Three-year-old Children's Use of Category Labels and Motion in Drawing Inferences about Animal Kinds

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Abstract

Linguistic labels, information about category memberships, have been found to be more important than perceptual information in guiding young children's inferences about animal kinds. However, perceptual information of static shape cues has often been stressed. A recent study has shown that young children tended to use dynamic perceptual cues, such as motion, more often than static shape cues to make categorical judgments. The overriding effects of linguistic labels over perceptual information in young children's inferences need to be re-examined. This paper was an attempt to examine how 3-year-old children use category labels and motion cues to draw inferences about animal kinds. Data showed that preschool children tended to use motion more often than labels when confronted with a choice between labels and motion. This provides support for our view that the role of category labels in young children's categorical judgments is not as important as what has been suggested in previous studies.

Introduction

The Importance of Category Labels

The importance of linguistic information in preschool children's inductive inferences about animal kinds has well been demonstrated in a series of studies by Gelman and her colleagues (e.g., Gelman & Markman, 1986, 1987; Gelman & Coley, 1990). In their studies, the extent to which children use category labels and perceptual appearance was examined. For instance, 2½ years old children were found to be more likely to assign a property, e.g., "lives in a nest", from a bluebird to an atypical bird, dodo, which looked different from the target but shared the same label "bird" than to a dinosaur which looked similar to the bluebird but carried a different label "dinosaur" (Gelman and Coley, 1990). However, when the stimuli were not labeled, they tended to draw inferences based more on perceptual similarity than on the similarity of verbal labels. The young children were able to go beyond perceptual appearance and use linguistic labels to draw inferences, suggesting that linguistic information is more powerful than perceptual information for preschoolers to draw accurate categorical judgments. As Gelman and Coley (1990) stated that for young children "language conveys important information beyond that which meets the eye" (p.804).

Despite of this, the role of category labels remains to be determined as perceptual characteristics have generally been taken as static perceptual cues in Gelman et al.'s studies. Perceptual cues should also include dynamic properties, such as motion.

The Importance of Motion Information

In a recent study by Mak and Vera (1999), 4 and 7-year-old children have been found to categorize animals based more on motion similarity than on static shape similarity. For instance, they were more likely to categorize, for example, a donkey with an antelope than with a horse when the antelope and the donkey were shown to jump in the same manner even thought the donkey looked more similar to the horse than to the antelope. The children tended to infer that the donkey shared the same property of "having poor vision" that was ascribed to the antelope rather than the property of "having good vision" ascribed to the horse. The role of motion information has been stressed.

As such, this paper tried to look further into the role of category labels and include motion information to study young children's inductive inferences about animal kinds. We will argue that the effectiveness of verbal labels is not as important as Gelman et al. have suggested.

Effectiveness of Category Labels?

Doubts have been raised about the significance of verbal labels in guiding children's categorical judgments. Although Gelman and Coley's (1990) studies found that young children were ready to draw inferences about animals based more on label similarity than on static shape similarity, their use of linguistic information seems to rely on the correspondence between the label and the perceptual information of the animal stimuli. If children find the labels are not congruent with the animal stimuli, they would not use the linguistic information. They would do so only when they believe that the labels and the stimuli match with one another. This has been illustrated in some of Gelman et al.'s studies.

For instance, Davidson and Gelman (1990) found that young children did not use familiar verbal labels to draw inferences about novel animal categories. In this study, 4- and 5-year-old children were tested with some imaginary animals; in one of the experimental conditions, familiar category labels (e.g., "cow" and "deer") were used. Results, which were different from those in Gelman and Coley's (1990) study, showed the preschool children tended not to draw inferences based more on label similarity than on perceptual similarity. This might be due to the fact that the children did not find the labels "cow" and "deer" congruent with the imaginary stimuli and therefore did not make judgments based on the labels.

Even when novel linguistic labels (e.g., "zav" and "traw") were used, the children did not use the novel labels and were more likely to use labels than perceptual appearance to draw inferences. The children, in this instance, might not to be able to relate the novel labels to the imaginary animals; confronted with a choice between perceptual and linguistic information, they opted for static perceptual cues.

Therefore, if children find that the familiar labels and the animal stimuli do not match with one another, they would not use category labels. Only when children believe that the labels go well with the stimuli do they begin to find the linguistic information useful. Here are some more examples.

In Gelman and Markman's (1987) study, familiar animal categories (e.g., "cat" and "skunk") were used. Three- and 4-year-old children were found to be more likely to assign a property, "can see in the dark", from a target cat to another cat (which was shown in different coloring and posture) than to a skunk (which looked similar to the target cat) when the animal stimuli were labeled accordingly. However, the children also succeeded in doing so even when verbal labels were not provided. A follow-up study showed that children were able to determine the categorical memberships of the stimuli perceptually when the stimuli were not labeled. The animal stimuli seemed to be too familiar to the young children that they could make use of the subtle perceptual cues to draw accurate inferences and did not need to rely on the linguistic information (Gelman & Markman, 1987). Gelman and Markman (1987) unexpectedly found that familiar linguistic labels could not help the 3- and 4-year-olds. Only when 2½-year-old children were tested did they begin to find that verbal labes could help young children to draw inferences about familiar animals (e.g., "bird" and "dinosaur"). This may be due to the fact that the 2½ year-olds were somewhat but not completely familiar with the animal stimuli. They were not able to use the subtle perceptual cues to determine the category memberships of the stimuli and needed to rely on the category labels provided to draw accurate inferences.

This may also be true in the 3- and 4-year-olds in Gelman and Markman's (1986) study who were found to be guided by the similarity and dissimilarity of linguistic labels in drawing inferences about familiar animals (e.g., "bat", "bird", "dolphin", "fish"). In the experiment, young children were shown, for example, a "bird" set which included two target animals, a flamingo and a bat (which looked very different from one another, and a test animals), a blackbird (which looked more like the bat than the flamingo). In the conflict condition where the flamingo and the blackbird were labeled a "bird" and the bat a "bat", the children were more likely to categorize the blackbird with the flamingo than with the bat even though the blackbird looked more similar to the bat than to the flamingo. However, in the no-conflict condition where the bat and the blackbird were labeled a "bat" and the flamingo a "bird", the children tended to categorize the blackbird and the bat together. In other words, the children tended to make categorical judgments based more on linguistic similarity than on perceptual similarity. They were more likely to categorize the blackbird and the flamingo together when they shared the same label "bird" than when the blackbird was labeled a "bat" instead of a "bird", suggesting that the young children were not so familiar with the animal categories, birds and bats, that they were willing to accept the names, "bird" and "bat", to be used to label the blackbird. If the stimuli were completely familiar to them, they would not have been guided by the similarity and dissimilarity of verbal labels, like the 4 and 5-year-olds in Gelman and Markman's (1987) later study.

To summarize, the effectiveness of familiar linguistic labels in guiding young children's inferences is rather limited, which relies on two major factors – whether children find the familiar linguistic labels and the perceptual information of the animal stimuli match with one another and their familiarity with the stimuli. Only when children believe that the linguistic labels are not in conflict with the stimuli and they are somewhat but not completely familiar with the stimuli does the linguistic information become useful. Otherwise, linguistic labels cannot help children to draw accurate

Table 1

Animation items, category labels and target properties used.

Pair	Test displays			Target displays			
	Animal	Motion	Label	Animal	Motion Same/Different	Label Same/Different	Property
1	Horse	Walk	"Horse"	Donkey	Walk/Jump	"Horse"/ "Donkey"	Good vision
2	Quail	Walk	"Quail"	Sparrow	Walk/Hop	"Quail"/ "Sparrow"	Good hearing

inferences. The effectiveness of linguistic labels in guiding children's inferences is not as significant as Gelman et al. have proposed.

The Present Study

In view of the above, it seems to be reasonable to believe that perceptual information, including both static and motion cues, may not be relatively unimportant in comparison to familiar verbal labels. It is evident that young children not only rely on linguistic labels but also use perceptual characteristics to draw inferences about animal kinds. In this paper, we would like to like to examine to what extent young children use familiar linguistic labels and motion cues to draw inferences.

It is postulated that young children, such as 3-year-old children (who have been found to be ready to draw inferences based on the similarity and dissimilarity of familiar linguistic labels), would use both verbal labels and motion cues to draw inferences about animals. However, when confronted with a choice between labels and motion, they would tend to use motion information more often than linguistic information.

Method

Design

To examine the extent to which 3-year-olds use familiar linguistic labels and motion cues to draw inferences about animal kinds, an inductive methodology used in previous studies (Gelman & Markman, 1986, 1987; Gelman & Coley, 1990; Mak & Vera, 1999) was adopted. Here, young children were required to consider a pair of animals, a target and a test. They were taught a new property about the target animal and were asked whether the target property was true for the test animal.

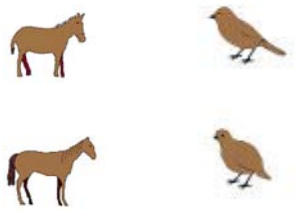
The independent variable was three *motion/label* conditions: *label and motion*, *label only* and *motion only*. The dependent measure was children's responses on the inference questions: whether they would generalize the target properties to the test animals.

Participants

Two hundred and twenty 3-year-old children from three kindergartens in Hong Kong participated: 110 girls and 110 boys, ranging in age from 3 years to 3 years 11 months with a mean age of 3 years 7 months.

Stimuli

There were two pairs of animal stimuli: (1) a donkey and a horse, and (2) a sparrow and a quail. Each pair consisted of animals with similar appearance and two series of animations: same and different movement. The movement of the animals in the animations was slightly slower than the corresponding real motion, but they all moved in the same speed. Also, all the stimuli were drawn in the same brown color with black outline. The drawings of the animal stimuli used for the animations are shown in Fig. 1, and the details of the animation items are shown in Table 1.



Pair 1 Pair 2

Figure 1
The drawings of animal stimuli used for the animation items.

Control Studies

Property Controls

Some control studies were run to make certain if 3-year-old children have any biases in assigning the target properties to the test animals which were shown to be static or with certain movement and linguistic labels. In these controls, children were shown the test animals alone (i.e., the horse and the quail) one at a time and were asked if the target properties (i.e., "good vision" and "good hearing") were true for the horse and the quail respectively. Results are summarized in Table 2.

Table 2
Percentages of "yes" responses for 3-year-old children in the Property Controls.

Control Condition	Percentage
Static	52.5
Label only	57.5
Motion only	52.5
Label and Motion	55

n=20 (half boys and half girls)

Data showed that 3-year-olds performed at about chance level in saying that the target properties were true for the test animals, showing no biases in giving "yes" responses to the test animals.

Static Controls

Two animals of similar appearance were adopted. To confirm if young children were ready to draw inferences based on the static perceptual similarity of the animal stimuli, a static control study was also conducted. In this control, 3-year-old children (10 boys and 10 girls) were presented with two sets of animals but one set at a time without motion. Children were tested to see if they would generalize the target properties to the test animals based on static shape information alone. Data showed that the young children were willing to do so 85% of the time, which was significantly above chance level, $p<.0005$ (1-tailed), suggesting that 3-year-olds were ready to draw inferences based on the static shape similarity of the animal stimuli.

Procedure

This was a between-subject design, so that a child (e.g., being assigned to the *Same-Label and Different-Movement* condition) was tested with two pairs of animals. One was the *donkey/horse* pair; both were labeled a "horse" but were shown to move in different manners (i.e., the donkey jumped and the horse walked). The other one was the *sparrow/quail* pair; both shared the same name "quail" but were shown to move differently (i.e., the sparrow hoped and the quail walked). The presentation order of the two pairs was counterbalanced across participants. Each child was tested individually. Throughout the experiment, instructions were given in Cantonese, the major Chinese dialect used in Hong Kong. Each child was tested individually

Children were shown two pairs of animals, one pair at a time. They were first taught a new property about the target animal in each pair and were then asked to infer whether the target property applied to the test animal. The animal stimuli were labeled according to the label conditions. Taking the *donkey/horse* pair in the *Same (Different) Label* conditions as an example, the experimenters first pointed to the donkey and said, "See this *horse* (*donkey*). This *horse* (*donkey*) has *good vision*; it can see things clearly at a great distance." The experimenter then pointed to the horse and said, "See this *horse* (*horse*). Does this *horse* (*horse*) have *good vision*, like this *horse* (*donkey*) (referring to the donkey) that can see things clearly at a great distance? Or, this *horse* (*horse*), unlike this *horse* (*donkey*), does not have *good vision*?"

At the end of the experiment, children in the *Same Label* groups, who were given somewhat misleading labels for the target animals, were shown the stimuli again and were told that the experimenters had made a mistake in saying that the donkey (sparrow) was a *horse* (*quail*). The experimenters further explained to the children that its proper name should be *donkey* (*sparrow*) instead of *horse* (*quail*).

Results

Children's responses on the inference questions were coded as 1 when they said "yes" (i.e., generalizing the target properties to the test animals) and 0 when they said "no" (i.e., not generalizing the target properties to the test animals). These scores were summed within participants, and the score for each participant ranged form 0 to 2. For each condition, a one-sample *t*-test was conducted to examine if children performed significantly above or below 50% chance level. Results are summarized in Table 3.

Motion only condition

Data in these conditions clearly show that 3-year-old children were ready to draw inferences about the animal stimuli based on the similarity and dissimilarity of the motion information. When two animals with similar appearance were shown to move in the same manner, the young children tended to infer that the test animals shared the same property ascribed to the target animals (87.5% of the time, significantly above chance level); when the two animals moved differently, the children tended not to do so (20% of the time, significantly below chance).

Table 3
Percentages of "yes" responses for 3-year-old children in *Label only*, *Motion only* and *Label and Motion* conditions.

Condition		Percentage	
Motion only	Same	87.5	***
	Different	20	++
Label only	Same	90	***
	Different	15	+++
Label and Motion	Same Label/Different Motion	10	+++
	Different Label/Same Motion	82.5	***

n=20 (half boys and half girls)
*** above chance, $P<.0005$, one-tailed
+++ below chance, $P<.0005$, one-tailed

++ below chance, $P<.005$, one-tailed

Label only condition

Three-year-old children were also found to draw inferences based on the similarity and dissimilarity of the linguistic labels provided in the experiment. When two animals with similar appearance shared the same name, the 3-year-olds tended to agree that the target properties were also true for the test animals (90% of the time, significantly above chance). The children did not do so (15% of the time, significantly below chance) when the two animals were labeled with different names.

Label and Motion condition

In these conditions, label similarity and motion similarity were in contrast with one another. Results indicate that the 3-year-olds were more likely to draw inferences about the animal stimuli based on motion information than on linguistic information. When two animals moved in the same manner, the children tended to draw inferences 82.5% of the time (significantly above 50% chance level) even though the stimuli were labeled with different names; when two animals moved in different manners, they tended to draw inferences 20% of the time (significantly below chance) although the animal stimuli shared the same name.

In order to have a clearer picture of how children changed their choices between linguistic and motion information, 3-year-old children's responses in *Label only* and *Label and Motion* conditions are shown in Figure 2.

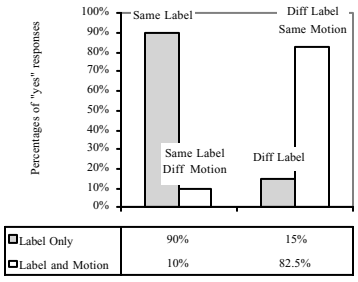


Figure 2
Percentages of "yes" responses for 3-year-old children in *Label only* and *Label and Motion* conditions.

This figure shows that 3-year-olds tended to shift their choices from linguistic labels to motion when contrasting motion information was introduced in addition to the linguistic information. Children drew inferences 90% of the time from a target to a test animal when two animal stimuli shared the same name in the *Label only* condition, whereas they made inferences only 10% of the time when additional different movement patterns were introduced to the stimuli in the *Label and Motion* condition. Moreover, children drew inferences 15% of the time when two stimuli were labeled with different names in the *Label only* condition, while they gave "yes" responses 82.5% of the time when the stimuli were shown to move in the same manner even though they were labeled with different names in the *Label and Motion* condition.

However, 3-year-olds did not change much about their choice of motion information when additional contrasting label information was introduced. Children's responses in *Motion only* and *Label and Motion* conditions are shown in Figure 3.

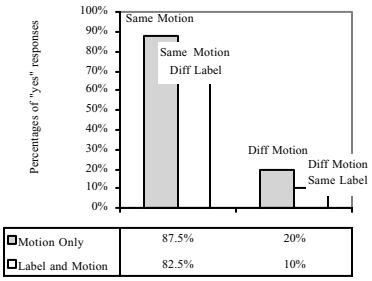


Figure 3
Percentages of "yes" responses for 3-year-old children in *Motion only* and *Label and Motion* conditions

This figure shows that children drew inferences 87.5% of the time when two animals moved in the same manner in the *Motion only* condition and did likewise 82.5% of the time even when different labels were ascribed to the stimuli in the *Label and Motion* condition. Moreover, when two animals moved in different manners in the *Motion only* condition, children made inferences only 20% of the time, and they drew inference 10% of the time even though the same label was ascribed to the stimuli in the *Label and Motion* condition.

Discussion

The current findings provide support for our hypothesis that linguistic information may not be relatively more important than perceptual information, including both static and dynamic characteristics, in guiding young children's inferences about animal kinds. Data show that 3-year-old children were ready to use both category labels and motion information to draw inferences. However, having to make a choice between labels and motion, children tended to use motion more often than familiar category labels.

Also, this seems to provide support our view that the effectiveness of category labels in guiding young children's inferences about animals may be rather limited. The importance of linguistic labels that has been suggested by previous studies need to be re-thought.

Although to what extent children use category labels and motion was compared in this study, we are not suggesting that linguistic and perceptual information play distinct roles in young children's inferences (for this argument, see also Gelman & Medin, 1993; Jones & Smith, 1993). Evidence has shown that children use both linguistic and perceptual (including static and dynamic) information to draw inferences. However, how static shape cues, motion and linguistic labels interact to guide children's inferences remains to be determined in future studies.

Acknowledgments

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