee undergoes transformation and ends up with the purpose of spiders, spinning webs to catch and kill insects, people think it is no longer a bee. They found a similar pattern in switched-at-birth tasks. If baby bees are raised by spiders and end up spinning webs, adults categorize them as spiders.

A similar pattern emerges for artifacts (Rose & Nichols, 2020). If a hotplate is changed to look like a clock, so long as it still heats up, adults judge that it is still a hotplate. Moreover, if a clock has all of its insides replaced with the insides of a hotplate, but still tells time, adults categorize it as a clock. Given that for both biological kinds and artifacts, adults rely on teleological considerations in determining what something is when using standard tests of essentialist thinking, this suggests that they elaborate essences in terms of purposes and thus essentialize both biological kinds and artifacts in terms of purposes.

Our findings suggest that children might too. What something is for is readily accessible to children and they can use what something is for to determine what it is in the face of striking and conflicting perceptual evidence. They can rely on purposes to overcome appearances at the basic-level, the more challenging superordinate-level, and in even more challenging tasks involving radical perceptual transformation. They can do so for artifacts. And importantly, they can also do so for biological kinds. Together, this suggests that children, like adults, can treat what something is for as determining what it is. What makes something the kind of thing it is—its essence—can be determined by its purpose. It's useful to contrast our proposal, teleological essentialism, with another view of essentialism: scientific essentialism.

Kripke (1980) and Putnam (1975) maintained that, for natural kinds, science uncovers properties that make things what they are—what makes something a lemon isn't that it is yellow, tart, with a certain kind of peel, but that it has the genetic structure of lemons. This insight has been codified in an influential view of essentialism in psychology—scientific essentialism (e.g., Gelman, 2003; Keil, 1989). Scientific essentialism acknowledges that laypeople rarely possess knowledge of the underlying features of things that science deems essential. Instead, scientific essences are typically represented in terms of placeholders that are restricted to natural and social kinds (Atran, 1998; Gelman, 2003, 2013; Keil, 1994, 1989). And there is a great deal of research on various aspects of scientific essentialism (see e.g., Gelman, 2004, for a review)—including that preschoolers can reason about the insides of things (Gelman & Wellman, 1991) and think that animals raised by different animals will grow up to be like their birth parents (e.g., Gelman & Wellman, 1991; Waxman, Medin, & Ross, 2007).

Scientific essentialism relies on placeholders. But Gelman and O'Reilly (1988) tried to provide elaborations, not in categorization tasks, but in induction tasks. If given scientific sounding information about the insides of things, such as that something "has auxin inside", will children generalize those properties? Their ability to do so is limited. While children had no trouble generalizing scientific properties at the basic-level—thinking that two different colored apples would have auxin inside—they struggled to generalize them at the superordinate-level, where perceptual differences between items are much more extreme.

We are not claiming that scientific essentialism has no place in children's reasoning about category membership and identity (Neufeld 2021; Joo and Yousif 2022; though see Toorman 2023). In fact, we would have liked to introduce elaborations of scientific essences in our own studies. But previous attempts have been unsuccessful (e.g., Gelman & O'Reilly, 1988), and it is hard to see how to provide meaningful elaborations of scientific essences to preschoolers. Part of the issue is that placeholders for scientific essences lack content that can be leveraged in categorizing and elaboration of scientific essences requires abstract knowledge of sophisticated concepts, such as DNA, that will have a protracted development. In contrast, from an early age, teleological considerations can already serve to elaborate some placeholders.

People may not always know what the purpose of something is—they might have teleological placeholders. But children's readiness to use teleological information in reasoning about category membership and identity suggests that it can provide a cognitively accessible and fruitful kind of content to fill out placeholders for essences.

It is an interesting further question how the teleological notions that children rely on to elaborate placeholders develops. In our experiments, we used objects with familiar purposes. A question for future research is how beneficial it would be in categorization and transformation tasks to provide children with novel purposes.

Another interesting, yet unresolved, question is what role different kinds of teleological notions play in the development and representation of placeholders. Purposes can be treated as either intrinsic—e.g., viewing a spider's purpose as building webs seems to be something intrinsic to the spider—or relational—e.g., viewing the purpose of a vulture as clearing carrion seems to concern its ecological role (e.g., Dink & Rips, 2017; Medin & Atran, 2004; Unsworth et al., 2012; Waxman, Medin, et al., 2013). Viewing purposes as either intrinsic or relational suggests a broader conception of essences. Scientific essentialism focuses only on intrinsic properties. But even in biology, essences can be construed as relational (Griffiths, 1999; Okasha, 2002; Sterelny & Griffiths, 1999). Vultures are scavengers, beavers are builders and bees are pollinators. In addition to ecological characterizations of the essential properties of species, anatomy also offers many examples of relational essences. The heart is one example. What makes something a heart is a relation it bears to blood circulation, namely, pumping. Teleological essentialism can capture relational essences. As such, teleological thinking might promote a broader conception of essentialist thinking, and one that is continuous with some aspects of science. Teleological essentialism suggests a reorientation of the landscape surrounding research on essentialist thinking and its development, opening new ways to think about how essences might be construed.

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Appendix A
Experiment 3 Norming Part 1: Saying what something's purpose is

The goal for the first part of our norming experiment was to determine whether there were purposes for some artifacts and animals that children tended to agree on.

Methods

Participants

We recruited 45 participants through Children Helping Science and Lookit who were between the ages of 4 and 6 and met our pre-registered inclusion criteria (*gender*: 25 female, 14 male, 3 no response/other; *language*: 30 English, 15 no response/other). Each age group included 15 participants. Participants were compensated $5 for their participation.

Materials

We created forty trials where 20 were artifacts and 20 were biological kinds. The full set of materials is shown in Figure A1

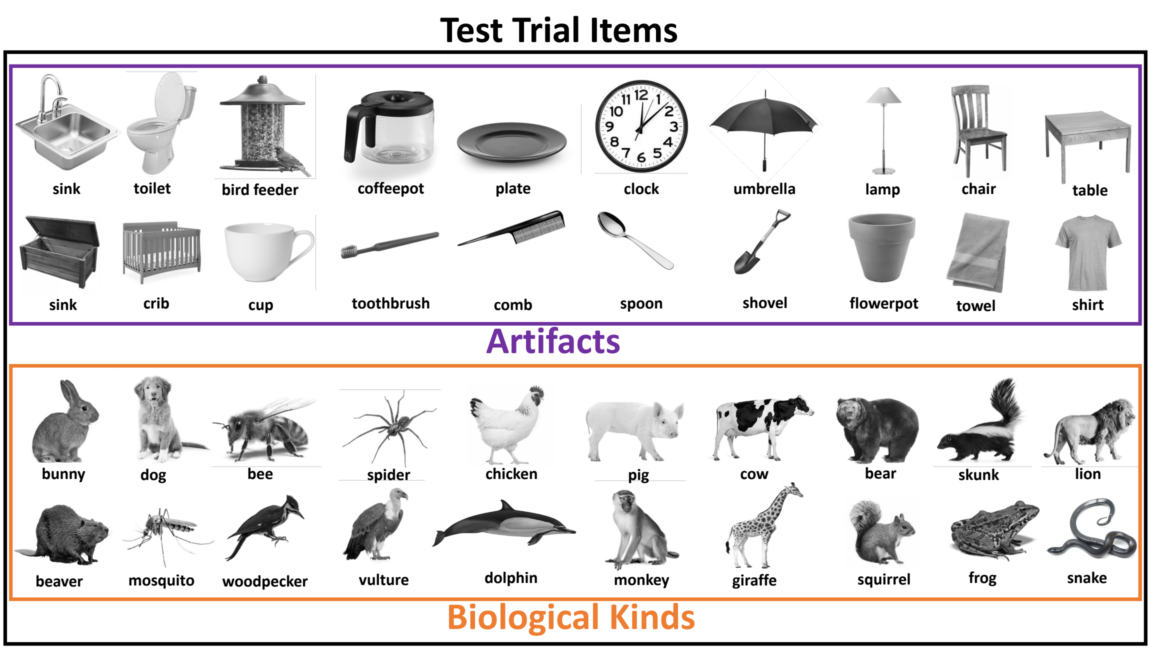

Figure A1

Norming Part 1 items*: All forty test items that children were asked what they are for. The top twenty (purple) are artifacts and the bottom twenty (orange) are biological kinds.*

Procedure

Participants were introduced to a puppet named Maggie, told that Maggie wants to learn what different things are for and that they would teach Maggie what different things are for. On each trial, participants were shown an object and told what it was (e.g., "See this? This is a sink."). Then they were asked whether they could tell Maggie what that object is for (e.g., "Can you tell Maggie what sinks are for?"). Children made their responses out loud.

Design

Participants were given all 40 items in a random order.

Results

Our pre-registration didn't include any hypotheses since we were only interested in identifying items that could be used in developing study materials. We computed the probability of each word produced for an item. Figure A2 shows the top items selected.

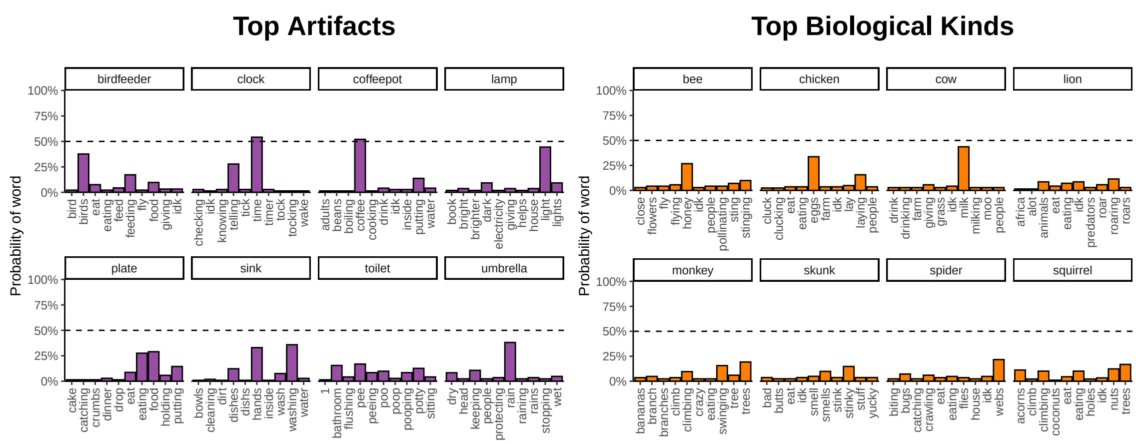

Figure A2

Norming Part 1 top items: *Top items for which children tended to converge on a purpose. The top eight artifacts are on the left (e.g., clocks tell time) and the top eight biological kinds are on the right (e.g., chickens lay eggs).*

Discussion

Having identified artifacts and biological kinds for which there is some convergence on what children say their purpose is, we now, as the second part of our norming study, use the purposes that children tended to mention in this study and ask whether children can identify which objects have these purposes.

Appendix B
Experiment 3 Norming Part 2: What has this purpose?

The goal for the second part of our norming experiment was to determine whether children could identify which objects had the purposes they attributed to them in the first part of our norming study.

Methods

Participants

We recruited 40 participants through Lookit who were between the ages of 4 and 5 and met our pre-registered inclusion criteria (*gender*: 21 female, 19 male; *language*: 39 English, 1 no response/other). Each age group included 20 participants. Participants were compensated $5 for their participation.

Materials

We created 28 trials that included 14 artifact pairs and 14 biological kind pairs. These pairs included all 16 items from part 1 of our norming as well as additional items used in that experiment. The full set of item pairs is shown in Figure B1

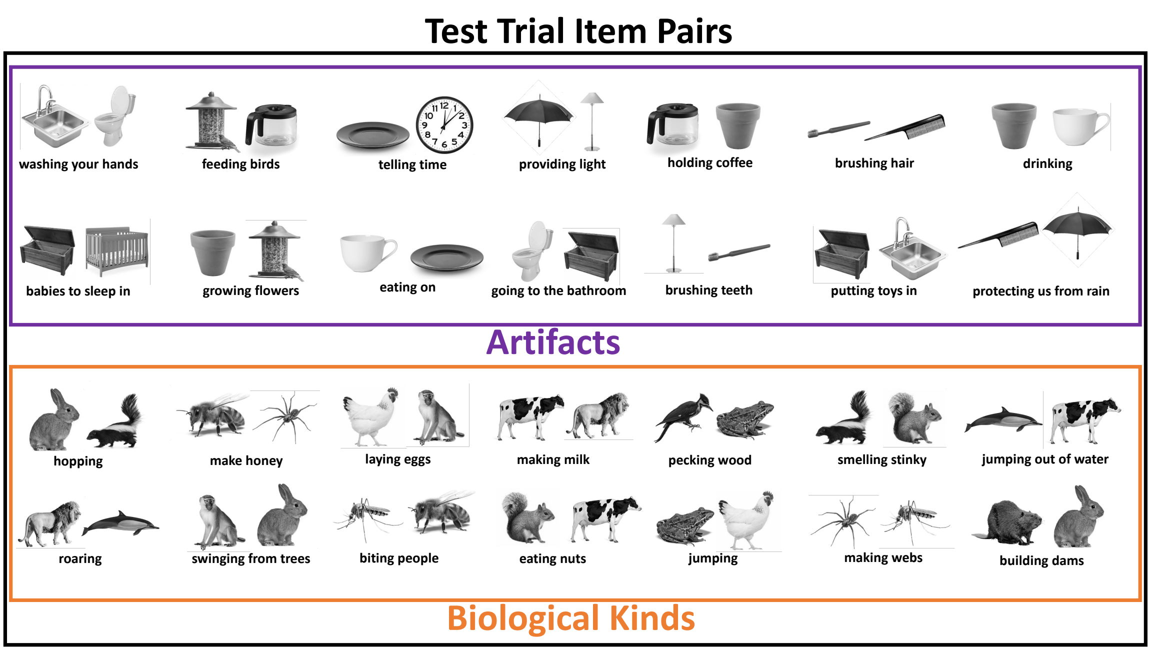

Figure B1

Norming Part 2 items: *Test trial item pairs with fourteen artifact pairs (e.g., a sink and toilet where the target purpose was washing hands) shown on top (purple) and fourteen biological kind pairs (e.g., a rabbit and skunk where the target purpose was hopping) shown on bottom (orange).*

Procedure

The procedure was similar to part 1 of our norming study. After being introduced to Maggie and told that they would teach her what different things are for, participants were then shown pairs of items. They were told what each item in the pair is (e.g., "See this? This is a sink. See this? This is a toilet"). Then they were asked which item in the pair is for some particular purpose (e.g., "Do you think sinks or toilets are for going to the bathroom?"). Responses were made out loud.

Design

The order of trials was randomized.

Results

Our pre-registration didn't include any hypotheses since we were only interested in identifying items that could be used in developing study materials. We computed the probability that the correct item was identified for a given purpose (see **??**).

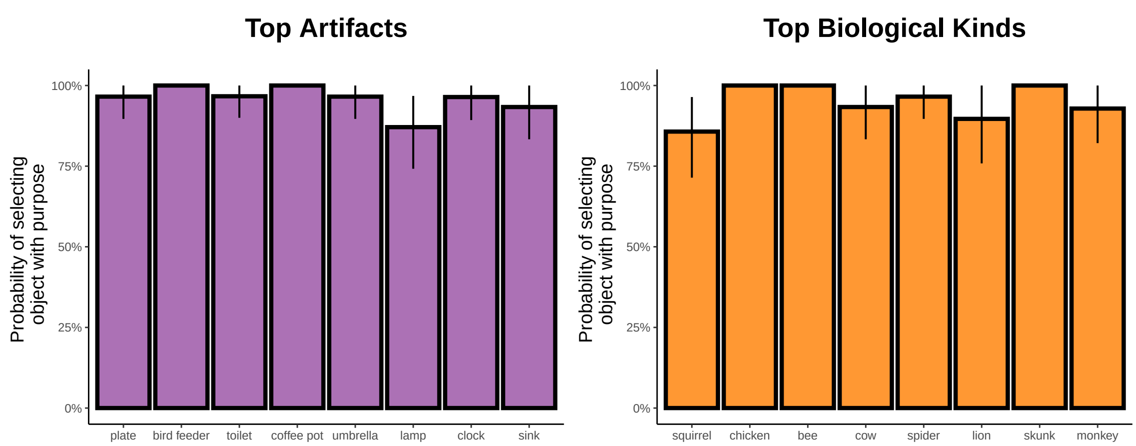

Figure B2

Norming Part 2 results*: Correct item selected when given a purpose and shown a pair of objects. Artifacts (purple) are shown on the left and biological kinds (orange) are shown on the right.*

Discussion

Children were overwhelmingly inclined to select the correct items when asked which of two had some particular purpose. Since they can identify which items have which purposes, we used these in our final experiment (Experiment 3) involving things transforming to look like other things.