PRESCHOOLERS' ABILITY TO CLASSIFY PAIRS OF PHOTOGRAPHS OF ANIMATE AND INANIMATE ANIMALS THAT ARE THE SAME OR DIFFERENT KIND

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ABSTRACT OF THE THESIS

Preschoolers' ability to classify pairs of photographs of animate and inanimate animals that are the same or different kind

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Brenneman, Zuza and Gelman (unpublished,2003) demonstrated that 3- and 4-year-old children could classify pairs of photographs of real and fabricated copies of animate objects into the correct animate and inanimate category. In their experiment, each pair consisted of photographs of a real and an artificial version of the same animal (i.e., a real and an artificial dog, a real and an artificial rabbit, etc). Here we label this Control condition. In the present follow-up Experimental condition, we sample stimuli from the Control study, but decreased the surface similarity of the pairs. To do this we assigned photo of real animal with randomly selected fake animal pictures. As a result, no pair of real-fake animal photos looked alike. Fifteen 3-year-old and fifteen 4-year-old children participated in the present study and results from the previous experiment was used as a Control comparison condition. Results showed that there was no significant difference between the present experiment and the previous experiment for both age groups (p=0.208). Still, inspection of the distributions of the 3- year-old children's performance, there was a tendency that the context of similarity facilitates three year old children's biological categorization.

Acknowledgment

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When 3- to 5-year-old children were shown familiar animals, statues, wheeled objects and rigid complex objects, they reliably indicated which ones can go up and down a hill by itself or needs help (Massey & Gelman, 1988). Although the children did not say much when asked to explain their answer, their results were very informative. They said that a statue did not have a "real" feet and was "just a furniture animal", or that an echidna had feet, even if they were not showing in the photograph, children can reason that it had feet and just sit on it. The study showed that 3-year-old to 5-year-old children can pay attention to the relevant surface feature cues for self-motion in the picture of objects to tell the animate items from inanimate items.

Other studies add weight to this conclusion. Three-year through 5-year-old old children can discriminate very similar looking pictures of a real animal and a fabricated version of that animal (Brenneman, Zuza and Gelman, 2003, Unpublished). Their subjects were shown pairs of pictures of very similar looking items, and told that one was a picture of a real animal which was taken at a zoo, and the other of a fabricated animal whose picture was taken at a store. To elicit an animate-inanimate frame of reference, children were told that the animals in the zoo can eat or drink and can move by themselves and the animals in the store cannot do these things and cannot move by themselves. And then, the experimenter said that she mistakenly dropped the pictures on the floor and asked the child to help her pick up and sort the pictures into the corresponding book. Results showed that children could also correctly sort the animate and inanimate pictures into the correct category. These results confirm the conclusion of Massey et al's (1988) study.

In the control condition, most pairs of photos contained the same kinds of part: all dogs had legs and eyes and all birds had eyes and wings. This probably reduces the usefulness for children to rely on the featured cues like legs, eyes and feet because they were the same kind animals (Brenneman et al., 2003). In this case, it is possible that this renders the substances of the photographed objects more salient for comparison. The textures of the real animal look more realistic than that of the fake animal pictures. And children need to have the knowledge of what substance to distinguish the pictures.

In the current dissimilar-surface condition, we explore another way to vary the context of surface similarity and its effect on children's classification of animate and inanimate pictures. We used the Brenneman et al's stimuli (2003) as a comparison condition but altered the task. Children were shown pairs of photos with low surface similarity where a living and nonliving item are randomly paired e.g., (real dog vs fake duck). Compared to the similar-surface condition, except for the continued differences of the textures between two items, this increases the differences of the featured cues. For example, when a photograph of a real bird was paired with a photo of a fake rhino, the fake rhino has feet which a real bird does not, and the real bird had tail and fake rhino does not. Children had different kinds of featured cues to decide which is animacy and which is not animacy. However, it was undetermined that adding extra cues to the comparison will make it easier or more difficult.

Work done by Gentner and Markman (1994) was related to the studies covered above. They showed adults different kinds of pairs of pictures, one kind is high-similarity pairs and one kind is low-similarity pairs, and asked subjects to list as many differences as possible in a limited amount of time. They found that it was not that the more dissimilar they were, the easier to list the differences. It was easier for adults to list more alignable differences for the similar pairs than the dissimilar pairs. Alignable differences mean that differences are related to commonalities (Gentner & Markman, 1994), and the differences are corresponded in the same spatial position in the two pictures.

In the Brenneman et al's study, the similar pairs have alignable differences (for example, both real and fake dogs have tails), and tails are the commonality between the two pictures, but one is made out of biological stuff and one is not, and this difference would not be considered as alignable difference. And when comparing two things which have an aligned structure, the alignable difference between them will pop out and attract subject's attention (Sagi, Gentner & Lovett, 2012). According to the structure alignment theory (Gentner & Markman, 1994; Markman & Gentner, 1996), we reasoned as that the similar pairs highlights the alignable differences and also provide a reference which can help children to compare the textures made of the objects in the pictures and categorize them into the correct category. When looking at one picture alone, sometimes it's difficult to judge if it's made of biological substance or not. But if there are two pictures, you can refer to another aligned picture and compare, it can become easier for children to decide which is the animate object and which is the inanimate object.

In the current study, the dissimilar pairs have nonalignable differences, which mean that the differences are not related to the commonalities (Gentner & Markman, 1994). In the two pictures, the spatial elements do not correspond to each other and they do not share the same perceived common structure (Markman & Gentner, 1996). For example, a fake duck has feet, but a real butterfly does not. We assumed as that the dissimilar pairs provide a less strong reference for children to compare and contrast the differences between the two objects' textures in the pictures. And it could be more difficult for children to judge which is animate and which is inanimate without the proper reference.

However, when we say two items look very similar, it can mean that two item's shape was similar, two item's color was similar or two item's features were similar, etc. Therefore, what similarity means in the present study shifts. Two items might share the similar color or similar shape. Our assumptions that surface-similarity condition will be easier for the children were based on the idea that children have an intuitive biological concept, and clearly know that in this task, the differences in textures are the cues that matters. After the differences in texture pop out, the task becomes easier. But if children are perceptual bound, and could only use one dimensional cue (e.g. shape) and highly rely on the perceptual shape similarities (Piaget, 1970) to do the categorization, then it will not be easier for them to categorize in surface-similar condition when two pictures of objects share similar shape but different textures because they were unable to combine different cues to make the judgment. According to Inhelder and Piaget (1964) children put two objects which look similar into the same category, so in surface-similar condition, it will be harder for children to separate the two pictures and categorize them. But in the surface-dissimilar condition, because two pictures look not alike, children are able to use the cues (texture) beyond the surface similarity (shape) to do the categorization, and it will make the task easier, and we predict that under the perceptual-bound theory, children would perform better in the dissimilar condition.

Methods

Participants

Dissimilar condition

Fifteen four year old (M= 4 year and 7 months, SD= 3.51 months) and fifteen three year old (M=3 year and 6 months, SD= 3.71 months) children participated in the current condition. Children were recruited from local preschools and represented a range of socioeconomic and ethnic backgrounds. Four subjects were dropped because of response bias.

Brenneman et al's condition

Sixteen three year old (M = 3 year and 6 months, SD= 3.48 months) and eighteen four year old children (M = 4 year and 4 months, SD= 2.92 months) participated in the previous condition (Brenneman, etc., 2003). The data of two 3-year-olds (both 3;5 years) were dropped from analyses due to a position response bias (e.g., always choosing the photo on the right).

Materials

Dissimilar condition:

There were two books: one was called the zoo book and another one was called the store book. Each book had two pictures of examples. In the zoo book, the examples were pictures of koala and puma, and in the store book, the examples were pictures of camel and duck. All pictures were colored. Test pictures were consisted of one animal pictures random paired with another dissimilar inanimate objects. There were eighteen pairs in a total. The sequence of the pairs was fixed. The order of the position of the pictures were counterbalanced.

Brenneman et al's condition

The test pictures consisted of one animal picture paired with the picture of inanimate object of similar looking. Pictures were the same as the control condition except that it had three extra pairs. The pair of pictures were rated by adults from easy, medium to difficult. The sequence started from two easy pairs, one difficult pair and two easy pairs and then in a random sequence.

Design & Procedure

The two experimental conditions, look-alike and look-different photos of real and not-real animals were run separately, at different times and by different experimenters.

Brenneman et al's condition

Children were tested individually. The experimenter and the child sat next to each other on one side of the table. In front of the kids, there were two books equally distant to the child. The experimenter demonstrated the pictures in the two books, and showed the kids there were two kinds of books, one was called the zoo book and another one was called the store book. The zoo book had lots of pictures of real animals, and the store book had pictures of not real animals. Real animals can move by themselves while not real animals cannot. Then the experimenter opened the zoo book and showed kids two pictures of real animals, one is a real Koala and another one is a real puma. Then the experimenter talked about the not real animals could not move by themselves and showed kids two pictures of not real animals, one is a fake camel and another one is a fake duck. The experimenter explained both two animals cannot move by themselves because they were not real animals. In the test phase, the experimenter pretend the pictures were dropped on the floor and mixed by an accident. And then the child were asked to help sort the picture. The kids were shown two pictures and asked to give the real (the name of the animal) picture for the zoo book and the not real (the name of the animal) picture for the store book.

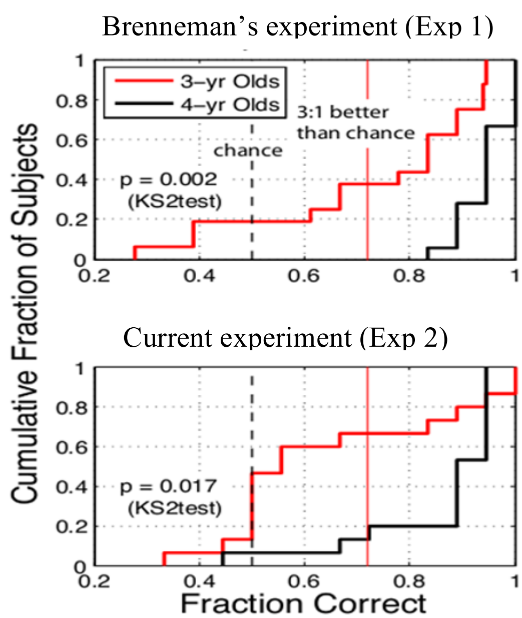
Dissimilar condition

The procedure was the same except that in the test phase, the experimenter won't mention the name of the animal when ask the child to give the picture for zoo and store book.

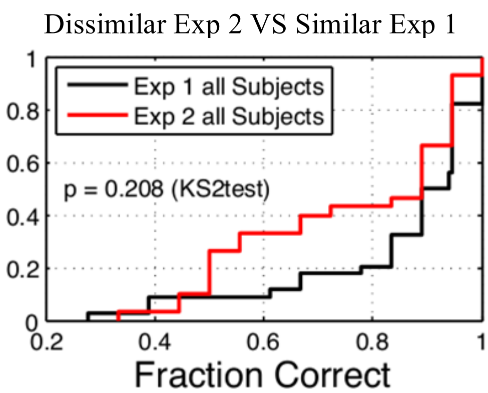
Results

A Two-sample Kolmogorov-Smirnov test was conducted in both experiments. Four year old children perform significantly better than three year old children in both first and second conditions, $p=0.002<0.01$, $p=0.017<0.05$.The cumulative distribution plots were graphed the common eighteen pairs in both experiments (See *Figure 1*). The binomial probability of 13 pairs correct out of 18 is 0.033 which means when children got 13 pairs correct out of 18, they performed significant better than chance. In experiment 1 (See *Figure 1*), *60%* three year old children's correct on all the pairs was higher than chance, however, in experiment 2, there were only *40%* three year children did better than chance. For all the items performance, in the Brenneman et al's condition, the binominal probability of 12 correct out of 16 is 0.028 and the binominal probability of 13 correct out of 18 is 0.033. This means that in the first similar condition, if twelve or more out of 16 three year old children and thirteen or more out of 18 four year old children got one pair correct, it means for this single item, children perform significantly better than chance. In the current dissimilar condition, the binominal probability of 11 correct out of

15 is 0.41 and it means that if eleven or more three year old or four year old children got one pair correct, it means for the single item, children perform significantly better than chance. Results showed that three year old children in the first similar condition (odds 12/16) perform significant better than chance in 11 pairs and only 4 pairs in the second dissimilar condition (odds 11/15). And four year old children perform 17 pairs out of 18 pairs (odds 13/18) better than chance in the similar condition and 18 pairs in the current dissimilar condition (odds 11/15). It seems that there was a tendency that three year old children perform better in the similar condition than the dissimilar condition. However, when we ran the KS2 tests between the two experiments comparing all subject's performance, the difference was not significant, p=0.208>0.05.



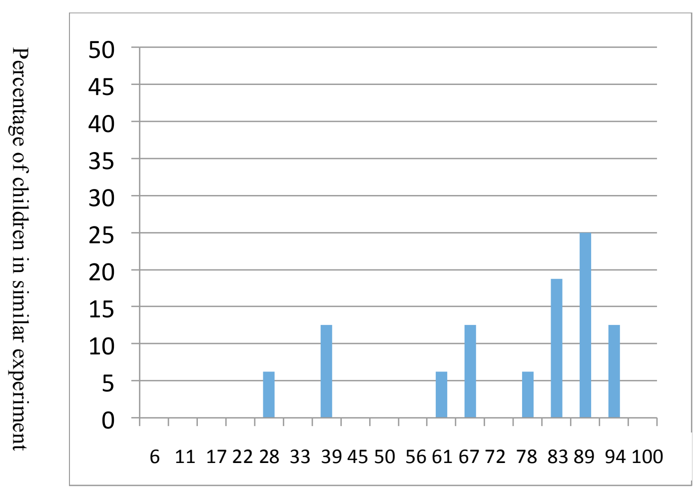
Firgure 1. Cumulative distributions of the correct of all pairs in both experiments for both age groups



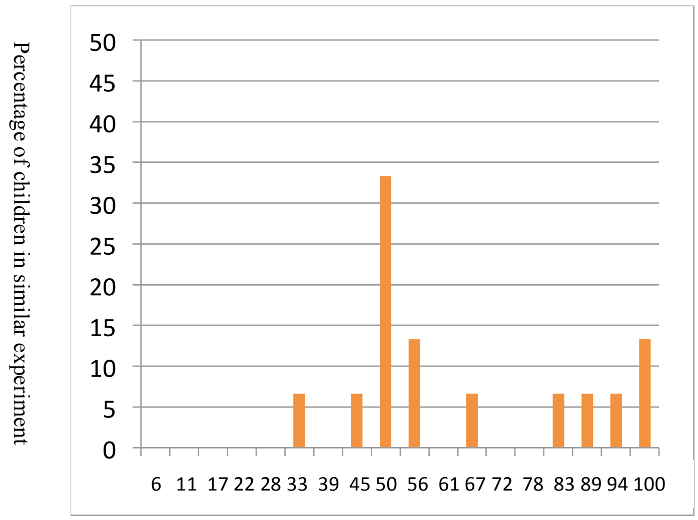
Firgure 2. Differences of cumulative distributions of the correct of all pairs between similar condition and dissimilar condition

Comparing the distributions of children's performance

Since there was no significant difference between neither three-year nor four-year old children in the two experiments, one of the reasons could be that two experiment was done by two different experimenters. And the variances of the data are too large to detect a difference. In order to show more clear distributions of children's performance



Percentage of correctness in 18 trails for three year old in similar experiment

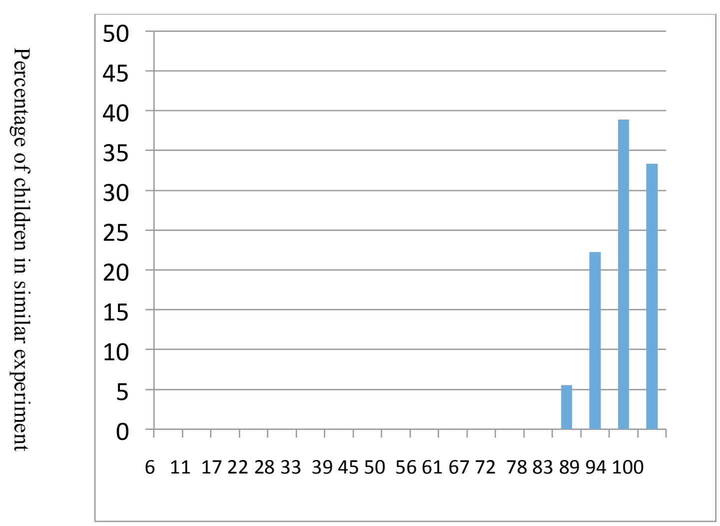


Percentage of correctness in 18 trails for three year old in dissimilar experiment

Figure 3 Three-year old children's performance on the overall eighteen trails in both experiments

between two experiments, we graphed the distributions of children's performance separately. For four-year old children, the distributions are not very different (see *Figure* 4).

For three-year old children, we can see children's performance is in a wide range (See *Figure* 3). From the descriptive statistics, more children were distributed at



Percentage of correctness in 18 trails for four year old in similar experiment

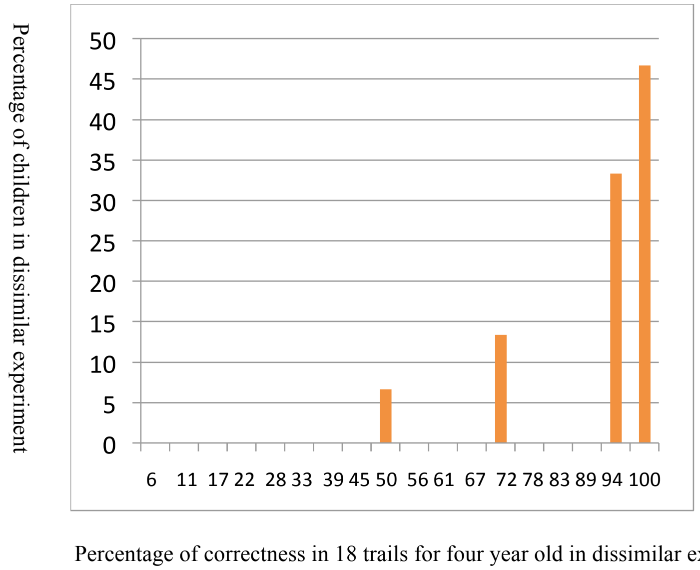


Figure 4 Four-year old children's performance on the overall eighteen trails in both experiments

78% or higher percentage of correct in similar experiment than dissimilar experiment.

Individual items performance

Although three-year old children's performance on dissimilar experiment is not very good overall, there are still four pairs they can perform significantly better than

Firgure 5. Four pairs which three-year old children perform significantly better than chance in dissimilar condition chance (See *Figure 5*).

Discussion

Four year old children's performance adds to previous findings that show they can judge correctly wide range pictures are either animates or not. In addition, eight month old infants were surprised if a box which has fur outside and looks like animal thing make an inanimate noise when it is shakn. They were not surprised when the inanimate thing looks like a box made the same noise. This shows that they treat animate, but not inanimate, items, as if they have insides that belong to objects that are animate (Massey & Gelman, 1988, Setoh, Wu, Baillargeon & Gelman, 2013). In both the current and previous study (Breneman, etc. 2003, Massey & Gelman, 1988, Gelman, Durgin & Kaufman, 1995), children were judging pictures of animate and inanimate objects instead of real animal or real artifacts. None of the pictures were real animals or jumping in front of them, but children could understand that the pictures were representations of both animate and inanimate objects. They also know what are the relevant features and cues to pay attention to in this kind of task. Four year old children's ability to judge correctly the pictures of animate and inanimate objects indicated their early biological thinking, their causal reasoning about what is relevant in this task and are able to pay attention to the relevant cues which can solve the task.

When comparing the two conditions, both three and four year old children did not perform either significantly worse or better when two pictures looked very dissimilar as opposed to very similar. There were several possible reasons for this.

For the common developmental perceptual bound hypothesis (Piaget, 1970; McClelland & Siegler , 2001), even though if children were perception bound, and the dissimilar condition makes it easier for them to separate animals from inanimate objects into two categories, but it does not promise which categories each picture should go in to. And categorizing animals from inanimate objects itself depends on conceptual understanding, without the conceptual understanding, even though the dissimilarity context probably promote children to discriminate one object from another, but it does not shed light on which category each picture should go to. The demand of the task already denies the perceptual bound theory since children need to have certain kind of understanding of biological concept to perform well on this task. And if they are perceptual bound, then they were not even able to do well in the similar study.

For the comparing hypothesis, the trend of the performance in the dissimilar condition looks worse than the similar condition. One reason that it's not significant worse is that in the similar conditions, the scale of the pairs was from easy, medium to difficult. This means some of the pictures are easy to tell which is real and not real and some of the picture are more difficult to tell. The strategy of solving both tasks could be identifying one of the picture to be obvious real and leave the rest one picture to be not real or to be obvious not real and leave the rest one to be real. If these were the strategy, then it doesn't really matter which picture it compares to because each picture can be easily identified itself. Only when it is not certain which one is real and which one is not real, the similar looking paired-pictures will probably show advantage since it highlights the differences more. And in our dissimilar condition, the paired is random and not scaled. And it will be better if we put two difficult scaled dissimilar looking pictures together and see if it is much more difficult than when difficult scaled similar looking pictures were paired together.

Two different experimenters could potentially cause the variances of children's performance to be too large. Future experiments need to be done to see if there will be a replication of the results. The future experiments should be done by one experimenter and also extend subject number, and see will the variances caused by small subject size and different experimenters decreased and found a tendency that three year old children actually do need the context of surface similarity to facilitate their categorization.

Previously, the author was concerned a potential experimenter effect since the experimenter is not the native speaker and has an accent when testing the children. Another native speaker ran several three-year-old children and got similar tendency of results and eliminate this possibility.

Summary

For four year old children, they acquired enough knowledge to perform well in categorizing animate from inanimate in different kinds of context. But for three year old children, there was a possible tendency that the context of similarity facilitates children's biological categorization. Future experiments need to be done to see if it can be replicated.

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