Inductive Inferences Across Time and Identity: Are Category Members More Alike Than Single Individuals?

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Abstract

Young children tend to expect that two members of the same category will share properties, yet they frequently deny that a individual's properties will remain stable across time and context. Two experiments, involving 72 4- to 5-year olds, 72 7- to 8-year olds and 84 undergraduates explored the factors that lead children to generalize properties across- and within-individuals. Results suggest that for adults and older children reasoning about individuals is similar to reasoning about a homogenous class. In contrast, young children showed distinct patterns of reasoning across and within individuals, suggesting that for young children the two contexts may present distinct inductive problems. The discussion addresses how features of each problem contribute to young children's willingness to make inductive generalizations.

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One of the most common yet remarkable features of cognition is the tendency to project familiar experiences onto novel ones. One day a baby becomes fussy after eating tomatoes. Will the baby be fussy after eating tomatoes on another occasion? Will another baby also be fussy after eating tomatoes? Understanding when people do and do not generalize is the central question in the study of inductive inference. Cognitive psychologists have developed sophisticated models of induction, and work in cognitive development suggests there may be important differences in the ways children of different ages project their knowledge. The focus of the experiments described in this paper is a seeming paradox in the developmental literature. The paradox relates to the two inductive problems posed above. Which is the more secure inference about tomato reactivity: to the same baby across time, or to a different baby? Existing research seems to imply that young children think two different babies are more alike (more likely to have the same reaction to tomatoes) than the same baby at different times.

Research on person perception (PP) suggests that, before age seven or eight, children tend not to generalize an individual's behavior across time and context (see Ruble & Dweck, 1995 for review). When asked if a person who shared in the past will share again in the future, adults typically predict consistency, young children often do not (Kalish, 2002; Rholes & Ruble, 1984). Originally children's reluctance to predict consistency was ascribed to general cognitive or information processing limitations (Rotenberg, 1982). More recently the psychological content has been seen as the critical feature; young children do not see people as possessing stable personality traits (Kalish, 2002; Miller & Aloise, 1989). However, it is also possible that young children are generally unlikely to predict stability in an individual across time.

Research on category-based induction (CBI) suggests that young children are strongly motivated to project properties from one category member to another (see Gelman & Kalish, 1993 for review). By the age of two-years children begin to judge that animals sharing the same basic-level label will also share the same underlying properties (Gelman & Coley 1991). If one bird is found to have a property, another will as well. Although there are debates regarding whether these inductions are based in overall similarity (Sloutsky & Lo, 1999) or more theoretical/essentialist beliefs (Gelman, 2003) there is general agreement that young children are often willing inductivists on CBI tasks.

Person perception and category-based induction tasks provide somewhat contradictory pictures of young children's inference behavior. However, the two kinds of tasks have not been directly compared. Without direct comparison, it is difficult to assess whether people really perform differently and, if so, what might account for such differences. The following examples are typical of PP and CBI paradigms.

PP: Johnny shared his food yesterday. Will he share his food again today?

CBI: This bird has omat inside. Does this other bird have omat inside?

The core difference between the two formats is that PP asks whether a property will be stable within an individual across time, while CBI asks whether a property will be shared across individuals (within a category). The above examples of PP and CBI differ in many ways. Many of those differences are characteristic, due to the specific literatures that have used PP and CBI methods. Notably, most CBI tasks have explored how people generalize natural properties of animals identified by category label; PP typically concerns psychological properties of humans identified by proper nouns. In our terms, projecting psychological properties to humans identified by proper names could still be a CBI question ("Johnny shares his food, will Tommy share his food?"). Similarly, projection to an individual across time is the core of PP regardless of the actor or property type. "Yesterday this bird had omat inside. Will it have omat now?" has the core PP structure. This paper addresses two research questions investigating the issue of differences in rates of projection. First, when directly compared, will people project properties more often across individuals within a category or within an individual across time? Second, assuming there are some differences, are those differences due to characteristic or core features of the two formats?

Past research has suggested that natural properties (e.g., has blood) might be more projectable than psychological properties (e.g., feels happy; Coley 1995; Kalish, 2002). CBI tasks typically involve biological properties while PP studies often use psychological. Thus observed differences between CBI and PP may be due to the characteristic properties used in the two kinds of tasks. CBI and PP tasks also vary on the labels attributed to subjects; one uses category labels the other proper names. Labeling with a common term (rather than a distinct name) may highlight similarities. Thus the greater willingness to project in CBI could be an artifact of the descriptive labels used. Finally, humans are a very familiar category. Even young children know that people vary and their behavior is complex. In contrast most people in modern, industrialized cultures have very limited experience with animals. What people do know about animals may be relatively general characteristics of kinds (Medin & Atran, in press). Thus people may be more willing to generalize about animals than humans, one more source of observed differences between CBI and PP. Few studies have investigated biological and psychological property types in one paradigm (see Graham et al. 2003, and Kalish 2002 for exceptions). No single study has compared both CBI and PP directly on property, category-type, or label. The existing literature does not clearly identify the source of different rates of projection in CBI and PP. It remains possible that characteristic task attributes may account for the different patterns of inferences reported in the literature.

The core difference between PP and CBI can be characterized as target scope; is the projection to the same individual or a different individual? Intuitively it seems that induction within an individual is more secure than induction across individuals. Individuals can be treated as categories formed over multiple instances. One way to conceptualize the individual "John" is as a generalization over encounters with John at time 1, John at time 2, etc. (cf. Barsalou, Huttenlocher, & Lamberts,

1998). Kinds are also formed through exposure to multiple exemplars ("Person" is a generalization over John 1, Mary 2, etc.; see Medin & Shaffer 1978). "John" is a more homogenous category than "Person" because the individual instances of the category "Person" include all those of "John" plus many others. Importantly, this analysis is not specific to thinking about people. Plausibly, any individual (e.g., bird, tire) is more homogenous a "kind" than the class that includes it and other similar instances.

People are more willing to generalize within groups of relatively similar elements than within groups of relatively dissimilar elements. Both children and adults respect homogeneity when making inductions within categories (Gelman, 1988). The principle of homogeneity seems to extend to reasoning about individuals. A basic level match is a better basis for induction than a super-ordinate level match, a sub-ordinate level match (e.g., breed of dog) is better than a basic level, and an individual level match (same dog) is better still. Intuitively it seems that the same individual across time must be at least as homogenous a "kind" as any kind containing more than one individual. If this principle holds, then both children and adults may be expected to make more inductions within an individual than across an individual.

Although the principle of homogeneity predicts people will make more inductions within than across individuals, it is not clear that inductions always conform to the principle. Recently Medin and colleagues have developed a relevance-based account of inductive inference (Medin, Coley, Storms, & Hayes; 2003). The substance of the theory is that principles, such as homogeneity, are not the sole determinants of induction. Specific knowledge might give salience to various sorts of relations that warrant inferences. For example, evidence that grass has enzyme X may lead people to conclude that cows have enzyme X, even though the category containing both grass and cows is low on homogeneity (Medin, et al., 2003). Knowledge that cows eat grass makes the connection relevant. Within and across individual problems might have different relevance effects. For example, designating two individuals as members of the same kind might make their similarities more relevant. Drawing attention to an individual's behavior at two times might make contextual variation more relevant. Although there is no direct evidence for the effects of target scope, several researchers have argued that concepts of individuals are not just very homogeneous kinds. Notions of individual identity make shared features less central to concepts of individuals (Blok, Newman, & Rips, in press; see also Barsalou et al. 1998). Thus there may be reasons to believe that homogeneity will not account for target scope differences in inductions.

A second feature of PP and CBI formats is that PP projections are made across time, while CBI projections are not (at least not explicitly). The premises and conclusions of a PP task must be time-marked. As a consequence, PP tasks typically involve the projection of states or events (e.g., "Johnny *shared* his food last week"; Rholes & Ruble, 1986). CBI tasks involve projection of atemporal or traitlike properties (e.g., "this bird *feeds its babies mashed up food*"; Gelman & Markman, 1986). There have been several demonstrations that the way a property is lexicalized affects projections (Bales & Sera, 1995; Gelman & Heyman 1999; Graham, Welder, & McCrimmon 2003).

For example, Gelman & Heyman (1999) showed that attributing a property to an agent via a noun phrase (e.g., a person *is a carrot eater*) supports inductive inferences to a greater degree than describing a state or series of states (e.g., a person *eats carrots whenever she can*). One prediction is that people will be more willing to project traitlike (atemporal) than statelike (temporally marked) properties. Note that although projection across time is necessary for the PP format, it is not incompatible with the CBI format. Thus the two formats may be equated for the mention of time. Further, it is possible to use both statelike and traitlike properties in both across- and within-individual projection tasks (see Experiment 2 below).

In the existing literature on inductive inference it appears that children may expect two members of the same category to be more alike than the same individual observed on different occasions. This result may be more apparent than real, an effect, perhaps, of extraneous task differences. The present study explores some of the factors that dispose people to make inductions. Experiment 1 attempted to replicate the difference between CBI and PP tasks for a matched set of properties. In Experiment 2 we examine the relationship between target scope (individual or category member) and temporal marking of properties (traitlike or statelike) while controlling for various confounding variables, such as actor type, property, and label.

Experiment 1

The goal of Experiment 1 was to directly compare performance on category-based induction (CBI) and person perception (PP) tasks. The design of Experiment 1 was purposely confounded. The CBI and PP tasks varied on a number of dimensions (e.g., human vs. non-human subjects, temporary vs. enduring properties) as is typical in the literature. The strategy is to first replicate age differences in projections and then (in Experiment 2) to explore some of the factors that might be responsible for the difference. Based on past literature, all participants were expected to generalize in the CBI task. In the PP task, preschool-aged children would show low rates of projection relative to older children and adults, and perhaps relative to performance on the CBI task.

Property content was controlled. Experiment 1 used a matched set of psychological and natural properties across both CBI and PP tasks. It is not clear from past research, whether rates of projection in a PP task would differ from those in a CBI task for all property types. Little research has explored projections of psychological properties in a CBI framework (though see Graham, et. al, 2002). It is unclear whether young children's reluctance to generalize psychological attributes holds generally or is specific to the PP context. Kalish (2002) found that young children would project biological properties of individuals across time. The literature supports the prediction that young children will show low rates of projection for psychological properties in the PP format, and relatively high rates of projection for biological properties in the CBI format.

Method

Participants. 32 young children (M = 5;2, range = 4;2 - 5;10), 32 older children (M = 7;10, range = 7;0 - 8;11) and 32 adults (undergraduates) participated in this study. Children were recruited from preschool and after school programs. Approximately equal numbers of boys and

girls participated. Adults were recruited from introductory Psychology courses and received course credit for their participation.

Design. An equal number of participants from each age group were randomly assigned into one of two conditions: PP or CBI. The PP task involved time-marked events of human actors, and the CBI task used stable, atemporal properties ascribed to basic-level animals. A matched set of 14 properties was used across conditions. Properties were constructed to be similar to the natural and psychological properties used in CBI (e.g., Gelman, 1988; Gelman & Markman, 1985) and PP (e.g., Rholes & Ruble, 1984) studies. There were six natural properties; three *biological* (e.g., has omit inside), and three *ecological* (e.g., feeds her babies kilon milk), and six psychological properties; three *volitional* (e.g., plays with friends/plays alone) and three *ability* (e.g., remembers where he hid grigon berries). One general difference is that CBI tasks often use blank properties assumed to be novel (e.g., has omit inside) while PP tasks typically involve familiar attributes (e.g., playing with friends). To make some equation for familiarity, all psychological properties involved a novel word. An accidental property (e.g., piece of wet grass on leg) and an obvious property (e.g., gets wet when in the water) were also included. Two sets of items were constructed with complimentary properties in order to control for possible response biases (see Appendix A for list of properties). Property sets were randomly assigned within each condition. The items consisted of two parts: an ascription of a property to the base and an inference question to the target. A follow-up question assessed the strength of projection after each inference question.

Materials and Procedure. Children were interviewed individually at their preschool or after school program in a quiet area. Adults completed these tasks on computers in groups of twelve. Pictures of actors accompanied each story. The premise for each item in the PP condition specified a particular property a person *did* or *had* in the past (statelike property). A picture of a person was introduced and participants were told, "A few weeks ago <person's name> <property>." Participants were then shown a picture of the same person and asked the inference question; "Now today, here is <person's name> again. Do you think <person's name> <property> like last time?" Follow-up questions for positive judgments asked whether the actor would always or just sometimes show the property; follow-up questions for negative judgments asked never or sometimes. The premise for CBI items ascribed traitlike properties to animals, something the animal *does* or *has*. Participants were shown a picture of an animal (e.g., a "bird") and told, "This <animal> <property>." Participants were then shown a picture of an animal from the same basic-level (e.g., another "bird") and asked; "See this other <animal>? Do you think this other <animal > <property> like this one?" Follow-up questions asked whether all or some (some or none for negative judgments) of the category members would show the property.

Results

Responses were scored a 1 when projections were made ("yes" response) and a 0 when a projection was not made ("no" response). Proportions of projections are shown in Figure1. All participants made projections at rates greater than chance to the obvious item across conditions (Myounger = .81,

Molder = . 91, Madult = .90, all p<.01, Wilcoxon tests). Furthermore, in both conditions young children responded at chance for the accidental items (M = .59), while adults and older children responded at rates below chance to the accidental items (Madult = .29 ,Molder = .25, both p<.01, Wilcoxon tests)[1]. Thus, participants were not showing a simple bias to predict similarity or difference across all items.

Responses were analyzed in a 3 (Age: younger, older, adult) x 2 (Property: natural, psychological) x 2 (Target: category, individual) ANOVA with the final factor between subjects. The analysis revealed an overall main effect of property F(1, 96) = 15.9, p<.0001. There was a property x age interaction F(1, 96) = 14.8, p<.0001. Adults made more projections for natural than psychological properties, F(1,96) = 23.0, p<.001. Older children and adults made more projections for natural properties than did young children, F(2, 96) = 8.7, p<.001. Also, there was a property x condition interaction F(1, 94) = 9.9, p<.01. Participants made more projections in the CBI than PP condition only for biological

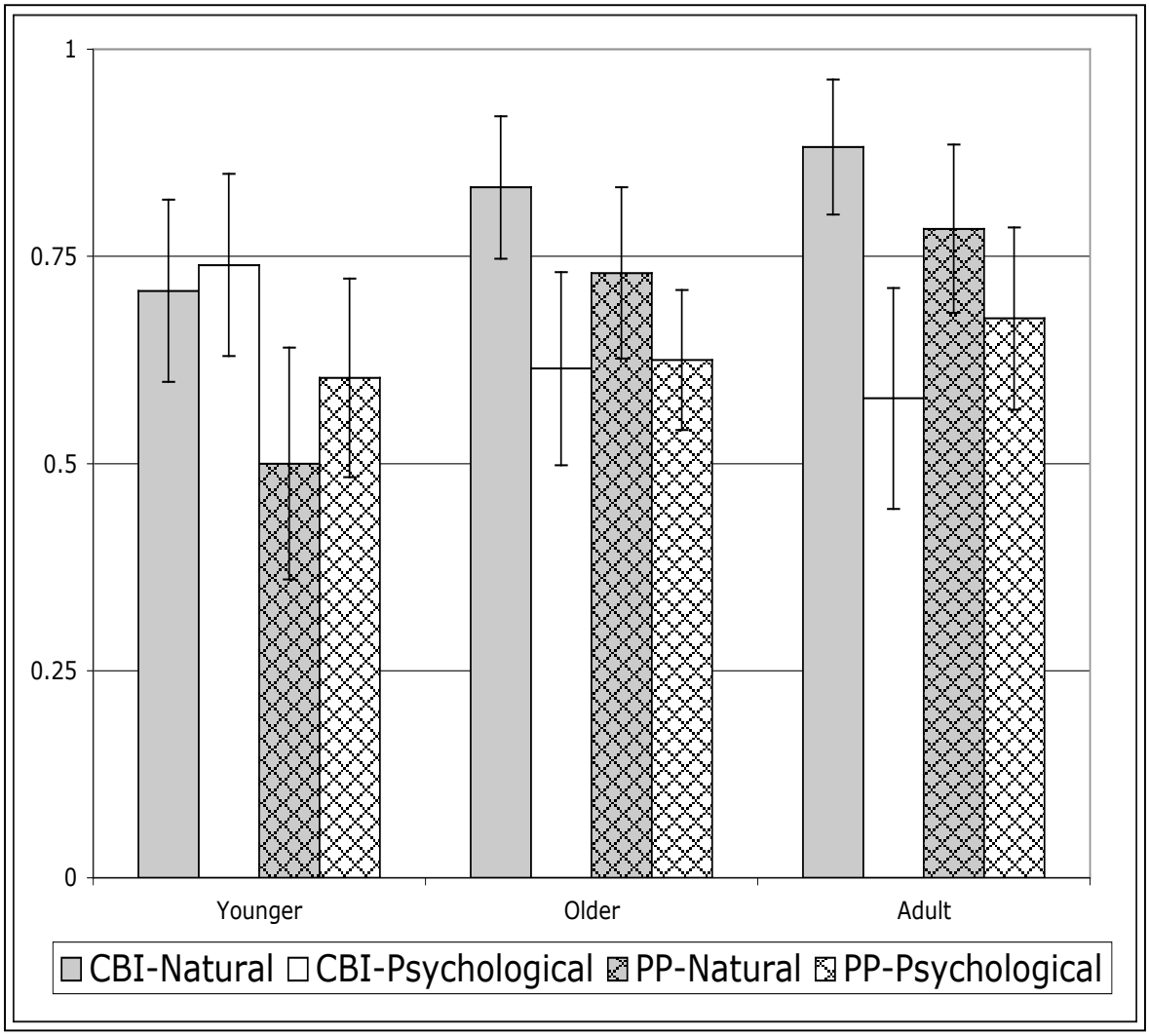


Figure 1. Mean proportion of positive projections in Experiment 1 for CBI and PP conditions.

properties $F(1, 96) = 8.6$, $p<.005$ and more natural than psychological projections only in the CBI condition $F(1, 96) = 25.8$, $p<.001$.

The condition manipulation affected younger children differently than older participants. Participants in all three age groups made positive projections in the CBI condition at rates significantly greater than chance. Older children and adults, but not younger children, also extended properties in the PP context. Younger children were less likely to make projections in the PP condition than in the CBI condition, $F(1, 96) = 7.1$, $p<.01$. There was no general condition difference for older children or adults. Younger children made fewer projections in the PP condition than did older participants, $F(2, 96) = 3.9$, $p<.05$. There were no age differences in the CBI condition. All participants extended enduring properties from one animal to another. Younger children were reluctant to generalize temporary properties of a person across time.

The effect of condition was also apparent in younger children's individual patterns of projections. Participants had 12 opportunities to project properties (not including obvious and accidental items). A participant was considered to be a consistent projector if he or she answered positively to 10 or more of the 12 items ($p(10 \text{ or more of } 12) < .02$, assuming .5 chance of positive answer on each item). Eight younger children projected consistently in the CBI condition, only four did so in the PP condition. There were also more consistent projectors in the CBI than PP conditions among older children (6 and 2, respectively). Adults were equally likely to project consistently; eight did so in the CBI condition, nine in the PP condition.

Analyses were also conducted on the follow-up questions, which asked participants to qualify their inferences: Would the property hold true of all other instances or only some? Older children and adults were more likely to make strong generalizations (say "all" rather than "some") for natural properties than for psychological ones $F(1, 90) = 14.2$, $F(1, 90) = 6.7$, $p<.01$, respectively. Younger children were not. Adults made stronger generalization in the CBI than the PP condition, $F(1,90) = 4.1$, $p<.05$., other participants did not. Looking across all age-groups, people made stronger generalizations for the natural properties than the psychological properties only in the category condition, $F(1, 90) = 18.2$, $p<.001$. These results paralleled the findings from the property projection question. Older participants saw natural properties as better bases for induction. The CBI condition was especially conducive to generalizations

A final set of analyses looked at property content. Did participants treat all natural and psychological properties alike? The study design involved ecological and biological, as well as volitional and ability items. For adults, inferences did not differ by property content; both types of natural and psychology properties elicited the same condition effects. In the category condition older children made more projections for ability, rather volitional properties, $t(15) = 4.39$, $p<.01$, while younger children showed the opposite pattern, preferring volitional to ability properties, $t(15) = 3.58$, $p <.01$. The only property difference in the PP condition was younger children's higher proportion of inferences for ecological, rather than biological properties $t(15) = 3.22$, $p<.01$.

Discussion

The results from Experiment 1 generally replicated findings in the category-based induction and person-perception literatures. Young children generalized in the CBI condition but not the PP condition. The effect is not (simply) due to a tendency to predict more stability for natural than psychological properties. More projections were made in the CBI than PP conditions controlling for property content. Property type did have an effect. Adults and Older children showed the predicted condition difference only for natural properties. Younger children preferred CBI to PP for both types of properties. The purposely, confounded design of Experiment 1 does not allow conclusions about which task factors may have contributed to condition differences. For example, more projections in the CBI condition could indicate a preference for category rather than individual projections, or a preference for projecting to animals rather than humans. Nonetheless, Experiment 1 does confirm that there is a phenomenon that needs explaining: Especially, why did young children's projections differ from chance in the CBI but not PP condition?

Experiment 2

Experiment 2 focused on the significance of property form (traitlike, statelike) and target scope (individual, category). Other factors that varied in Experiment 1 were controlled. One interpretation of the results from Experiment 1 is that reasoning about humans is fundamentally different than reasoning about animals. In Experiment 2 we equated actor and property type to test the hypothesis that reasoning about a single individual presents a different problem than reasoning about a class of individuals. In Experiment 2 all targets were non-human animals identified by basic-level category labels.

In Experiment 1, children were generally unwilling to predict consistency in the same individual over time. There were property content effects, both between natural and psychological properties and within each type. The properties designated "natural" included both morphological and behavioral attributes. Although both natural and psychological properties included novel words, the psychological items involved familiar actions or attributes (with novel targets). Thus the properties may have differed in familiarity or novelty. Experiment 2 involved a clearer set of property types. Items in Experiment 2 were divided into biological, volitional, and ambiguous properties. If children are simply unwilling to project confusing properties, they should show an overall unwillingness in projecting ambiguous properties. Another possibility is the temporal marking of properties was confusing to children. Being asked whether a person can have the same property in the future may alone suggest a property is not stable. If children are compelled to predict change for properties marked by time, then property type and target should make little difference. In Experiment 2 we investigated these possibilities by matching statelike and traitlike properties with projections to individuals and to category members.

Adults and older children were predicted to show a cumulative effect of task features. Certain features of an inductive problem support projection, while other features may undermine projection. The additive assumption is that each factor has the same impact (at least as supportive or undermining) independent of the other features of the

task. In particular, individual (rather than category) scope, and traitlike (rather than statelike) properties both contribute to more positive projections. Young children may show a different cumulative pattern; for them category rather than individual scope may support projections. Alternatively, there may be an interactive pattern such that combinations of features have different effects than would be predicted from each individually. Perhaps category scope is a better warrant only in the context of other aspects of the task.

Methods

Participants. 40 younger children (M- 5;1 range 4;1 - 5;10), 40 older children (M- 7;6, range 7;0 - 8;9) and 44 adults (undergraduates) participated in study 2. All participants were drawn from the same population as Experiment 1, though no individual participated in both experiments.

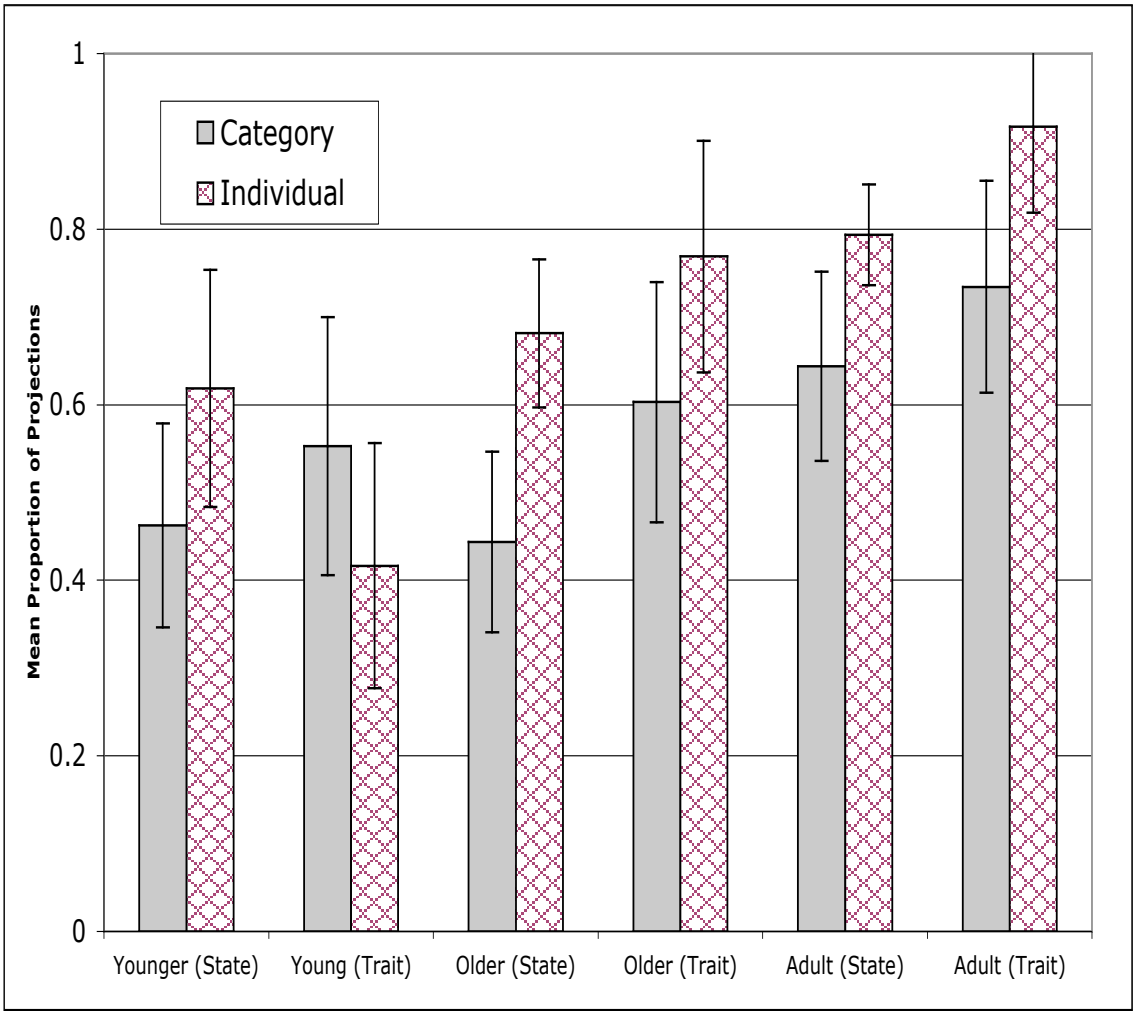
Design. Each participant heard 16 descriptions of basic-level animals ascribed novel properties. An equal number of participants from each age group were randomly assigned into one of two property conditions; *traitlike* and *statelike*. In the traitlike condition participants were told about a non-temporally marked property of an animal; something the animal does or has (e.g., "this <animal> has/does <property>"). In the statelike condition properties were described using the past tense, something the animal did or had at a point in the past (e.g., "this <animal> had/did <property>"). Target scope was a within subjects variable. There were two sets of target scope questions; category and individual. For the eight category targets a picture of a different basic-level category member was shown and participants were told, "Now today, here is a different <animal>. Do you think this <animal> will <property> like the one before?" Additionally, there were eight individual targets for which a picture of the same individual was shown and participants were told, "Now today, here is the same <animal>. Do you think it will <property>, like before?" Questions were counterbalanced and each set of target questions was blocked. For each set of questions, four items were volitional, four were biological and eight were ambiguous. The entire set of items is presented in Appendix B.

Materials & Procedure. For children, descriptions were presented verbally and accompanied by laminated color pictures of agents in the stories. Adults saw computerized displays of text and pictures of agents. Children were interviewed individually, adults completed this procedure on individual computers in groups of twelve. To address the need for temporal separation between base and target in the individual target scope condition, the items were presented in the context of a trip to the zoo. The experimenter was now visiting a zoo and wondered whether the animals would have the same properties as observed on a prior trip.

Results and Discussion

Figure 2 presents the mean proportions of projections to the new target (either same animal, or different animal). These scores were analyzed in a 3 (Age: younger, older, adult) X 2 (Property form: statelike, traitlike) X 2 (Target scope: category, individual) ANOVA, with the last factor within subjects. Because of the number of factors in the experiment, property content effects were analyzed separately. This analysis revealed a significant main effect of target scope, $F(1, 119) = 22.1$, $p<.0001$. However, this effect was conditioned by significant two- and three-

Figure 2. Mean proportion of positive projections in Experiment 2 for category and individual targets.



way interactions. Adults and older children consistently made more projections in the individual than category cases, Adults: F(1 119) = 13.6, Older: F(1, 119) = 18.2, both p<.0001. As is apparent in Figure 2, younger children's projections were strongly affected by property type resulting in no consistent target scope difference. Similarly, adults and older children made more projections in the traitlike than statelike property conditions, Adults: F(1, 80) = 4.3, Older: F(1, 80) = 5.3, both p<.05. Younger children showed no consistent distinction. Analysis of simple effects for the three-way interaction showed only that young children made more projections within individuals in the statelike than traitlike condition. Younger children's response patterns are clearer when property content is considered.

Additional analyses involved separate ANOVA's for each age group by property type. For biological properties, adults and older children showed a main effect of property form, projecting biological properties more in the state, rather than trait condition; adults F(1, 43) = 12.1, p<.01 and older F(1, 38) = 9.9, p<.01. Younger children showed only an

interaction $F(1, 38) = 7.54$, $p<.01$; projecting to category members more in the trait condition and to individuals more in the state condition. Adults showed the same interaction pattern for volitional properties $F(1, 43) = 11.1$, $p<.01$, projecting volitional properties more to category members in the trait condition, and more projections to individuals in the state condition. For ambiguous properties older participants showed an overall main effect of target; they made more projections of ambiguous behaviors to individuals than category members; adults $F(1, 43) = 18.0$, $p<.01$ and older $F(1, 38) = 8.7$, $p<.01$. Younger children tended to show an interaction $F(1, 38) = 3.7$, $p=.06$, making more projections of ambiguous properties to individuals than category members in the state condition.

The final set of analyses explored individual patterns of projections. Each participant made predictions for eight category items and eight individual items. An individual was considered to be a consistent projectors if s/he projected seven or eight of the properties ($p(7 \text{ or } 8 \text{ of } 8) < .05$, binomial probability assuming chance = .5). Table 1 shows the number of participants classified as consistent projectors. Adults showed the predicted pattern, more people consistently projected to individuals than to categories and more consistently projected traitlike than statelike properties. Older children showed only the individual/category distinction. Very few younger children consistently projected properties. However, there were somewhat more consistent projectors in the statelike property condition than in the traitlike condition, the opposite of the predicted, and adult, pattern.

Table 1. Number of Participants Showing Consistent Projection Patterns
Experiment 2

		Category	Individual
Adults			
	Trait	12	19
	State	6	11
Older			
	Trait	1	8
	State	1	8
Younger	Trait	2	2
	State	6	6

General Discussion

The goal of Experiments 1 and 2 was to explore some of the factors that lead people to project properties from a known case to a novel one. Experiment 1 reproduced an effect that seems to exist in the inductive inference literature. Young children will generalize in category-based induction tasks, but tend not to project properties in person-perception tasks. Older children and adults generalize in both contexts, although the type of property in question also affects inferences. This performance leads to the somewhat paradoxical situation in which young children may expect an individual to be more similar to a different category member than to itself across time. Experiment 2 both confirmed this finding and began to offer some explanation for children's inductive inferences.

A central question motivating Experiments 1 & 2 was how inductions within an individual are related to inductions across individuals. For adults and older children, the relation seems straightforward. The inductive problem of reasoning about a single individual across time is similar to the inductive problem of reasoning about two individuals. The principle of

homogeneity may be applied in both cases. Whenever people will judge a second individual to share the property of a first, they will also judge that the first individual will have the property at a future time. An individual is at least as similar to itself (over time) as it is to other individuals. Much as we anticipate two similar kinds share properties, adults and older children seem also to expect that an individual will maintain similar properties over time. The results from Experiments 1 and 2 suggest that older children's and adults inductive projections are consistent with the principle of homogeneity for reasoning about individuals.

Preschool-aged children follow the principle of category homogeneity when making category-based inductions (Gelman, 1988). However, these young children may not apply the principle of homogeneity when reasoning about an individual. Young children may have distinct strategies for thinking about kinds and individuals. The two strategies can be understood as akin to the semantic/episodic distinction. Categorical content fits within a system of relations that are atemporal, semantic knowledge. Kinds of things have properties, but those property possessions are not events, do not occur at specific times. Individuals display properties on particular occasions, and though property displays may predict future displays, they do not indicate atemporal attributes. In short, categories possess properties, individuals display them. One can decide that an event will reoccur (be stable) or that two individuals will display the same property, but displays are not stable and events are not shared. Children know that attributes possessed by one member of a category might be possessed by another, and that attributes displayed by an individual at one time might be displayed at another, but they may not have linked or integrated these two kinds of inferences.

The results of the current study are consistent with research on conceptions of identity. This literature explores intuitions about the bases of category and individual identity; what makes some thing the kind (e.g., dog) and individual (e.g., Rover) it is? One conclusion of this work is that people reason differently about individual and category identity (Gutheil & Rosengren 1996). Individual identity seems primarily based in causal-historical connection while category identity may be based on possession of specific properties (Blok, et al., in press, though see Burge, 1979 and Millikan, 1998 for philosophical arguments that kinds have a causal historical basis as well). Thus what makes an individual the individual it is (what makes Rover, Rover) is the connection between past and present states. Individuals are like events in that they unfold over time within particular regions of space. The connection to the current study is that work on identity seems to suggest that events are central for thinking about individuals while properties are central for thinking about categories.

Events may be more relevant to individuals, properties more relevant to categories (see Sperber & Wilson, 1986). Medin and colleagues (Medin, et al., 2003) have recently proposed a relevance theory of inductive inference. The claim is that a property will be projected if participants are able to readily construct some salient, meaningful connection between base and target; such a connection makes the base relevant to the target. Similarity and homogeneity are some factors that may contribute to relevance, but there are many others (e.g., the fact that cows eat grass makes grass

relevant to projecting properties of cows, Medin, et al., 2003). Study 2 suggests that, at least for young children, property form affects relevance as well. Young children see property ascriptions as very relevant for categories, but events or displays are more relevant for individuals. Asking about a temporary property of another category member, or an enduring property of an individual may be perceived as anomalous by young children.

Property type also contributes to relevance (Coley, 1995; Heit & Rubenstien, 1994). The assumption is that certain properties are more stable by virtue of their content. For example, natural properties are more projectable because they are enduring and stable, while psychological properties are temporary and volitional. The findings from this study suggest that target scope and property form may also play a role in deciding if a property is projectable. The relation between psychological properties and an individual seems to be the most relevant. Conversely, natural properties are more relevant to cross-individual inferences. Property form may also have an impact on determining whether a property projects. For instance, a temporally marked biological property might be interpreted as biologically unstable (e.g., disease, illness). Thus, findings from this study suggest that the projectability of a property depends not just on content (natural or psychological) but also on the way the property is presented and the scope of the projection.

The original question motivating this study was whether young children see categories or individuals as stronger bases for inductive inferences. Past work had shown that children would often project properties from one category member to another, but would frequently fail to project properties within an individual across time. The results of Experiments 1 and 2 both support and extend this finding. Even when confounding factors are controlled, young children will, in some circumstances, make more projections across individuals than within. Older children and adults did not show this pattern (on the non-confounded tests); within individual projections were higher than across individual. On the one hand, these results confirm the important role categories play in young children's inductive inferences. There is a strong intuition that members of the same category will share properties. At the same time, the results suggest there is no general category (or individual) advantage. In some cases young children were unwilling to project from one category member to another and, instead, preferred to project within individuals. The exact basis for children's switching between category- and individual-based inductions remains a matter for future research. The current study suggests that intuitions about the relevance of different properties to categories and individuals may be part of the explanation.

Researchers studying category-based induction and person perception have each discovered important phenomena regarding the development of inductive inference using distinct paradigms. Recent efforts have been devoted to integrating findings and methods across these two literatures (Gelman & Heyman,1999; Heyman & Gelman, 2000; Kalish, 2002). One way to address the two literatures is to ask if reasoning about an individual is the same as reasoning about a kind. It seems apparent that deciding whether two birds will share a property involves much the same process as deciding whether a

property true of a single bird in the past will be exhibited in the same bird in the future. For adults and older children the two problems do seem similar; both turn on the stability of the properties and the similarity of the subjects. For younger children, the differences between the problems may be greater. One involves atemporal properties of categories while the other involves situational displays by an individual. Categories are made up of individuals; facts about kinds and facts about instances must be related. For adults and older children an individual may function like a maximally homogeneous category. For younger children, an individual may be something other than the sum of its (temporal) parts.

References

Aloise, P.A. (1993). Trait confirmation and disconfirmation: The development of attribution biases. *Journal of Experimental Child Psychology, 55*, 177-193.

Bales,D.W. & Sera, M.D. (1995). Preschooler's understanding of stable and changeable characteristics. *Cognitive Development, 10*, 69-107.

Barsalou, L.W., Huttenlocher, J., Lamberts, K. (1998). Basing categorization on individuals and events. *Cognitive Psychology, 36,* 203-272.

Blok , S., Newman, G., & Rips, L.J. (in press). Individuals and their concepts. In W-k. Ahn, R.L. Goldstone, B.C. Love, A.B. Markman, & P. Wolff (Eds.), Categorization inside and outside the lab. Washington, D.C.: American Psychological Association.

Burge, T. (1979). Individualism and the mental. *Midwest Studies in Philosophy, 4*, 73-121.

Coley, J.D. (1995). Emerging differentiation of folkbiology and folkpsychology: Attributions of biological and psychological properties to living things. *Child Development, 66*, 1856-1874.

Heyman, G.D., & Diesendruck, G. (2002). The Spanish ser/estar distinction in bilingual children's reasoning about human psychological characteristics. *Developmental Psychology, 38*, 407-417.

Heyman, G.D., & Gelman, S.A. (2000). Preschool children's use of trait labels to make inductive inferences. *Journal of Experimental Child Psychology, 77*, 1-19.

Gelman, S.A. (2003). *The essential child: Origins of essentialism in everyday thought*. London: Oxford University Press.

Gelman, S.A. (1988). The development of induction within natural kind and artifact categories. *Cognitive Psychology, 20*, 65-95.

Gelman, S.A. & Coley, J.D. (1991). The importance of knowing a dodo is a bird: Categories and inference in 2-year-old children. *Developmental Psychology, 26*, 796-804.

Gelman, S.A. & Heyman, G.D. (1999). Carrot-eaters and Creature-believers:

The effects of lexicalization on children's inferences about social categories. *Psychological Science,10(6)*, 489-493.

Gelman, S. A., & Kalish, C. W. (1993). Categories and causality. In R. Pasnak & M. L. Howe (Eds.), *Emerging themes in cognitive development,* (pp. 3-32). New York: Springer-Verlag.

Gelman, S.A. & Markman, E.M. (1986). Categories and induction in young children. *Cognition,23*, 183-209.

Graham, S.A., Welder, A.N., & McCrimmon, A.W. (2003). Hot dogs and zavy cats: Preschoolers' and adults' Expectations about familiar and novel adjectives. *Brain and Language, 84*, 16-37.

Gutheil, G., & Rosengren, K.S. (1996). A rose by any other name: Preschooler's understanding of individual identity across name and appearance change. *British Journal of Developmental Psychology, 14, 477-498.*

Heyman, G.D. & Gelman, S.A. (2000). Preschool children's use of trait labels to make inductive inferences. *Journal of Experimental Child Psychology, 77*, 1-19.

Kalish, C.W. (2002). Children's predictions of consistency in people's actions. *Cognition, 84*, 237-265.

Lopez, A., Gelman, S.A., & Gutheil, G. (1992). The development of category-based induction. *Child Development, 63,* 1070-1090.

Medin, D.L. & Schaffer, M.M. (1978). Context theory of classification learning. *Psychological Review, 85*, 207-238.

Medin, D.L., Coley, J.D., Storms, G., & Hayes, B.K. (2003). A relevance theory of induction. *Psychonomic Bulletin and Review, 10*, 517-532.

Miller, & Aloise (1989).

Millikan, R. G. (1998). A common structure for concepts of individuals, stuffs, and real kinds: More mama, more milk, and more mouse. *Behavioral and Brain Sciences, 9*, 55-100

Rips, L. J. (1989). Similarity, typicality, and categorization. In S. Vosniadou & A. Ortony (Eds.), *Similarity and analogical reasoning* (pp. 21-59). New York: Cambridge University Press.

Rholes, W.S. & Ruble, D.N. (1984). Children's understanding of dispositional characteristics of others. *Child Development, 55*, 550-[1]560.

Rholes, W.D.. & Ruble, D.N. (1986). Children's impressions of other persons: Effects of temporal separation of behavioral information. *Child Development, 57*, 872-878.

Rotenberg, K.J. (1982). Development of character constancy of self and other. *Child Development, 53*, 505-515.

Ruble, D. N. & Dweck, C. S. (1995). Self-perceptions, person conceptions, and their development. In N. Eisenberg (Ed). *Social development. Review of personality and social psychology, 15*. (pp. 109-139). Thousand Oaks, CA: Sage Publications.

Sloutsky, V.M., & Lo, Y.F., (1999). How much does a shared name make things similar? Part 1. Linguistic labels and the development of similarity judgements. *Developmental Psychology, 6*, 1478-1492.

Sperber, D., & Wilson, D. (1986). *Relevance: Communication and Cognition*. Cambridge, MA.: Harvard University Press.

Notes:

[1] In these analyses chance was assumed to be 50% because the response was a forced-choice between two options. However, adults' and older children's responses likely reflect their judgments of the base rate of the accidental property. There was no independent measure of base rates, so the basis for responses cannot be assessed. The point of the accidental items was to demonstrate that participants would not project properties indiscriminately. Note that the use of the complimentary property sets for the natural and psychological properties eliminates the base rate problem for these items (both random guessing and consistent prediction of one property would yield 50%).

Appendix A

Items used in Experiment 1.

Item type	Property
Natural – Ecological	goes/went in tulik water (climb/ed dygo tree) to stay cool
Natural – Ecological	feeds/fed baby hurti milk (grigon berries)
Natural – Ecological	hunts/hunted rooga birds (freppy deer)
Natural – Biological	has/had a heart made of liton (pectin)
Natural – Biological	has/had a square (round) auxin organ
Natural – Biological	has/had unti (omat) inside
Psychological – Ability	forgets/forgot (remembers/ed) where dyno food was hidden
Psychological – Ability	is/was happy (scared) when it sees a kylo dog
Psychological – Ability	Gets/Got(Did/Does not get) confused when trying to tell difference between yuil and olin fruit.
Psychological – Volitional	keeps/kept (shares/ed) yummy gino food
Psychological – Volitional	Gives/gave up (tries/ed hard) when climbing dygo trees
Psychological – Volitional	plays/played with friends (by self) in the futi field
Obvious	gets/got wet in polik water
Accident	has/had a juno bug (piece of tilo grass) on leg

Appendix B

Items used in Experiment 2

Item type	Item
Biological	Had a heart made of pectin
Biological	Had green pokil cells
Biological	Had yimma bones
Biological	Had juni blood
Volitional	shared gino food
Volitional	gave up whenit tried to climb a dygo tree
Volitional	played in the futi field with friends
Volitional	liked renko food
Ambiguous	pankered with a bird
Ambiguous	pollicked when near a dog
Ambiguous	gunkeled in the water
Ambiguous	fleckered when outside
Ambiguous	had omat inside
Ambiguous	had a round auxin
Ambiguous	had two flibbles
Ambiguous	had a small umblat