

The impact of counter-perceptual testimony on children's categorization after a delay

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Abstract

When preschoolers are presented with a label for an entity that conflicts with its appearance, they sometimes rely on the new label rather than on the entity's appearance to categorize the entity and to infer its properties. We examined whether children's learning from such claims is short-lived or long lasting and whether the persistence of their learning depends on the degree of fit between that claim and the available perceptual evidence. Children aged 3- to 5-years ($n = 71$) were asked to categorize hybrids. These hybrids combined 75% of the features of one animal or object with 25% of the features from a different animal or object. After categorizing each hybrid, children heard an informant provide a contrary label. Immediately after they were provided this new label children often re-categorized the entities accordingly, especially when the label matched the hybrid's predominant features. Children's endorsement of the informant's label proved long-lasting when it matched the hybrid's predominant features, typically persisting even after five weeks. In contrast, children's endorsement often faded over time when the informant's label did not match the hybrid's predominant features. Overall, children were more skeptical of testimony that was more discrepant with the perceptual evidence available to them, and they were less likely to continue endorsing it after a delay. Findings have implications for our understanding of how children eventually come to represent and believe in counter-perceptual and counterintuitive concepts.

Key words: preschoolers; counter-testimony; memory

The impact of counter-perceptual testimony on children's categorization after a delay

Counterintuitive and counter-perceptual aspects of the biological and physical world are, by their nature, not readily apparent. Thus, when learning about these natural phenomena, children must rely on the testimony of others (Harris & Koenig, 2006; Lane & Harris, 2014). Indeed, testimony does appear to be an effective means of acquiring some of these concepts. In an influential set of studies, Gelman and Markman (1986; 1987) showed that when children are presented with a label for an animal that conflicts with several of the animal's physical features, preschoolers often rely on that label rather than on its appearance to assign the animal to a category and to make inductive inferences about its properties. However, children do not blindly trust what they are told; their endorsement of counter-perceptual testimony is moderated by the fit between the claim and the perceptual evidence that is available to them. Young children are more willing to defer to an informant's claim when it is supported by (at least) some perceptual evidence than when it completely conflicts with that evidence (Bernard, Harris, Terrier, & Clément, 2015). Yet, it is noteworthy that, even in cases when entities are clearly discrepant from the informant's label, some will at times endorse that label (e.g., Lane, Harris, Gelman, & Wellman, 2014).

Children's endorsement of counter-perceptual testimony appears to reflect belief-change, rather than compliance, because they will subsequently pass on counter-perceptual labels to a naïve experimenter (Jaswal, Lima, & Small, 2009). However, children's acceptance of counter-perceptual testimony has been examined only at brief delays. For example, in Jaswal et al. (2009), children were asked to teach a naïve experimenter only minutes after receiving an informant's testimony (see also, Chan & Tardif, 2013). Thus, we do not yet know whether such counter-perceptual testimony has

only an immediate impact or a long-term impact on children's categorization. The current study was designed to address this question, and to explore whether any long-term impact of such testimony depends on its fit with the perceptual evidence. Given that children have better recall for story details that are less rather than more counterintuitive (Banerjee, Haque, Spelke, 2013), we hypothesized that over time children would be more likely to continue endorsing testimony that was less rather than more discrepant with the visual evidence. This would partially explain why children's acquisition of counter-perceptual ideas and concepts is so difficult – even when children endorse such ideas and concepts immediately following instruction, their endorsement may be short-lived as they struggle to represent and encode the testimony into memory.

Thus, we asked two questions about the impact of the fit between the testimony and the visual evidence on children's categorization. First, we asked if children are more likely to immediately endorse counter-perceptual testimony that is mostly consistent rather than only moderately consistent with the perceptual evidence. Second, we asked if the *persistence* with which children endorse counter-perceptual testimony also depends on the fit between label and visual features.

To address these questions, we asked 3- to 5-year-olds to categorize hybrid pictures of animals and objects (e.g., Bernard et al., 2015; Jaswal, 2004; Jaswal & Markman, 2007). These hybrids take 75% of their visual features from one animal or object and 25% of their visual features from a different animal or object (Jaswal et al., 2009). Immediately following their initial categorization of the hybrid, an informant gives children testimony that runs counter to their initial judgment. Because children often choose to categorize these hybrids according to their predominant features, we can assess whether children are

more likely to defer to an informant if the informant's classification of the hybrid is mostly consistent with the hybrid's visual features (because the child initially selected the moderately consistent label) or only moderately consistent with the hybrid's visual features (because the child initially selected the mostly consistent label). By asking children to re-categorize the hybrids after a delay and varying the length of this delay between children, we can also answer our second research question: is the persistence of children's endorsement moderated by the fit between the testimony and the hybrid's visual features?

Although previous research has not examined the long-term impact of counter-perceptual testimony, prior work does indicate that informant characteristics moderate their encoding of testimony (Sabbagh & Shafman, 2009). As well, young children remember the characteristics of informants (e.g., their accuracy) after a delay and continue to use that information in deciding which informant to trust (e.g., Corriveau & Harris, 2009). Thus, it is possible that an informant's epistemic characteristics have both an immediate and a lingering effect on children's endorsement of claims made by that informant. Given this possibility, we presented children with two types of informants – a mother and a teacher. Each informant provided testimony about two object hybrids and two animal hybrids. We selected a teacher and a mother as informants because preschoolers understand teachers to be particularly knowledgeable (Cimpian & Markman, 2008; Ziv & Frye, 2004) and in some cases children endorse testimony from more knowledgeable experts over testimony from their own mother (Boseovski & Thurman, 2014). This design allowed us to explore whether preschoolers place greater trust in one of these two types of informants immediately after receiving testimony and also after a delay.

Method

Participants

Children ($n = 71$) were recruited from three preschools in Boston, USA (36 girls; $M_{age} = 4.81$ years, $Range = 3.48 - 5.94$). Parents reported having completed either: some high school (13%), high school (14%), some college (13%), college (22%), graduate school (34%), or did not report (4%). Children were described by their parents as either White (39%), Hispanic (38%), Black (7%), Asian (3%), or other (13%). The surveys were completed by the children's mothers (87%), fathers (6%), or unspecified caregivers (8%). Eight additional children were recruited but were not included in analyses because they did not complete the delayed testing session.

Procedure

Two iPads were placed in front of the child, each displaying a picture of one of the two informants in front of a blue background. The informants were both women in their mid- to late-thirties and wore similar clothing. The experimenter said: "I know these two women. This woman is a teacher. She teaches children the same age as you. This woman is a mom. She has a boy/girl the same age as you." Whether the teacher or the mother was introduced first and whether informant 1 or 2 was identified as the teacher or the mother was counterbalanced across children. Next, as memory checks, children were asked to point to the teacher and to the mother. All children passed these memory checks. Children were then told: "We're going to look at some animals and objects. Then, one of these two women will tell you about them. After that I will ask you some questions."

Children were shown four laminated hybrid-animal pictures and four laminated hybrid-object pictures, each 8.5 inches by 11 inches (Supplementary Online Material (SOM))

1). These hybrids, used in prior research, combine 75% of features of one animal or object with 25% of the features from a different animal or object (Bernard et al., 2015; Corriveau et al., 2009; Jaswal, 2004; Jaswal & Markman, 2007). For example, the cat-dog is composed of 75% cat features and 25% dog features. We conducted pilot testing with these hybrids to create two sets (detailed in SOM1). Each set was composed of two animals and two objects.

Before testing each child, the experimenter shuffled the eight pictures to randomize the order of their presentation. Children were shown each picture one at a time and told: “I am going to show you a picture, do you think this is a [75% label] or a [25% label]?” The order of the labels was counterbalanced across children. After children had categorized the hybrid by selecting a label, the experimenter told children, “Let’s ask the [teacher/mother]”, and played the video of the informant naming the hybrid. The informant always stated that the hybrid was a different entity from what the child believed. For example, if the child stated that the cat-dog was “a dog”, the informant in the video would say (holding the same picture of the cat-dog presented to the child): “This is a cat”. Conversely, if the child stated that the cat-dog was “a cat”, the informant in the video would say: “This is a dog.”

For each trial, children received testimony from only one informant. The mother provided information about 4 hybrids and the teacher provided information about 4 hybrids. For half the children within each age group, the teacher provided information about the hybrids in Set 1 and the mother provided information about the hybrids in Set 2 (see SOM1). The reverse was true for the other half of the children within each age group. Because the pictures were presented in a random order, the claims made by a given

informant were not blocked (i.e., the informant depended on which item was randomly selected for that set).

Following this testimony, children's receptivity to the informant's alternative categorization was assessed by asking them to make an inference about the hybrid. For example, for the cat-dog, children were asked: "Do you think this animal barks or meows?" Thus, children were asked to make an inference about the hybrid's characteristics – an inference they could base either on their initial categorization or on the subsequent counter-claim made by the informant (SOM1 includes the inference questions).

To assess whether the testimony that children received influenced their longer-term categorization of the hybrid, children were questioned again in a second test session. The experimenter shuffled the eight hybrid pictures before testing each child to randomize the order of their presentation. Children were shown each picture one at a time and told: "I am going to show you a picture, do you think this is a [75% label] or a [25% label]?" The order of the labels was counterbalanced across children. Children were not reminded that they had seen the pictures before but the experimenter was familiar to them from the initial test session. Children were retested between 4 and 44 days ($M = 22$ days, $SD = 14$ days; for a stem and leaf plot of this distribution see SOM2). In SOM6, we provide plots of our raw data along with detailed information about the number of data points included at each time point.

Results

We first examined whether children were more likely to accept the informant's counter testimony when it was mostly (i.e., 75%) consistent rather than only moderately (i.e., 25%) consistent with the perceptual evidence. We then turn to our second question of

whether children's continued endorsement of the informant's label was moderated by the fit between the testimony and the hybrid's features.

All analyses employed multi-level logistic regression, for two reasons. First, multi-level regression can account for the repeated-measures study design (i.e., children were asked about 8 items on two successive occasions). Second, logistic regression can model dichotomous data (in this case the use of one label over another) and is therefore the most appropriate statistical model. We used Stata 14's – xtlogit – command to conduct these analyses. Regression coefficients are displayed as Odds-Ratios.

Analyses of children's endorsement of the experimenter's counter-testimony in the first and delayed test session revealed no main effect of, or interactions with participant's Gender, Item Type (i.e., Animals vs. Object), Informant Type (i.e., Mother vs. Teacher) or participant's Age (calculated as days/365). Thus, analyses are reported without these covariates. Regression models with these variables included as controls are included in SOM. Post-hoc analyses are General Linear Hypothesis (GLH) tests.

Endorsement of counter-testimony in the first session

As expected, children initially categorized the majority of the hybrids, 5.37 items out of 8 items ($SD = 1.47$, $Range = 3$ to 8) or 67%, in terms of their predominant visual features. To assess whether children were more likely to defer to the informant's subsequent counter testimony when making category-based inferences if that testimony was mostly (i.e., 75%) consistent rather than only moderately (i.e., 25%) consistent with the perceptual evidence, we coded children's inferences in terms of how often they reflected deference to the label provided by the informant. Thus, children received 1 point

for each inference that was consistent with the informant's label (rather than their own initial categorization).

Children deferred 67% of the time when the informant's label did not match most of the hybrid's visible features and 77% when it did, a marginally significant difference, $OR = .63$, $z = 1.80$, $p = .07$, 95%CI [.38, 1.04] (see SOM3 for full regression table). Thus, children frequently deferred to the informant's label rather than sticking to their initial categorization but they were somewhat less likely to do so when that label clashed with most of the hybrid's features.

Endorsement of counter-testimony in the second (delayed) session

To assess the longer-term influence of the informants' counter-testimony on children's categorization of the hybrids, we coded whether children used the informant's label rather than their initial categorization when they were retested. We present two sets of analyses. In one set, we explore children's use of the informant's label after a delay if the informant's label (rather than the child's label) had been mostly consistent with the hybrid's predominant perceptual features. In the second set, we examined children's use the informant's label after a delay if the informant's label (rather than the child's label) had been mostly *inconsistent* with the hybrid's predominant perceptual features.

In both analyses, we assessed the probability that children used the informant's label (rather than their own initial label) as a function of whether they had either endorsed or rejected the informant's label immediately after first hearing that label. This allowed us to test whether children who initially endorsed the informant's label were significantly more likely to continue using it than children who did not initially endorse it.

When the informant's label was consistent with most of the hybrid's visible features, children who had initially endorsed that label were likely to continue doing so. In addition, children who had not initially endorsed that label remained *unlikely* to do so. Figure 1 illustrates this stable pattern of responding over delay time.

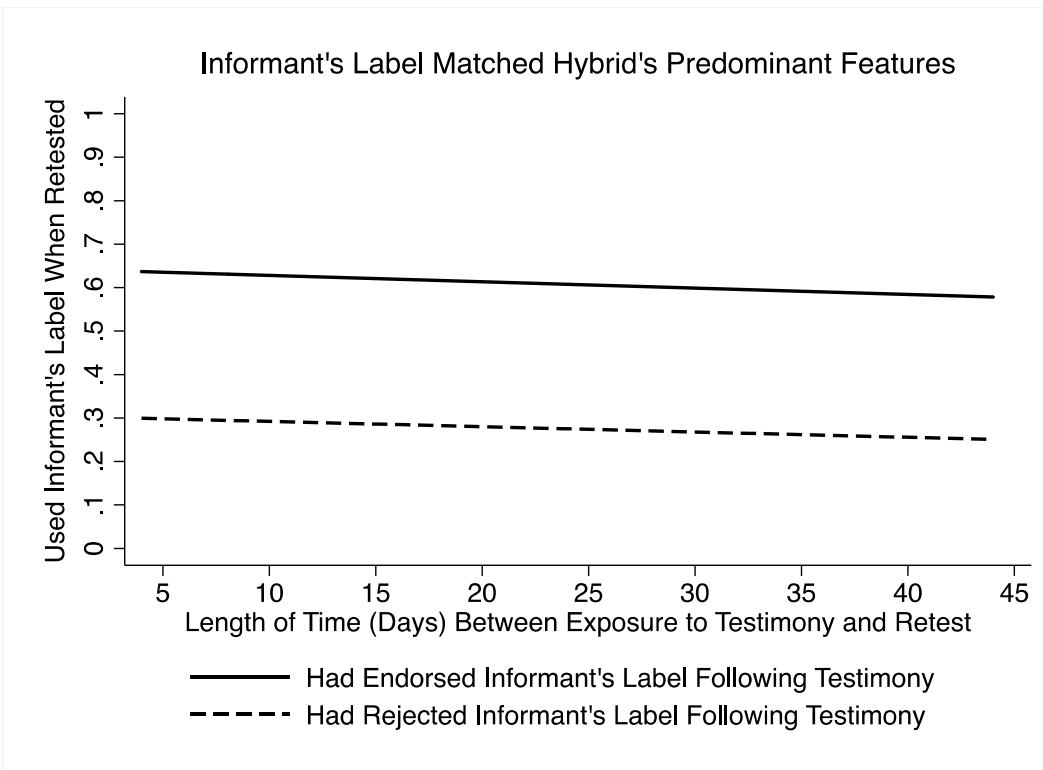


Figure 1. Probability that children used the informant's label to categorize the hybrid at varying delay lengths, as a function of whether they had initially endorsed or rejected that label.

If children had initially endorsed the informant's label rather than rejected it, they were 4.1 times more likely to continue endorsing that label during the delayed session, $OR = 4.10$, $z = 3.57$, $p < .001$, 95%CI [1.89, 8.90] (see SOM4 for full regression table). As is clear in Figure 1, children's level of endorsement remained constant no matter how many

days had elapsed between the first and the delayed session, $OR = .99$, $z = .51$, $p = .61$, and there was no interaction between the delay time and whether children had initially endorsed or rejected the informants' testimony, $OR = 1.00$, $z = .01$, $p = .99$.

A different pattern emerged when the informant's label was inconsistent with most of the hybrid's features. When children had initially endorsed that label, they were likely to continue doing so at shorter delays, but less likely to do so over time. In contrast, when children initially rejected the label, they were unlikely to endorse it at all delay intervals.

Figure 2 illustrates this interaction.

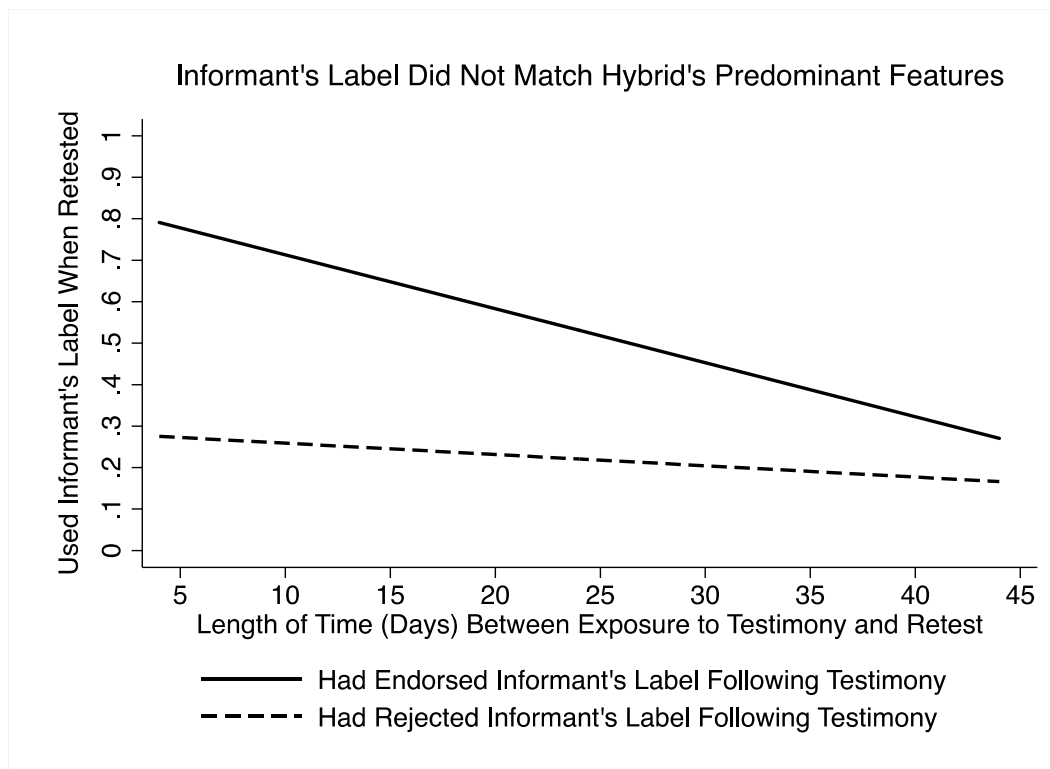


Figure 2. Probability that children used the informant's label to categorize the hybrid at varying delay lengths, as a function of whether they had initially endorsed or rejected that label.

Regression analyses confirmed the presence of a significant interaction between children's initial endorsement or rejection of the informant's testimony and the number days between tests, $OR = .96$, $z = 1.83$, $p = .07$, 95%CI [.92, 1.00] (see SOM5 for full regression table). When children had endorsed the informant's label, they often used that label at retest after a shorter delay, but were significantly less likely to do so after a longer delay, $OR = 2.34$, $z = 3.92$, $p < .001$, 95%CI [1.17, 3.50]. By contrast, when children had rejected the informant's label immediately after hearing it, they rarely endorsed the informant's label at retest both after a shorter and after a longer delay, $OR = .98$, $z = .82$, $p = .41$. More specifically, if children had endorsed rather than rejected the informant's label immediately after hearing it, the probability that they used that label *one* week later was 48 percentage points higher (75% vs. 27%) – a highly significant difference, GLH test, $\chi^2 = 18.36$, $p < .001$; by contrast, the probability that they used that label *five* weeks later was only 19 percentage points higher (38% vs. 19%) – a much less significant difference, GLH test, $\chi^2 = 6.26$, $p = .01$.

In sum, children's continued endorsement of the informant's label was moderated by the fit between that label and the hybrid's visual features. Children's endorsement of an informant's label that was mostly consistent with the visual evidence was particularly robust; it did not fade with time. In contrast, children's endorsement of an informant's label that was less consistent with the visual evidence faded over time.

Discussion

We examined whether children's learning from an informant's counter-perceptual claim is short-lived or long lasting and whether the persistence of their learning depends on the degree of fit between that claim and the available perceptual evidence. Following

their own categorization, children frequently deferred to the informant's alternative claim, although they were less likely to do so when that alternative claim clashed with most of the stimuli's visible features, a finding that is consistent with prior research (e.g., Bernard et al. 2015). Children's endorsement of the informant's claim was relatively stable over time when that claim was mostly consistent with the perceptual evidence. However, when it was only modestly consistent with the perceptual evidence, children's endorsement of the informants' label faded over time. Nonetheless, even after 5 weeks there was still a difference in children's endorsement of the informant's label if children had initially endorsed rather than rejected that label, suggesting that the counter-perceptual testimony was still exerting an influence on children's beliefs (albeit a small one).

An important implication of this study is that, in some cases a single exposure to counter-perceptual testimony from an adult is enough to shift some children's beliefs over a month-long period. This extends prior work in two ways. First, it demonstrates that children's endorsement of counter-intuitive testimony may reflect sustained rather than temporary belief change (Chan & Tardif, 2013; Jaswal, et al., 2009). Second, it reveals that the fit between testimony and perceptual evidence not only influences children's initial acceptance of testimony but also their *continued* acceptance of it. In other words, the findings demonstrate that the inherent difficulty of representing counter-perceptual claims not only influences children's willingness to accept such claims but also their ability to encode such claims into memory. This helps to explain why the acquisition of counter-perceptual concepts and ideas is a protracted process (Lane & Harris, 2014) – children's initial acceptance of such ideas does not necessarily lead to stable long-term representations in memory. An important methodological implication of these findings is

that researchers should consider assessing the longer-term impact of testimony on children's beliefs; indeed, children may revert to their initial beliefs after a delay.

One objection to our claim that the counter-testimony had a lasting influence is that the experimenter was the same for both testing sessions. It could be argued that children at the delayed test simply responded with what they thought the experimenter wanted to hear or that children simply learned that the counter-intuitive labels should be used in the presence of the experimenter. However, this seems unlikely for two reasons. First, the experimenter never gave feedback to the children and the experimenter was not the one who had provided children with the testimony. It is therefore unlikely that children would infer that the experimenter preferred one label or another. Second, the long-term effect of the testimony differed depending on whether children had initially endorsed or rejected it and also on whether the informant's claim had been consistent or inconsistent with the majority of the hybrid's perceptual features. If children were making categorization decisions only to please the experimenter, it is unlikely that they would exhibit this response pattern.

It is important to emphasize that children were provided with testimony that was only *partially* counter-perceptual. Thus, at a minimum the testimony was consistent with a minority of the stimuli's perceptual features. It remains to be seen how long-lasting children's beliefs would be following more dramatically counter-perceptual testimony, for example, when informed that an object belongs to a category that is completely different from the one that it appears to belong to (e.g., Lane, et al. , 2014).

We found no difference in children's initial and delayed endorsement of the counter-testimony as a function of informant type (i.e., mother vs. teacher). This suggests that

preschoolers perceive mothers and teachers to be equally trustworthy when faced with these entities and labels. Future research should directly assess children's attribution of knowledge to mothers and teachers to confirm this interpretation. Moreover, additional research on children's recall of counter-testimony should be conducted using informants who differ more dramatically in their expertise.

In conclusion, we found that young children tend to initially endorse an informant's labels for novel entities, even when those labels conflict with their own prior categorization. However, the long-term impact of such conflicting testimony depends on its fit with the available perceptual evidence. If the label is consistent with most of that evidence, children continue to endorse it – even after several weeks – with the same probability. However, if the label is inconsistent with most of the visible evidence, its impact on children's belief weakens substantially over time.

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