

Individuation, Identity and Proper Names in Cognitive
Development

by

Cristina M. Sorrentino

Diplôme en Études Collegiales, Computer Science Technology
Vanier College, 1987

B.A., Psychology
McGill University, 1993

Submitted to the Department of Brain and Cognitive Sciences
in Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy in Cognitive Science

at the

Massachusetts Institute of Technology

February, 1999

© 1999 Massachusetts Institute of Technology
All rights reserved

OCT 13 1999

LIBRARIES

ARCHIVES

Signature of author Cristina M. Sorrentino
Department of Brain and Cognitive Sciences
October 2, 1998

Certified by Susan Carey
Susan Carey
Professor of Psychology, New York University
Thesis Supervisor

Certified by Elizabeth S. Spelke
Elizabeth S. Spelke
Professor of Psychology
Thesis Supervisor

Accepted by Gerald E. Schneider
Gerald E. Schneider
Professor of Neuroscience
Chairman, Department Graduate Committee

1.13

Individuation, Identity and Proper Names in Cognitive Development

by

Cristina M. Sorrentino

Submitted to the Department of Brain and Cognitive Sciences
on October 2, 1998 in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy in Cognitive Science

ABSTRACT

The ability to individuate entities (i.e. conceptualize one entity as distinct from two) and trace their identity (i.e. judge that an entity is the same one as an entity encountered before) is a fundamental component of the human mind and is critical to proper name reference (i.e. a proper name, like *Max*, refers to a unique individual, namely Max). Philosophers have proposed that sortals—concepts which refer to kinds of individuals—support these abilities (Gupta, 1980; Hirsch, 1982; Macnamara, 1986; Wiggins, 1967, 1980). However, while adults may well have sortal concepts and learn proper names for individuals, it is an open question whether children do so also. Proponents of the Continuity hypothesis (e.g. Macnamara, 1982; Pinker, 1984) argue that children and adults have fundamentally the same conceptual resources, whereas proponents of the Discontinuity hypothesis (e.g. Piaget, 1954; Quine, 1960, 1969) argue that children and adults have qualitatively different conceptual systems.

In this thesis, evidence is reviewed that very young infants have at least one sortal, physical object, which suggests that infants have the conceptual structure needed to support representations of kinds and individuals. Experiments probing infant understanding of the concept, person, suggest that infants have the ability to reason about the action and appearance of others, but data presented in the thesis falls short of providing conclusive evidence that infants under a year are able to individuate people. Evidence is presented that by age three, children represent unique individuals and interpret proper names in an adult-like manner as referring to unique individuals. This rules out a discontinuity alternative, namely that preschoolers represent proper names as referring to highly similar objects or to restricted subkinds. Evidence is also presented that children as young as two years are like adults in being willing to accept a range of individuals as namable if given information which highlights the named objects' importance, such as the attribution of mental states to the object.

Together these findings provide support for the continuity hypothesis and suggest a number of avenues of research into children's understanding of kinds, individuals, and their names.

Thesis Supervisor: Susan Carey
Title: Professor of Psychology
New York University

Thesis Supervisor: Elizabeth S. Spelke
Title: Professor of Psychology

Acknowledgments

This has been a rather long journey and a good number of people deserve a good deal of thanks. John Macnamara, more than any other person, set me on this journey. John was a cognitive scientist *par excellence*, although he would never have described himself as one. He had a virtually unerring sense of what constitutes a deep and interesting question in the study of cognitive development. His thinking influenced me profoundly, and I miss his sharp mind, kindness and wisdom very much. When I was almost finished at McGill, I decided I wanted to be a philosopher. Upon discovering this, John told me about a person called *Susan Carey* at MIT and handed me a copy of Susan's book, *Conceptual Change in Childhood*. I have never looked back.

Little did I know then that by coming to MIT I would be so privileged as to have as my advisors two such incredible women as Susan Carey and Elizabeth Spelke. Both Susan and Liz have been wonderful mentors and role-models. Their boundless enthusiasm for my work has revitalized me many a time over the years.

Susan is a rarity in our field because she is a philosophically-minded cognitive development researcher. More than anyone she has given me an appreciation for the quest to turn a deep question or set of questions into a framework for a research program or even a testable hypothesis. I owe Susan a great deal for her immense help in clarifying my ideas and deepening the scope of my research and thinking. Her long experience in the domain of concept acquisition has been, and continues to be, invaluable to me. I have enjoyed working with her very much—so much so that I have accepted a post-doctoral fellowship in her lab at New York University. As if there weren't enough to thank Susan for, I am also grateful to her for this opportunity.

Liz shares with Susan a deep appreciation for the joining of philosophical questions with an empirical research program. Although I have seen Liz in action many times now, I still find her brilliance breathtaking. Whereas ideas come to most of us relatively slowly, Liz designs permutations of key

experiments as she brushes her teeth in the morning. She can come up with a killer control experiment or counter-argument while walking across a room to write something on the blackboard or while her conversation partner is finishing a sentence. I have benefited enormously from Liz's generosity with ideas and resources, and from her scientific rigor and numerous insightful comments.

I am grateful to both Steven Pinker and Molly Potter for serving as members of my thesis committee. Steve's insightful comments and criticisms have been extremely helpful, and his interest and enthusiasm for my work have been inspiring. I thank him also for his statistical advice and for dipping into his vast knowledge of many literatures to suggest helpful references. I plan to do my best in following his excellent advice to 'test more subjects'.

Molly's sharp mind and provocative questions and comments have helped keep me on my toes over the years. Molly has the wisdom which comes from having been in academia for many years, and I admire her deep commitment to intellectual life. I thank her also for her interest in my work and her encouragement.

I owe a great deal of thanks to Fei Xu, the unofficial member of my committee. Fei's unparalleled peer mentorship has contributed enormously to my training. Fei and I worked closely on a number of projects investigating the infant conceptual system and she taught me simply tons about experimental design and statistical analysis. She has listened to presentations without number and read a truly ridiculous amount of my writing, never failing to offer insightful criticism on everything from the smallest of details to the largest of ideas. I admire Fei's work immensely, and I hope that she feels that her efforts have been worthwhile in that she now has another colleague to return the favor of critiquing her work.

I am grateful to Ted Adelson for acting as temporary committee member during Steve's sabbatical so that I could sit my oral exam.

Matthew Shapiro was the first scientist I ever met and my first undergraduate mentor. I found his passion for doing science infectious. He

introduced me to work on the understanding of transitive inferences in children by way of teaching the same to rats. It was an uncanny foreshadowing of my interest in cognitive development. Paul Pietroski introduced me to the language of philosophers and was such a terrific teacher that I took three of his classes. I owe him some appreciation of what an argument is, a great deal of appreciation of how difficult straight exegesis is, and some appreciation of the use-mention distinction (which everyone seems to mangle, including me).

I have found the work of both Paul Bloom and Geoff Hall simply inspirational and their perspectives have influenced my thinking and the work in this thesis rather deeply. I would like to thank Luca Bonatti for providing details of his experiments and data. His enthusiasm for work on infant individuation of people and other animals is warming.

I am grateful to both Jan Ellertsen and Denise Heintze for administrative help, from reminders that it was registration day (already!), to the juggling of funds to keep me in the academic pink. Pat Claffey put me in the way of reading a number of important and interesting papers. I will miss her enthusiasm for the work of past and present graduate students in the department, and her impressive knowledge of library catalogue systems.

Thanks to Kirsten Condry for her help with all matters lab-related, and much-appreciated help preparing pictures for a study on inferences which does not appear in the thesis, for drawing slides of zavs for my defense talk, and for typing the bulk of the references in my thesis and catching a bunch of errors. Thanks also to Jenny Welch, a previous lab manager and “big person”, and to the undergraduates I supervised, John Dukellis, Aphrodite Kakouros, Jenn Kelly, Elizabeth Krumm, Creola Petrescu (also the “head stimulus”), Mandy Mobley, and Jessica Penney (craftsperson of the zavs). Special thanks to Aphrodite and Jenn for help testing subjects and to Elizabeth for everything. With their help, and in partial fulfillment of the requirements of my doctoral thesis I painted and repainted two of my rather well-used zavs, performed evil surgery on toys, constructed strange new objects, great and small, changed the perceived area of a room, set up two infant experiments the world’s smallest lab room, and bought

coloring books and crayons without number. I also had the privilege of working with between 300 and 400 children between the ages of 7 months and five years. I am deeply indebted to them, as well as to their parents, teachers and daycare directors.

My friends have kept me going many times and given me a great deal of joy. Adele Matan made the first three years I was at MIT particularly special. Adele is a difficult one to convince! She has a better ability than most to see both sides of a question and talking to her helped me think about many of my assumptions, why I hold them, and how to convince others of their validity. Adele is a wonderful friend. I treasure her listening ear, sympathy, wisdom and advice. She took my personal betterment in hand a number of times and dragged me off to activities I was always "too busy" for, such as an IAP sushi course and regular swims. Her crowning achievement was dragging me off to the Grand Canyon. I'll never forget that trip, with Adele hiking in her sneakers (don't ask!) An inexperienced hiker, she never once flagged. I am still recovering from Adele's move to Israel but there's always email, and in time, more phone calls and even a trip!

Fei, who truly deserves two paragraphs of her own in this acknowledgment, has given me a great deal of sympathy and advice. Plus she has been just great to hang out with. I have a very vivid memory of her warm welcome when I first arrived at MIT. We went to The Trucks and bought one of those food-filled Styrofoam containers that proliferate at lunch-time in these parts, and sat on the lawn next to Building 20 getting to know one another. Our friendship blossomed from there. And as if I didn't have enough to be grateful for already, I owe Fei huge thanks for lending me her PowerBook for months. A large portion of this thesis was written on it, and a large amount of my sanity saved.

Jenn Messer has been a terrific friend. From our Honours seminar at McGill in which we toiled over Pinker and Bloom's article on the evolution of language, among others, to our recent trip to western Ontario, Jenn has been just great to be with. I admire her immensely. Very few people attend veterinary college full-time, square dance, play ice hockey, enact programs for the humane

treatment of research animals, and own and manage a puppy training school with two employees. And Jenn is one of the most insightful people I know when it comes to talking about psychology in the lay sense. She has given me a great deal of comfort and advice, particularly in recent years.

I very much enjoyed sharing an office with Jenny Ganger, and more recently living in the same building. Her dedication to her work has had a very positive influence on me, and I thank her for putting up with frequent visits to our office by my dog, Max, as well as turning a blind eye to my chronically untidy desk. Weekly dinners with Jenny and Fei did my soul a lot of good, and I will miss them. James Thomas had the indignity to leave BCS for CMU after only two short years, but has nevertheless managed to find time to entertain me and listen to me gripe over the years, for which I am truly grateful. Chris Moore, my fellow mind-brainer and X-philer, gave me a new appreciation for neuroscience and good-naturedly challenged most of my assumptions about the mind and brain over numerous cups of coffee. Josh Tenenbaum has shown the greatest willingness of anyone I have ever met to engage in conversations about the deepest topics in cognitive science, usually in the hallways and stair-wells of E10. Talking with him has had a major influence on my thinking, and I will very much miss the ease with which it has been possible to do so. I am also grateful to him for his help with calculating probabilities. Yaoda Xu has lighted many, many late nights in E10, and I have greatly enjoyed our conversations and outings. I thank Bill Turkel and John Mikhail for stimulating conversations, Bill for his deep thought and deep, deep skepticism about almost everything, and John for his deep thought and even greater enthusiasm for cognitive science than my own. Yair Weiss and Emo Todorov have been a pleasure to know and I thank Emo for greatly easing the burden of TAing 9.63 at a very difficult time for me.

For memorable and often inspirational and thought-provoking conversations I thank Marie Coppola, Gavin Huntley-Fenner, Geoff Hall, John Houde, John J. Kim, Susan Johnson, Gary Marcus, David Poeppel, Sandeep Prasada, Gregg Solomon, and Manuela Ungureanu.

Several people helped a great deal in reminding me of life beyond the ship, E10. For many enjoyable hours of escape I thank Richard Blaylock, Hoyt Bleakley, Alexandra Fisher, James and Valerie Jennings, Sarah and Gregg Lebovitz, and David Seuss. I'm also grateful to them and other 'adults in the Boston area' for their intuitions about what *zavy* means. Hoyt deserves special thanks for proof reading portions of my thesis and for teaching me how to calculate trinomial probabilities. Nina Quint was not only a wonderful "big person", but is also a wonderful person and a lovely friend. Lauren Dade and I have traveled along very similar personal and professional paths and I have tremendously enjoyed visits with her in Montreal and Vermont.

My thanks goes out to the B nard family, especially to Louise and Anik, for their love and support.

I could not have undertaken this journey if I had not had the family I have. My gratitude to them is much greater than this short acknowledgment could possibly convey. I have drawn strength from the love and support of my parents, Lidia and Alessandro, untold times. They have taught me a great deal about integrity, honesty, and sincerity. My brothers and sisters, John, Paul, Viviana and Claudia, have looked out for their little sister for years. Their love and encouragement have warmed me and sustained me many times. Email has done a great deal to bridge the distance between Boston and Melbourne, Australia. Viv has been particularly valiant in keeping me informed of the doings of the family. The comings and goings of my sisters-in-law, Stefania and Doreen, my brother-in-law, Jady Mulqueeny, and the antics of my nephews and nieces, Chiara, Lorenzo, Emma and John, have cheered me over and again. Claudia's long missives from exotic lands are something I treasure. My mother's frequent letters, full of solicitude and encouragement, have been a greater source of comfort than she may know.

Patrick B nard accompanied me for much of this journey. I am deeply grateful to him for the many good years, and for all his love, help and encouragement.

The work in this thesis was supported in part by NIH grant number T32MH18823 to the Department of Brain and Cognitive Sciences, by NSF grant number BNS 9012075 to Susan Carey, and by NIH grant number R37-HD23103 to Elizabeth Spelke.

This thesis is dedicated to my parents, Lidia and Alessandro Sorrentino, for all that they have given me, but especially for the greatest of those things, love.

Table of Contents

Chapter 1.	Individuation, Identity and Proper Name Representation in Adulthood	17
1.0	Introduction	
1.1	Sortals	
1.2	Kinds and the properties of their members	
1.3	Proper names	
1.3.1	Do proper names really refer to unique individuals?	
1.3.2	Do Proper Names have Meaning?	
1.3.3	What is a Namable Individual?	
1.4	Sortals, Proper Names and Cognitive Development: Continuity vs. Discontinuity	
Chapter 2.	Infants' Understanding of <u>Person</u>	31
2.0	Introduction	
2.1	Infant Sensitivity to People and Other Intentional Entities	
2.1.1	Face Perception in Newborns	
2.1.2	Imitation of Faces and Acts	
2.1.3	Contingency and the Detection of Intentionality	
2.1.4	Infant Sensitivity to Goal-directed Behavior	
2.1.5	Infants Distinguish Animate and Inanimate Entities	
2.1.6	Implications of Infant Sensitivity to People and Other Intentional Entities for Person Individuation and Identity	
2.2	Individuation and Identification Abilities in Infancy	
2.2.1	Inanimate Object Individuation and Identity	
2.2.2	Person Individuation and Identity	
2.2.3	Individuating a Person and an Inanimate Object	
2.2.3.1	Individuating a Doll's Head and an Inanimate Object	

	2.2.3.2	Individuating a Live Person and an Inanimate Object	
	2.2.3.3	Discussion of Research on Infants' Ability to Individuate a Person and an Inanimate Object	
	2.3	Conclusion	
Chapter 3.		Children and Adults Interpret Proper Names as Referring to Unique Individuals	91
	3.0	Introduction	
	3.1	Experiment 1	
	3.1.1	Method	
	3.1.2	Results	
	3.1.3	Discussion	
	3.2	Experiment 2	
	3.2.1	Method	
	3.2.2	Results	
	3.2.3	Discussion	
	3.3	Conclusion	
Chapter 4.		Beyond Names for Animals: The Role of Syntax, Pragmatics, and Mental State Attribution on Preschoolers' Proper Name Learning	133
	4.0	Introduction	
	4.1	Preschooler's Use of Linguistic and Non-linguistic Cues to Learn Proper Names	
	4.1.1	A Candidate Individual	
	4.1.2	Pragmatics of Proper Name Introduction	
	4.1.3	The Attribution of Mental States	
	4.2	Experiment 1	
	4.2.1	Method	
	4.2.2	Results	
	4.2.3	Discussion	
	4.3	Experiment 2	
	4.3.1	Method	
	4.3.2	Results and Discussion	

4.4	Experiment 3	
4.4.1	Method	
4.4.2	Results and Discussion	
Chapter 5.	Conclusion	187
5.0	Summary	
5.1	Future Directions	
References		193
Appendix		201

CHAPTER 1

Individuation, Identity and Proper Name Representation in Adulthood

1.0 Introduction

The human mind has the ability to individuate entities of many kinds and identify them over time. Individuals are pervasive. Common examples include people and other animals, every day objects, such as cups and chairs, places such as cities, and mental states such as ideas. Each person, each cup, each city and each idea is treated as distinct from other individuals, which means that each can be counted and that the identity of each can be traced over time. Human minds thus treat two people or a person and an idea as two distinct individuals, and can count each. And human minds can trace the identity of individuals as disparate as people and ideas insofar as it makes sense for a person to ask "Is this the same person/idea that I have encountered before?" Often it is possible to give a determinate answer to this question. Because they can be identified over time, in principle all individuals can be referred to with a proper name (e.g. *Max*)¹, although some individuals, such as people and cities, are more readily taken as candidates for proper names than other individuals, such as cups and ideas. Even if an individual is not given a proper name, languages have devices for referring to it as such. For example, in languages with a count/mass distinction, count nouns such as *person* or *place* function as kind labels. In these languages, a demonstrative (e.g. *this*) or a definite article (e.g. *the*) can be used to refer to an individual of a given kind (e.g. *this cup* or *the idea*).

This thesis brings a cognitive development perspective to the study of people's ability to individuate entities, identify them over time and learn proper names for them. But before turning to children's abilities, it is important to offer some account of individuation, identity and proper naming in adults to be clear about what must be learned or acquired during the course of development. Sections 1.1, 1.2 and 1.3 provide a brief introduction to one such account. Section 1.4 introduces the Continuity and Discontinuity hypotheses of cognitive development and gives a sketch of the remaining chapters of the thesis.

¹ Throughout the thesis, I will use normal script when using a part of speech, such as a count noun, underline to denote a concept such as the concept person, and italics to mention particular words such as *red* or *person*.

1.1 Sortals

Sortals are concepts which provide criteria of individuation and identity (Gupta, 1980; Hirsch, 1982; Macnamara, 1986; Wiggins, 1967, 1980), in addition to criteria of application which are provided by all concepts.² Sortals denote kinds³ such as person and place, and the extensions of kinds denoted by sortals contain individuated entities, namely people and places. That is, a person is a member of the kind person and a place is a member of the kind place. Count nouns are lexicalized sortals which is why count nouns such as *person* and *place* refer to kinds and why these words specify what to count. For example, the answer to “How many words are on this page?”, is a different number than the answer to “How many letters are on this page?” or “How many sentences are on this page?” This is because *letter*, *word* and *sentence* are different lexicalized sortals, and therefore specify different kinds of individuals. Not all kinds have individuals in their extension. For example, the substances sand and water are not individuated and are referred to using mass nouns such as *sand* and *water*. Substances cannot be counted without first being individuated, that is divided into portions such as piles and drops. Indeed, the partitive expressions *pile* and *drop* are sortals. Because sortals denote kinds of individuated entities and provide criteria of identity, sortals support proper name reference. A proper name refers to a unique individual, that is, the one named by the name.

Different sortals provide different criteria of application, individuation and identity (Macnamara, 1986). The criteria of application specify the necessary and sufficient conditions for applying a concept in a given situation. As mentioned, all concepts supply criteria of application. For example, the predicate *red* has criteria of application such that it applies in instances where red is present, but not in instances where, for example, only green is present. In the case of sortals, the criteria of application give the conditions for judging that an entity is a member of the kind denoted by the sortal. Very often the criteria of application for a given sortal are impossible to state explicitly. For example, specifying the criteria of application of a sortal as familiar as *dog* is notoriously

² These criteria are instantiations of corresponding principles (i.e. the principles of application, individuation and identity) which are associated with the kind denoted by the sortal.

³ The nature of kinds is a deep philosophical question which is left open here. I follow Macnamara's (1986) lead and simply assume that kinds refer to something and that much can be said about kinds and their extensions without specifying their metaphysical status.

difficult. However, this does not prevent people from successfully applying the sortal to all dogs and only dogs.

The criteria of individuation specify where one individual of a given kind ends and another individual begins. In virtue of having the concept chair, a person is able to judge where the boundaries of a chair are and so will not confuse one chair with two chairs, or a chair with the carpet it is sitting on. The criteria of individuation also prevent a person from judging that a part of a chair, such as one of its legs, is itself a chair, since the sortal *chair* does not refer to a particular chair part (although, a part may fall under a different sortal, along with different criteria of application, individuation and identity, e.g. *chair-leg*).

The criteria of identity specify the conditions for judging whether an individual within the kind designated by the sortal is the same individual over time. Entities belonging to different kinds vary in the changes which they may undergo while remaining members of the kind. That is, the range of properties which may change while identity is maintained are kind-dependent. For example, size is typically not a dimension along which a given inanimate object may vary and still remain the same individual. To illustrate, imagine a person leaving her house in the morning and returning home to find that a chair in the house, while identical in all other properties to a chair left at the same location in the morning, namely shape, color, texture etc., is twice the size. The person would immediately assume that the chair was not the same one as had been left in the morning, since the criteria of identity for the kind chair do not include changes of size. In contrast, the criteria of identity for the kind person allow individual people to undergo a vast array of physical property changes, down to the replacement of every molecule in the body of an individual person, while still maintaining the identity of the individual. For example, we judge a woman to be the same person as the baby she was, even though the grown woman differs quite radically in size and appearance from the baby.

Although all sortals perform the same logical function of providing criteria for application, individuation and identity, sortals stand in different relationships to one another. One of these is a part-whole relationship. An example was given above with chair and chair-leg. Other examples include person and head, and theory and principle. Another relationship is one of inclusive hierarchy. Some sortals, such as physical object are more general than other sortals such as chair. Both physical objects in general and chairs specifically can be individuated on the basis of information about the object's internal

cohesiveness and its location in space and time (i.e. spatiotemporal information). However the sortals differ in the range of entities to which they apply, physical object applies to a much wider range of entities than chair, and includes the extension of chair in its extension. These sortals also have different criteria of identity. Inclusive hierarchies are not limited to inanimate objects. Animal applies to a broader range of entities than person, while including the extension of person in its extension. Mental state and desire also stand in a hierarchical relationship. Of the variety of levels in a hierarchy, many have argued that sortals at the basic level, those at the level of chair, rather than physical object or kitchen chair, are psychologically privileged because these denote kinds which most easily evoke an image of a typical member, tend to be referred to with a single word, and tend to be the first for which children learn words (Brown, 1958; Macnamara, 1986; Markman, 1989; Rosch & Mervis, 1975; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976).

1.2 Kinds and the Properties of their Members

The relationship between kinds and the properties of their members is complex. This is best illustrated by a kind like animal. The perceptible properties of animals are determined by deep, often hidden, causal properties specified by animal. For example, the fact that animals give birth to animals of like kind, and not, say, to cups, is because animals have a complex internal structure which coupled with the right behavior leads to the creation of offspring of the same kind. Animals' inherent nature causes a huge cluster of interrelated morphological and behavioral properties. Many animals have legs, mouths, intestinal tracts, reproductive tracts, etc. and as a consequence they locomote, eat, digest, and procreate.⁴ People represent this sort of knowledge about different kinds and their members allowing them to reason about kind members and make inferences based on what they know and learn. For example, if people are told that one animal has a particular property (e.g. having a particular body part or behavior), they are likely to extend the property to some degree to animals of different kinds and to a large degree to animals of the same kind (Carey, 1985; Gelman & Markman, 1986; Rips, 1975). Much cognitive development research is devoted to children's knowledge of kinds and how it develops. Although the

⁴ All animals locomote, take in nutrients, give off waste and reproduce in some manner; details of morphology and behavior are kind-specific, e.g. zebras differ from worms on all of the above.

emphasis of the work in this thesis is on individuation and the tracing of identity, the research presented in the subsequent chapters contributes to our understanding of children's (and adults') knowledge of kinds as well as individuals.

1.3 Proper Names

As mentioned above, proper names refer to unique individuals. Proper names are supported by sortals because sortals provide candidate individuals and criteria of identity which allow the tracing of a given individual through time. Adults name individuals of extremely disparate kinds. These include not only people and animals, but also places, such as cities and mountains, institutions, such as universities and governments, events, such as wars and storms, complex artifacts, such as cars and boats, and media products such as films (Hall, in press; Valentine, 1996). Proper names are bestowed at some point in time, such as after the birth of a person⁵, the discovery of a place, or the creation of an institution or media product, and the individual bears the name throughout its existence.

In English, proper names have a particular grammatical profile. The syntax of proper names does not ordinarily allow them to be preceded by a determiner (e.g. *the*), a quantifier (e.g. *one*) or an adjective, or to be modified by pluralization (e.g. *two Aristotles*). Proper names thus contrast morphosyntactically with count nouns (which can be preceded by a determiner, pluralized, etc.), while patterning morphosyntactically with entire noun phrases like *the woolly sheep* and pronouns like *him*. This has led linguists to dub proper names and pronouns *lexical noun phrases*.

1.3.1 Do proper names really refer to unique individuals?

If proper names refer to unique individuals, then we should not expect to find cases in which non-individuals receive proper names. This seems to hold

⁵ Alford (1988) notes that societies differ in their practices around naming people. Names are sometimes bestowed at birth, sometimes bestowed in the months after birth, and sometimes bestowed only after the child reaches a year or two of age. In this latter case, the child is nonetheless referred to with an expression which functions as a proper name until the official name is assigned. Societies differ in their practices as regards the freedom with which names are used during the life of society members and after death. However this does not seem to be a reflection of the cognitive capacities of the members of the community. Rather, these are social conventions.

true for the extensions of mass nouns. Undifferentiated water and sand are not candidates for a proper name. They must first be individuated. If water is in a lake or a sea, or if sand is in a dune or an island, then these entities can be named. The question then becomes one of which sortal supports the proper name, whether *lake* or *island*, or whether *place*. In some cases at least, it is probably the latter sortal which supports the proper name. For example, if the water in a lake were to completely evaporate, the lake-bed would likely continue to be called by the same name. Likewise, if a volcano were to develop under an island of sand and a large part of the sand were replaced, first with lava and then with rock, the island would probably be called by the same name. Although any sortal can support a proper name in principle because it provides candidate individuals, one limit on the naming of an individual may be the extent to which the individual is ephemeral. A drop of water may coalesce with other drops or may evaporate before circumstances could arise to deem it sufficiently important to be named. In addition, entities like drops of water tend to be difficult to distinguish from one another as unique individuals.

Like the naming of individuated substances, the naming of collections is also consistent with the claim that proper names refer to unique individuals. Collections bring together multiple individuals of a kind to form an abstract individual. Examples include forests and families. Occasionally unrelated objects are brought together and named as a work of art. Naming of these individuals is likely supported by the sortals *forest*, *family* and *work of art*.

Many individuals bear more than one proper name. For example, a person may have an official name and a nick-name. This is not a problem for the claim that proper names refer to unique individuals. Each name uniquely designates that individual and not another one. The individual and the proper names referring to it stand in a one to many relationship. That proper names refer to unique individuals does not entail that each individual can only have one name.

The converse of the problem that an individual may have many proper names is that the very same name, such as *Alfred*, may be given to several different individuals. This has led philosophers such as Burge (1973) to argue that proper names, rather than referring to unique individuals, refer to a kind of individual, namely the kind with the individuals of that name in its extension. Whereas proper names are said to have distinct syntax from count nouns, Burge notes that sentences such as "There are a lot of Alfreds in the department" and

"The Alfred who arrived yesterday is very tall" are perfectly grammatical, suggesting that proper names are a kind of count noun. Reference to an individual, Burge argues, is attained via a demonstrative which singles out an individual from the kind. For example, sentences such as "John arrived today" are represented as [that John (as opposed to some other John)] arrived today.

That proper names can be pluralized under some conditions does not necessarily count as evidence against the proposal that proper names refer to individuals. At issue is whether pluralization of proper names is a special process which converts proper names into count nouns, or whether it is a reflection of the underlying representation of proper names as a kind of count noun, as Burge argues. Some evidence against Burge's view comes from work by Hall (1996) exploring four-year-old children's default assumptions about proper name reference. Hall showed children two pictures of very similar cats with a salient property such as being covered in multicolored fluorescent circles. He pointed to each picture in turn and said "See, this cat is zavy". Children were more likely to interpret *zavy* as an adjective referring to the salient property than they were to interpret the word as each cat's name. In contrast, children who were shown a single picture of a cat and told "See, this cat is zavy" overwhelmingly interpreted *zavy* as a proper name for the cat. If children represent proper names as referring to kinds with individuals of the same name in their extensions, then they should not be any less likely to interpret *zavy* as a proper name when it is applied to two individuals than when it is applied to only one. Hall's results challenge Burge's proposal by suggesting that children assume that proper names refer to unique individuals.

It is possible that children and adults make different assumptions about proper name reference, and that Burge's view more accurately reflects adults' assumptions. Some evidence against this possibility comes from work in psycholinguistics with adults. Marcus, Brinkmann, Clahsen, Wiese and Pinker (1995) point out that proper names derived from nouns, such as *Mickey Mouse*, do not pluralize in the same manner as the root noun (i.e. *mouse*) if they are turned into count nouns. For example, *Mickey Mouse* pluralizes to *Mickey Mouses* not **Mickey Mice*. On Burge's view, there is no explanation for this since proper names, like count nouns, refer to kinds and should function in the same manner as count nouns even during pluralization. But on the view that proper names refer to individuals, the pluralization of proper names creates an anomalous referent (a class instead of an individual) and must be handled by a

special process. Marcus *et al.* suggest that since the plural of *mouse* is not available in the representation of *Mickey Mouse* a default rule to add the suffix -s is implemented. Evidence that children as young as four represent *Mickey Mouse* in an adult-like manner and pluralize it as *Mickey Mouses* comes from work by Kim, Marcus, Pinker, Hollander and Coppola (1994).

1.3.2 Do Proper Names have Meaning?

Philosophers disagree about whether proper names designate individuals directly or whether they designate individuals via intermediary information which constitutes the proper name's meaning. Russell (1905) argues that the meaning of a proper name is given by a single necessary and sufficient definite description. For example, *Aristotle* refers to Aristotle by means of a description like "Aristotle was the Greek pupil of Plato and was the teacher of Alexander the Great" which uniquely determines the referent, namely Aristotle. This view has the problem that it is often difficult to come up with a single definite description to uniquely determine the referent of a proper name. For this reason others have argued that proper names are cluster concepts. For example, Searle (1958) suggests that proper names are associated with a conjunction of definite descriptions which uniquely determine the object designated by the name. No particular definite description is necessary to determine reference, but the cluster of descriptions is sufficient to do so. However, Searle's view succumbs to the criticism that *Aristotle* refers to Aristotle even if any number of the definite descriptions associated with the name turn out to be false. Thus if it turns out that the man we have come to know as Aristotle was born in Rome and was never educated, we would still call him *Aristotle* (assuming that this was his name). It might then be a matter of discovering who taught Alexander the Great and if that man was also a pupil of Plato etc. Kripke (1980) uses examples of this sort to argue that names designate their referents directly, without the mediation of other information. He proposes that proper names are *rigid designators* which refer to the unique individual named by the name through all actual and possible scenarios in which the individual exists.⁶ Once a proper name is assigned, it is passed from person to person in a causal chain which maintains

⁶ Many argue that kinds are also rigid designators (e.g. Putnam, 1975, Schwartz, 1979, Kripke, 1980, and Macnamara, 1986).

reference to the individual.⁷ In this way, a person can learn the name *Aristotle* and use it to refer to Aristotle even though he or she may know none of the facts of Aristotle's life (Schwartz, 1979).

1.3.3 What is a Namable Individual?

At least two factors seem to be crucial in determining an entity's status as a namable individual. The first is the individuality of the entity, that is, its importance as that individual and not some other. The second factor is people's need or desire to make reference to the individual because of its importance. Once an individual is construed as important and namable, the assignment of a proper name to it both highlights its importance as an individual and greatly facilitates reference. Although proper names are not short for a set of definite descriptions, in the absence of a proper name, definite descriptions may need to be used repeatedly to refer to an individual. The assignment of a proper name provides a less cumbersome mechanism of making reference to the individual.

The importance of an individual as that individual and people's need or desire to make reference to it play a role in the naming of individuals which commonly bear a proper name. In the case of people, perhaps the prototypical namable entities, there is no question that each person is unique and is constantly referred to by family members, teachers, employers, the government etc., hence every person has a proper name. Places are also important as individuals and people need to refer to them. For example, a country has its own unique geographic location, government, and citizens. This makes a country a unique individual and it is given a proper name to allow people to readily make reference to it and keep it distinct from other countries. Important events, such as World War II, are given proper names because they affect many people and hence are remembered and referred to long after they have taken place. Some complex artifacts, such as boats or computers, have names. This could be because their internal workings are complex which makes them seem analogous to people and thus namable. Or it could be because the more complex an entity is, the greater its individuality, the easier it is to distinguish from other entities and the easier it is to construe as a namable entity. Also, people have the need or desire to refer to complex artifacts, e.g. *The Titanic*, *HAL*.

⁷ Many societies permit individuals to change their names (Alford, 1988). Presumably, the causal chain from the original naming event is passed along to the new name.

Although some individuals are more readily construed as namable than others, there do not seem to be in principle constraints on what counts as a namable individual. For example, simple artifacts usually are not assigned proper names. However, in times past swords and guns received proper names (Rogan, 1990, c.f. Turkel, 1996), and in the present day, artifacts may be named in the process of becoming a work of art (Bloom, 1996).

Individuals may gain importance through any number of mechanisms, and once they are deemed sufficiently important, a proper name may be assigned to highlight the individual's importance and to facilitate reference. Even an individual which is normally construed as a highly unlikely candidate for a proper name can come to be seen as important and namable. To illustrate, imagine a bit of dust in a far corner of a house, in a spot which is hard to reach by broom or vacuum cleaner. If this bit of dust generates enough interest, for example, in the mind of a person frustrated by his attempt to clean it from the hard-to-reach place, the bit of dust might come to have a name (e.g. *Dusty*) and might be discussed at the dinner table and so forth.

There is a correlation between an individual's having a proper name and talk about the named individual by analogy to people or in intentional terms (i.e. as having thoughts or intentions). For example, we can well imagine that if a bit of dust is dubbed *Dusty*, *Dusty* might soon be referred to with *he* or *she*, and might be conceived of as "stubborn" or "sneaky" in virtue of not "wanting" to be removed. Turkel (1996) argues that this correlation between proper naming and attribution of person-like or intentional properties comes about because people name entities that they can anthropomorphise, that is entities that they can construe as being ones with which they can interact in a social manner (Hall, 1994, raises a possibility similar to this). Although cultures differ in the kinds of individuals they will name, on this view all individuals which receive names are named because of their similarity to people. This may seem odd in the case of natural objects like rivers and mountains, but even talk about these individuals includes analogies to people. For example, rivers are described as having mouths, and mountains are described as having shoulders or feet (Porteous, 1986, c.f. Turkel, 1996). An alternative to Turkel's proposal is that the order of causality goes in the other direction. As suggested above in the case of complex artifacts such as cars, it is possible that features of the to-be-named entity, such as its internal complexity, or its geographical location, lead people to notice the individuality of the entity and compel them to make reference to the individual.

A proper name is given to the individual facilitating reference. The proper name itself then shapes thinking about the individual and leads to talk of the individual by analogy to people.

1.4 Sortals, Proper Names and Cognitive Development: Continuity vs. Discontinuity

The foregoing provides a characterization of the adult mind as regards reference to kinds and individuals. Where does this elaborate conceptual system come from? There are at least two proposals about its origin. Proponents of the Continuity hypothesis (e.g. Macnamara, 1982; Pinker, 1984) argue that fundamental human conceptual capacities are present very early in life. Although children and adults behave very differently (for example, young infants do not produce language, and even older children are characterized as “universal novices”, Carey, 1990), children and adults are nonetheless fundamentally similar in terms of their cognitive capacities, and specifically in terms of their ability to represent kinds of individuals and specific individuals. On this view, development consists in learning mappings between core concepts and language, and in the elaboration of knowledge. Evidence of adult-like concepts in infancy and evidence that children interpret words in an adult-like manner provides support for the Continuity hypothesis.

In contrast to proponents of the Continuity hypothesis, proponents of the Discontinuity hypothesis argue that children and adults behave differently because they differ in their fundamental conceptual capacities (e.g. Piaget, 1954; Quine, 1960, 1969). On this view, children's conceptual apparatus is initially simple relative to adults', and in particular, whereas adults represent kinds of individuals and specific individuals, children do not begin life with the ability to do so. Cognitive development proceeds by means of general purpose learning mechanisms which form associations between the child's experiences, and help the child to construct adult concepts and learn language. Evidence that young children lack adult concepts and that they interpret words in a different manner from adults provides support for the Discontinuity hypothesis.

The work presented in the subsequent chapters of this thesis bear on the Continuity and Discontinuity hypotheses. Chapter 2 investigates infants' understanding of the concept person. There is evidence consistent with the Continuity hypothesis which suggests that very young infants have the

conceptual machinery to individuate inanimate objects well before they learn language. Also consistent with the Continuity hypothesis is evidence that prelinguistic infants, like older children and adults, represent people as intentional entities. The evidence that infants as old as 10 months are able to individuate and identify people is not conclusive and therefore does not provide support for either the Continuity or Discontinuity hypothesis. Nonetheless, the results of research with young infants suggests that at least some of the elaborate conceptual structure required to support representations of kinds and individuals is present very early in life.

Chapters 3 and 4 explore children's understanding of proper names. As suggested above, proper name representation depends on the ability to individuate entities and identify them over time. Chapter 3 tests a Discontinuity proposal about proper name reference in development, namely that children interpret proper names as referring to highly similar individuals or to restricted kinds of animals (namely a kind with very similar animals in its extension).⁸ Evidence is presented that 3-year-old children interpret proper names in an adult-like manner as referring to an individual whose identity is traced through space and time. This is consistent with the Continuity hypothesis.

Chapter 4 explores some conditions under which 2- to 4-year-old children construe an individual as namable. Children of this age have been thought to interpret proper names as referring only to individual people, animals and their surrogates, such as animal toys. However, the evidence presented in Chapter 4 suggests that even 2-year-olds are able to learn a proper name for a non-animal individual if given cues highlighting the individual's importance, such as the use of a proper name for the individual in the subject position of the sentences describing the individual and the attribution of mental states to the individual. This provides support for the Continuity hypothesis by suggesting that young children are like adults in that they are prepared to accept a range of individuals as candidates for proper names.

⁸ This proposal contrasts with Burge's (1972) proposal described above in three respects. First, Burge's proposal that proper names are represented as referring to kinds of individuals with the same name is a claim about the adult state, whereas the claim here is about the developing child's state, not the adult's. Second, Burge's proposal makes no appeal to the physical appearance of the referents of proper names, whereas on this proposal physical appearance is key. Third, Burge makes reference to kinds of individuals, whereas the current proposal can be couched in terms of highly similar individuals which are not necessarily represented by the child as belonging to a kind since, on one version of this proposal, children may not represent kinds at all at some point in development.

Chapter 5 concludes the thesis, summarizing the work presented and outlining future directions of research in cognitive development on representation of kinds and individuals and on reference to them.

CHAPTER 2

Infants' Understanding of Person

2.0 Introduction

In everyday language, the noun *individual* means a particular person. Deploying this concept depends on being able to individuate people and identify them over time, abilities which are at the heart of social interaction and form an integral part of our mental lives. Moreover, as noted in Chapter 1, proper name representation also requires the same abilities. In this chapter I discuss the developmental course of children's ability to individuate and identify people. I begin by reviewing research on infants' understanding of people and other intentional entities. I then describe research on children's ability to individuate and identify people and inanimate entities, including two studies I conducted in collaboration with Fei Xu and Susan Carey on infants' ability to individuate a person and an inanimate object. I conclude the chapter by discussing some implications of work on person individuation and identity for theories of the development and organization of conceptual knowledge in infancy and for proper name learning.

2.1 Infant Sensitivity to People and Other Intentional Entities

There are several lines of research which provide evidence that infants are sensitive to the appearance and behavior of people and can detect the intentionality (i.e. presence of thoughts and intentions) of entities which behave in appropriate ways (e.g. behaving as if toward a goal).

2.1.1 Face Perception in Newborns

Infants tested shortly after birth show evidence of distinguishing faces from other stimuli and recognizing faces they have seen before. For example, Goren, Sarten and Wu (1975) showed that newborn infants prefer to visually track moving, face-like line drawings, as opposed to moving line drawings composed of the same "eyes", "nose" and "mouth" in a random jumble. And Bushnell, Sai and Mulling (1989) showed that babies just a few hours old can

distinguish their mother's face from the faces of others (see also Walton, Bower, & Bower, 1992). As these findings suggest, infants' sensitivity to faces allows them to focus on people in their environment and learn about them.

It is worth considering why evidence that a newborn can distinguish her mother from another person does not constitute evidence that the infant can conceive of her mother as an individual which she can identify over time. Sensitivity to features is neither necessary nor sufficient for individuation. The infant may be able to recognize her mothers' features as familiar without inferring that she is in the presence of a person, let alone one and the same person (see Quine, 1960, 1969 for a version of this view). Indeed, infants may be able to process faces without understanding that faces belong to people. The concept person may be learned, and may develop out of innate abilities to attend to people. Discrimination of features is also not necessary for object individuation, since objects can be individuated purely on the basis of spatiotemporal information. For example, if an object appears at one location, and a featurally identical object (i.e. an object whose perceptible features—size, shape, color, texture, etc. —are identical to the first) appears at a second location, this is sufficient information to infer that there are two objects present, even though the objects are otherwise not distinguishable. Given that simple recognition of features is neither necessary nor sufficient for assessing infants' ability to individuate people, what is needed is a methodology which does not rely on simple recognition of person properties as a measure of this ability in infants. The method employed by Xu and Carey (1996) described in section 2.2 does just this.

2.1.2 Imitation of Faces and Acts

Meltzoff and Moore (1977, 1983, 1992, 1994) have shown that infants of different ages will imitate certain facial expressions modeled by other people. Newborn infants will imitate tongue protrusion, mouth opening and lip protrusion (Meltzoff & Moore, 1983). Six-week-old and three-month-old infants will imitate an expression modeled by their mother (e.g. tongue protrusion) and imitate a different expression modeled shortly after by a stranger (e.g. mouth opening), if they are given clear spatiotemporal information that their mother has left the room and a new person has arrived (Meltzoff & Moore, 1992). Infants as young as six weeks are also able to hold an imitated expression in memory for

at least 24 hours. Infants who see a stranger model a facial expression such as tongue protrusion, not only imitate the expression immediately after seeing it, but spontaneously produce the expression when they see the person the following day and the person has a neutral expression (Meltzoff & Moore, 1994). Although it has been argued that imitation is an unreflective, automatic response to a salient stimulus (Jacobson, 1979; Eibl-Eibesfeldt, 1989), the finding that infants will imitate a range of expressions, together with the finding that infants can remember facial expressions they have imitated suggests that this is not the case. This is further supported by work by Legerstee (1991) who found that 5- to 8-week-old infants will imitate tongue protrusions and mouth openings modeled by an adult, but not by an object matched to the human models on color, size and movement. This suggests that infants do not simply imitate any stimulus, but selectively imitate people.

Meltzoff and Moore (1992, 1994, 1995, 1998) suggest that imitation behavior may serve a cognitive function, helping infants to learn about people. For example, deferred imitation may allow infants to communicate non-verbally with people and attempt to establish the identity of the person, by allowing infants to ask the person via the imitation of the previous day's expression whether the person is the same individual they saw the previous day. An alternative possibility is that infants are not seeking to establish the identity of the person, but are recalling an activity of the previous day in response to features of the situation, such as the familiarity of the room and the appearance of a person before them. Further research is needed to establish the role imitation plays in organizing infants' knowledge about people.

Infants begin to imitate people's actions on objects at about 9 months of age. For example, Meltzoff (1988) has shown that infants of this age are much more likely to produce an action with a toy, such as pressing a button which causes a toy to emit a noise, if they see the action modeled by an adult. By 18 months, infants are able to infer an action which a person intended to produce but failed. For example, Meltzoff (1995) showed that infants who see a person pick up a string of beads, move them toward a container as if to place them inside but drop the beads just short of the container are more likely to put the string of beads into the container themselves than infants who see a person pick up a string of beads and drop them next to the container without attempting to deposit them into the container. Infants in Meltzoff's study did not complete the acts of a mechanical device which "attempted" to perform an act, such as pulling

apart the ends of a wooden dumbbell without succeeding, leading Meltzoff to conclude that infants attribute intentions to humans but not to non-humans. However, Johnson, Booth, and O'Hearn (1998) used a similar paradigm and found that 15-month-olds are able to infer the intended actions of a non-human agent, an animated stuffed monkey, showing that infants will imitate both human and non-human agents and suggesting that infants are sensitive to the intentionality of entities other than people.

2.1.3 Contingency and the Detection of Intentionality

Even very young infants are able to detect when an animate or inanimate object responds contingently with the infant's own behavior. Two-month-old infants will dramatically increase their baseline kicking rate over a space of minutes if their foot is yoked to a mobile which turns in response to a kick (Rovee-Collier & Fagen, 1981). Watson (1972) showed that 3-month-old infants smile and coo when they interact with objects which behave contingently. This early sensitivity to contingency develops into forms which suggest that infants detect the intentionality of the entities they interact with when given the right circumstances. At about 9 months of age, infants begin to play games which require them to switch roles with their partner, such as "peek-a-boo" and give-and-take games (Bruner, 1975; Trevarthen, 1979). Sometime after 6 months of age, infants begin to follow the gaze of adults (Scaife & Bruner, 1975). The ability to follow eye-gaze and locate the objects of the regard of others develops over the ages of 6 to 18 months (Butterworth, 1991). This ability is not limited to human gazers. Johnson, Slaughter and Carey (in press) have shown that 12-month-old infants will follow the "gaze" of a non-human agent—a dog-sized, amorphous object—if the object has a schematized face or if the object responds contingently to the infants' behavior or both. At nine months, infants begin to point (Murphy & Messer, 1977). It is unclear, at least initially, if infants use pointing in an explicitly goal-directed manner to highlight objects and request them. Adult responsiveness to pointing may compensate for lack of understanding on the infant's part of the significance of the behavior and may indeed teach children that pointing can have positive consequences. In its mature form, however, pointing depends on being able to reliably follow eye-gaze, and align one's beliefs with the beliefs of the person at whom pointing is directed. Infants' ability to detect contingency and follow eye-gaze becomes increasingly sophisticated after 9

months. Baldwin and her colleagues (Baldwin & Moses, 1994) have shown that infants under a year do not associate their mother's emotional utterance (e.g. "yuck" or "how nice") with what they themselves are looking at, but with the object their mother is looking at. By 15 months of age, children are able to learn new words for objects the speaker is looking at even if children are looking at a different object when the word is introduced. These abilities strongly suggest that infants are able to attribute intentionality to adults at least by the end of the first year of life.

2.1.4 Infant Sensitivity to Goal-directed Behavior

Together with their developing sensitivity to contingency, infants show sensitivity to goal-directed behavior other than a person's looking to an object. Five-month-old infants are able to track the goal-object of a human hand (Woodward, under review a, under review b). When infants are shown a display with a bear and a ball, and see a hand repeatedly reaching for the bear until the display no longer interests them, infants recover their interest if the objects are switched and the hand reaches for the new object (i.e. the ball) at the old location (i.e. the location where the bear had been). Infants show the opposite pattern when instead of a hand they see a wooden rod with a knobby sponge repeatedly enter the display and touch the bear. Infants habituated to this display recover interest when the objects are switched and the rod enters the display and touches the bear (i.e. the old object) at the new location. That infants are tracking a particular goal, namely a hand reaching for a particular object, and not simply associating a hand with an object is shown by the difference in infant looking behavior when they are habituated to the back of a hand falling onto a bear instead of a hand grasping the bear. Five-month-old infants habituated to the former display show no preference for a hand falling on either object (Woodward, under review b). These results suggest that even very young infants are able to process goal-directed behavior such as a human hand reaching for a particular object.

Infants' sensitivity to goal-directed behavior is not limited to the behavior of humans. Nine- and twelve-month-old infants can apparently construe an animated event involving two cartoon dots as depicting rational or irrational behavior (Gergely, Csibra, , & Koós, 1994; Gergely, Nádasdy, Csibra, & Bíró, 1995). In one experiment, 9- and 12-month-old infants were habituated to a display in

which a large dot appeared on one side of a tall rectangular "barrier", and a second, smaller dot appeared on the other side of the "barrier". The dots first grew and shrank briefly in alternation. The smaller dot then approached the barrier, retreated, stopped momentarily, and then accelerated towards the barrier, jumped over it, landed on the other side and continued its motion until it reached the large dot. The two dots then grew and shrank briefly in alternation again. After habituation to repeated presentation of this display, infants were shown a display of the two dots in their original positions, but without the barrier between them. Infants did not recover interest when the small dot moved in a straight line (i.e. a novel trajectory) to join the large dot, however infants did recover interest when the small dot moved through the same parabolic trajectory as in the habituation display (i.e. a familiar trajectory). This suggests that infants encoded the small dot's behavior in a rational manner as an attempt to approach the large dot by passing through the smallest space necessary. Infants who were initially habituated to a different display, one in which the rectangular object was placed out of the way at one edge of the display, and the small dot passed through a parabolic trajectory to reach the large dot, did not recover interest when shown either the old trajectory or the new trajectory. This pattern of results suggests that infants did not encode the event as a rational one.

Csibra and Gergely (1996) extended these findings to displays depicting a different series of events. Nine- and twelve-month-old infants were habituated to a display in which a small dot followed a straight trajectory towards a gap in a barrier and passed through it just as a large dot, too large to fit through the gap, appeared from the side of the display as if in pursuit of the small dot. As it approached the small gap, the large dot moved around the barrier as if to continue pursuing the small dot, and the two dots disappeared off-screen. Infants were then shown two displays. One display contained the identical action sequence, except that the gap in the barrier was large enough to permit the passage of the large dot. The other display contained a different action sequence. In this display, the gap in the barrier was also large enough to permit the large dot to pass through, and so when the large dot appeared on screen, it passed through the gap in the barrier in pursuit of the small dot. Twelve-month-old infants recovered interest to the old action sequence, but not to the new action sequence, suggesting that they encoded the event in the habituation phase as one in which a large object pursued a small object, leading their finding odd the large

object's avoidance of a barrier with a gap large enough for it to pass through. Nine-month-olds showed no preference to the two events, suggesting that they did not encode the event as goal-directed. The ability to encode as goal-directed events involving non-human objects is evidently limited in younger infants. By twelve months then, infants are able to infer that non-human entities are intentional if the entities behave in a manner consistent with such an interpretation.

2.1.5 Infants Distinguish Animate and Inanimate Entities

There is an abundance of research on infants' ability to distinguish animate and inanimate entities (for review, see for example Gelman & Spelke, 1981, Legerstee, 1992 and Spelke, Phillips and Woodward, 1995a). In one illustrative experiment, Woodward, Phillips and Spelke (1993) examined whether infants reason differently about people and inanimate objects. Inanimate objects act in accord with the principle of contact: an object does not move around of its own accord, but it will move, for example, if another object hits it with sufficient force. People on the other hand, can both move around of their own accord, or be caused to move if another object sets them in motion. That is, person motion is not constrained by the principle of contact. To examine infant understanding of this principle, Woodward *et al.* first habituated 7-month-old infants to one of two televised displays. The first involved two inanimate objects: one object appeared from the far left of the display and disappeared behind an occluding screen in the middle of the display and another distinct object then appeared from behind the right side of the occluding screen and disappeared off the edge of the display. The sequence of events then reversed, with the second object appearing first. Another group of infants was habituated to a display involving people: one person appeared from the far left display and disappeared behind an occluding screen in the middle of the display and then a second person appeared from behind the right side of the occluding screen and disappeared off the display. The sequence of events then reversed. To test infant construal of the events, the occluding screen was removed. Infants habituated to inanimate objects saw one of two events. In the first event, an object appeared from one side of the display, moved to the center of the display and collided with the second object which was then set in motion. In the other event, an object appeared from one side of the display, moved to the center of the

display and stopped before touching the other object. After a pause, the other object moved away on its own. The infants habituated to the person display saw identical sequences with people. Woodward *et al.* found that the infants who were habituated to the inanimate object display showed renewed interest at the event in which the objects did not come into contact (i.e. a violation of the contact principle). In contrast, infants habituated to the display involving people showed no preference for either event, suggesting that infants do indeed reason differently about people and inanimate objects.

2.1.6 Implications of Infant Sensitivity to People and Other Intentional Entities for Person Individuation and Identity

Studies of infant sensitivity to people and other intentional entities suggest that infants commence gathering information about people from birth, and that infant ability to process information, such as contingency and eye-gaze, as well as to interpret events involving non-human agents, becomes increasingly sophisticated in the first year of life and beyond. These studies also suggest that infants can distinguish animate and inanimate entities. Research such as that summarized above informs thinking on how the infant conceptual system is organized. For example, the fact that infants as young as nine months have some sensitivity to the goal-directed behavior of non-human agents could indicate that infants have a developing concept intentional entity which is distinct from their developing concept person. Or alternatively, this research could indicate that infants have a single concept of person but may consider a wider range of entities people (e.g. dots, robots) than do adults, provided that the entities behave in an intentional manner. Furthermore, this research provides evidence that the infant conceptual system is organized into different domains which likely include a domain of physical object and a domain of psychology. This can be seen, for example, from the work by Gergely *et al.*, (1994). Infants were apparently able to attribute intentionality to entities which physically resembled inanimate objects more than they resembled people or other animals. This suggests that it was the behavior of the entities which prompted the infants to construe them as intentional. The entities which fall into the domain of psychology are evidently of an abstract nature.

The evidence that infants are sensitive to people's appearance and behavior and that they reason differently about animate and inanimate entities

raises the possibility that infants are able to individuate people. However, as noted in section 2.1.1, the ability to discriminate two entities, for example, a person and an inanimate object, is not sufficient for individuation. Moreover, evidence that infants reason differently about entities of different kinds also does not mean that infants individuate the entities. For example, in the study by Woodward *et al.*, 7-month-old infants showed evidence that they did not expect people to be subject to the principle of contact. This could be because infants of this age assume that people are not physical objects. If this is so, then it is possible that infants of this age may not be able to individuate two people or a person and an inanimate object. However, it is also possible that infants do individuate people, but do not do so on the basis of their status as physical objects. Instead, infants may individuate people on the basis of information about the people's goals or on the basis of their distinctive appearance. Alternatively, 7-month-old infants may assume that people and other intentional entities are physical objects, but may relax the principle of contact for this subset of physical objects. Even on this alternative, however, it is possible that infants are not able to individuate two people or a person and an inanimate object. The ability to engage in domain specific reasoning and the ability to individuate and identify people are distinct, although they may be related. In the next section, I turn to research designed to directly assess infants' ability to individuate and identify people and inanimate objects.

2.2 Individuation and Identification Abilities in Infancy

2.2.1 Inanimate Object Individuation and Identity

There is a growing literature on infants' ability to individuate inanimate objects and identify them over time. Spelke and Kestenbaum (1986; Spelke, Kestenbaum, Simons & Wein, 1995b) showed that by at least four months of age infants are able to use spatiotemporal information to individuate two objects. Infants were shown a display containing two opaque screens separated from each other by a noticeable gap. A rod emerged from behind one screen, moved to the side of the display, and returned behind the screen, and then a featurally identical rod emerged from behind the other screen, moved to the other side of the display, and returned behind it. Importantly, nothing appeared between the two screens and the rods were never shown together. Once the infants were

habituated to the display, the screens were removed to reveal a single rod moving back and forth, or two rods moving back and forth. Infants showed renewed interest at the display of a single rod but maintained habituation at the display of two rods. In a control condition, infants were habituated to what was effectively a single rod moving behind the screens and appearing between them. These infants showed renewed interest to the two rod outcome. These suggests that infants in the first condition encoded the habituation event as involving two objects presumably on the basis of a spatiotemporal principle such as that no object can move from one location (i.e. behind one screen) to another (i.e. behind the other screen) without traversing the space between the locations (i.e. the gap between the screens). On the other hand, infants in the control condition encoded the event as involving a single object presumably because the appearance of the rod between the two screens led them to infer that a single rod was responsible for event.

Xu and Carey (1996) showed that 10-month-olds are not able to individuate two inanimate objects, such as a ball and a toy duck, if they are only given information about the physical differences between the objects in virtue of their being of different kinds. In one experiment, infants were shown a display containing a single opaque screen (see Figure 1). A ball emerged briefly from one side of the screen and disappeared behind the screen, and then a toy duck emerged briefly from the other side of the screen and disappeared behind it. Infants were familiarized to this alternating presentation of the ball and the duck. Importantly, since the ball and the duck were never presented simultaneously, and since there was no other spatiotemporal information that there were two toys in the display, such as the space between two screens used by Spelke and Kestenbaum (1986; Spelke *et al.*, 1995a), infants could only use the physical differences between the two objects to infer that there were two objects behind the screen. After habituation, the screen was removed to reveal one of two outcomes: either the duck and the ball together, or just one of these two objects. Infants showed a preference for looking at the display containing two objects (see Figure 2). This mirrors their intrinsic preference for looking at two different objects and suggests that infants did not encode the event as involving two objects, presumably because they were not able to use the kind difference between the two objects signaled by their physical differences to infer that there were two distinct objects behind the screen. Ten-month-old infants who briefly saw the two objects simultaneously appearing from either side of the screen, and

who then saw the same familiarization sequence of alternating objects showed no preference for either of the two outcomes, and in fact looked less at the two object outcome than they would by intrinsic preference alone (see Figure 2). Thus 10-month-olds are able to individuate two objects in a display involving a single screen provided that they are given spatiotemporal information that there are two objects.

Xu, Carey, and Welch (under review) have shown that 10-month-olds' failure to individuate two objects on the basis of the kind differences between them is not due to a simple memory failure. Ten-month-old infants habituated to a display in which a human hand is suspended just above a toy duck perched on top of a toy car show no recovery of interest when the hand grasps the top of the duck and pulls both the duck and the car off the floor of the display. Infants do not prefer this outcome to an outcome in which the hand grasps the top of the duck and pulls the duck off the car, leaving the car on the floor of the display. Thus although the two objects are in full view of the infants, placing very little demand on their memories, infants fail to encode the display in terms of one object on top of another object, and hence show no preference for either of the two outcomes. In contrast, if infants are given spatiotemporal information that the display contains two objects by briefly being shown the duck laterally moved off the car, they recover interest when the hand reaches into the display and lifts the duck together with the car.

Infants undergo developmental change in their ability to individuate objects on the basis of kind differences. Xu and Carey (1996) showed that by 12 months, infants are able to use kind differences alone to individuate two objects. Infants of this age who were habituated to the alternating object emergences depicted in Figure 1 showed no preference for either the single object or two object outcome, overcoming their intrinsic preference for two objects. Also, unlike 10-month-old infants, 12-month-old infants who are shown a duck on a car do parse the display into two objects and evince interest when a hand grasps the duck and lifts both the duck and the car together off the floor of the display (Xu, Carey, & Welch, under review). However, there are limits on 12-month-olds' ability to individuate and identify objects. For example, Xu, Carey, and Quint (1997) showed that infants of this age are not able to individuate objects which belong to the same kind based on property differences alone (e.g. a small pink cup and a large yellow cup presented one at a time) (see also Leslie, Hall, & Tremoulet, 1997; Leslie, Xu, Tremoulet, & Scholl, 1998). This suggests that

children's ability to individuate and identify objects develops beyond the first year of life. Interestingly, children acquire their first words at this time and there is some evidence that the acquisition of sortals and the acquisition of language are linked (Xu, 1998; Xu & Carey, 1996).

To account for this pattern of findings, Xu and Carey (1996; Xu, 1997; Carey & Xu, in press) have proposed the Object-first hypothesis: the very first sortal that infants acquire is physical object, which provides spatiotemporal criteria of individuation and identity (Spelke, 1988, 1990; see Xu, 1997 for arguments that Spelke's notion of bounded physical object is a sortal). As discussed in Chapter 1, individuation and identity are supported by sortal concepts, which are lexicalized as count nouns like *ball* and *duck*. It is in virtue of these concepts that adults parse a display in which a duck and a ball emerge in alternation from behind a screen as involving two objects behind the screen, since the sortals ball and duck provide separate criteria for individuation and identity. Of course, adults are able to use spatiotemporal criteria alone to individuate and identify objects. This is because adults have roughly two hierarchically related levels of sortals, the more general sortal physical object and more specific sortals like ball and duck (Xu, 1997). Twelve-month-old infants presumably have these two levels of sortals also, but in particular they have some sortals like ball and duck which permit them to parse a spatiotemporally ambiguous display in an adult-like manner. However, infants of this age do not individuate on the basis of within-kind property differences (e.g. a small cup and a large cup), suggesting that they are still in the process of learning kind-dependent property variations. While this process is underway, infants may be insensitive to within-kind differences while attending to between-kind property differences. Later in development, children presumably become sensitive to within-kind property differences, since adults are able to individuate on the basis of these differences.

Infants ten months of age and younger show evidence that they do not have sortals more specific than physical object since they are not able to individuate inanimate objects on the basis of kind differences alone (Xu and Carey, 1996; see Wilcox and Baillargeon for arguments against this conclusion⁹).

⁹ Wilcox and Baillargeon (in press) argue that infants between the age of 9 and 10 months are able to individuate objects on the basis of featural information alone if shown an extremely simple event. In one experiment, infants were shown a display with a blue box and a screen. The box moved behind the screen and a red ball emerged from the other side of the screen. The screen was then lowered to reveal an empty location. Infants looked longer at this outcome than did infants who were shown a red ball and a screen, saw the ball move behind the screen and appear on the other

However there is evidence that infants between 9 and 11 months are able to individuate two inanimate objects under some conditions. Sabbagh and Baldwin (1997) showed that 11-month-old infants are able to individuate a computer-generated ball and hexagon on the basis of featural differences between the objects if the objects move in a manner which is consistent with their form (e.g. the ball rolls smoothly out from behind the screen, whereas the hexagon silently "clunks" out). This suggests that form-correlated motion can highlight kind differences between objects and allow infants under twelve months to individuate the objects in the absence of spatiotemporal information.

Xu and Carey (1996) discovered that a proportion of the 10-month-old infants in their experiment were able to individuate the two inanimate objects. These were infants whose parents reported that the infant understood some of the object labels for the objects used in the experiment (e.g. *ball* and *duck*). Consistent with this, Balaban and Waxman (1995) have shown that the presence of a word highlights the object kind of a presented object. They presented 9-month-old infants with pictures of an animal (e.g. pictures of individual pigs). Half the children heard the pictures paired with a count noun for the animal (e.g. a picture of a pig paired with "a pig"), whereas the other half of the children heard the pictures paired with a tone. The children who saw the pictures and heard the count noun looked reliably longer at a picture of a new kind of animal (e.g. a rabbit) compared to a new picture of the old kind of animal (e.g. another pig). Recently, Xu (1998) has shown that the use of a count noun for each of two objects allows 9-month-old infants not only to attend to kind differences, but to use these differences to individuate two objects of different kinds. Infants who heard "a duck" whenever a toy duck appeared from behind the edge of a screen, and "a ball" whenever a ball appeared from behind the other edge of the screen looked longer when the screen was removed to reveal only one of these objects,

side of the screen, and then saw the screen lowered to reveal an empty location. In contrast, infants who were shown just the screen alone, and then saw the blue box emerge once, return behind the screen and then the red ball emerge, did not look longer relative to the condition in which just the ball was shown when the screen was lowered to reveal an empty location. Although Wilcox and Baillargeon argue that this pattern of results challenge the conclusion of Xu and Carey (1996) that infants below 12 months are not able to individuate objects on the basis of featural information alone, the fragility of the ability of the infants to individuate the two objects in their study suggests that this procedure taps perceptual rather than conceptual abilities. The simple trajectory in the first condition described, together with the brief duration of the event may allow infants to construct two percepts, one of a box and one of a ball, leading to a violation of expectation when only one object is present. A minor modification such as a simple change in trajectory may prevent infants from constructing the percepts to match the number of objects involved in the event.

relative to their baseline preference, suggesting that the infants individuated the two objects. In contrast, infants who heard "a toy" whenever the duck appeared from behind the screen and "a toy" whenever the ball appeared from behind the screen looked longer when the screen was removed to reveal two objects, suggesting that infants in this condition did not individuate the two objects. These results suggest that the use of different count nouns highlights the kind differences between objects, whereas the use of the same count noun does not.

The above evidence suggests that there are conditions under which infants between 9 and 11 months are able to individuate objects. However, aside from the 10-month-old infants who already knew count nouns for some of the objects they saw in the experiment, infants presumably use the information presented, whether form-correlated motion or the presence of a count noun, to construct the sortals during the experiment leading to individuation of the objects presented. The question still remains: when do infants acquire sortals more specific than physical object on their own?

The evidence presented in the first part of this chapter suggests that infants under a year are sensitive to the distinction between people and inanimate objects. These differences may reflect infants' ability to individuate a person and an inanimate object. Such a finding would suggest that infants are equipped with at least one sortal other than physical object, presumably a sortal such as person, animal or animate entity, as the case might be. Also, evidence that infants can individuate distinct people on the basis of differences between them would suggest one of a number of things. If infants can individuate men and women, they may have sortals more specific than person, such as man and woman. Also, if infants are able to individuate people on the basis of properties, such as blond women, then this would suggest that, early in development, there are some kinds, such as woman, for which infants become sensitive to the properties which help distinguish one kind member from another. Members of the kind person are candidates for even more fine-grained individuation, namely on the basis of unique appearance. Being able to represent a person's unique appearance is important for individuating one person and another and for tracing a person's identity over time. It is possible to trace the identity of a person via a representation of the person as an intentional entity. For example, adults can trace the identity of individuals they have never seen, such as characters in books. However, physical appearance is a good means of reidentifying individuals and it is of interest to uncover whether infants are

sensitive to each person's unique physical appearance. It is possible that young infants have an adult-like grasp of person individuation and identity, just as it is possible that person individuation and identity undergoes development. The next two sections summarize studies aimed at addressing infants' ability to individuate and identify people and a person and an inanimate object, respectively.

2.2.2 Person Individuation and Identity

Bower (1974; Bower, 1982) attempted to assess whether infants conceive of their mother as a unique individual, that is that an infant understands that there is one and only one person that is the infant's mother. Using mirrors, Bower presented infants younger than five months of age and infants older than five months of age with three identical images of the infant's mother. Bower claimed that the younger infants did not find the simultaneous presentation of three mothers upsetting, but interacted with each in turn, whereas the older infants found the sight of three mothers quite disturbing and became upset. Bower concluded from this that the older infants represent their mothers as unique individuals, but younger infants do not.

There are at least two problems in interpreting the results of Bower's experiment. The first is that the older infants' reaction might reflect a growing sensitivity to contingent behavior, rather than reflecting the infants' understanding that they have more than one mother. As noted above, infants' sensitivity to contingency undergoes development. The older infants were likely more sensitive to contingent behavior than the younger infants and thus they might have noted that the three people were moving in exact synchrony, a sight that rarely if ever occurs outside of the laboratory and which might have upset the infants irrespective of whether they noted that the three images were of their mother. The second problem is that infants of both age groups may conceive of their mothers as a unique individuals, but the infants simply differ in how upset they are to discover that they apparently have more than one mother. That is, perhaps the young infants are delighted to discover that they are wrong in thinking that have one and only one mother, whereas older infants find the discovery disconcerting.

A pilot study reported in Meltzoff and Moore (1992) suggests that six-week-old infants do not individuate people on the basis of property differences. The

purpose of the experiment was to assess infants' ability to imitate the facial expression of a familiar person (i.e. the infant's mother) or an unfamiliar person (i.e. an experimenter). The experimenter varied his appearance to enhance his perceptual distinctiveness from the infant's mother, by donning a knit cap if the mother had hair standing away from the hairline, and wearing black-framed glasses if she did not wear glasses. After the infant was seated in a infant-chair, the first person (either the mother or the experimenter) came in and modeled, for example, a mouth opening expression. The person then left, and the second person entered the room and modeled a different expression, for example a tongue protrusion. Meltzoff and Moore discovered that the expression which the infant imitated in the presence of the second person varied as a function of whether the infant tracked the entry and exit of the two people. When the infants clearly tracked the people's entry and exit, they imitated the facial expression of the second person in the presence of this person. However, when the infants did not clearly track the entry and exit of the two people, they imitated the mouth opening of the first person in the presence of the second person, who in fact performed a tongue protrusion. These results suggest that infants who did not receive explicit spatiotemporal information that there were two people involved in the interaction did not individuate the two people. Infants may either have thought that the two people were one and the same person, or they may simply have been unsure whether the second person was the same as the first.

Wu (1997) used procedures similar to the single screen procedures used by Xu and Carey (1996) to investigate infants' ability to individuate people. In one experiment, 5- and 7-month-old infants were shown a televised display on which appeared an opaque screen. A man walked into view from the left-hand side of the television monitor, waved in the direction of the infant and walked behind the occluding screen. A woman then walked into view from the right-hand side of the television monitor, waved in the direction of the infant and walked behind the occluding screen. The man then walked out the way he had come, again waving at the infant, and the woman then also walked out the way she had come, waving at the infant. The man then reappeared from the left edge of the monitor, waved to the infant and walked behind the screen again, and the woman did the same from the right. Importantly, the man and the woman never appeared at the same time. Infants were then shown a display in which the occluding screen had been removed, and in the location which had been

occluded there stood either both the man and the woman, or just one of the two people. Seven-month-olds looked longer at the single person outcome, suggesting that they were able to use a combination of positional cues (i.e. emergence and disappearance of a person from the two opposite edges of the display) together with property differences (i.e. the differences of gender and dress between the two people) to individuate a man and a woman. Five-month-olds, on the other hand, showed a preference for looking at the two person outcome, suggesting that infants of this age are not able to individuate a man and a woman on the basis of spatiotemporal and property information. This age difference in ability to individuate people is consistent with the difference suggested by Bower (1974, 1982; see also Meltzoff & Moore, 1998).

In a second experiment, Wu (1997) presented 7-month-olds with the same sequence of emergences and disappearances of two people, but eliminated all featural information between the two people by using identical twin women dressed identically, instead of a man and a woman. Infants in the baseline condition showed no preference for looking at one person or two identical people. This finding is interesting in itself as it suggests that infants of this age have not noticed that people rarely look identical. Infants in the test condition also showed no preference for looking at one person or two people, suggesting that infants were unable to individuate the two people on the basis of positional information alone.

In a third experiment, Wu (1997) attempted to assess 7-, 9- and 11-month-old infants' ability to individuate a man and a woman on the basis of the property or kind differences between them. Infants in a baseline conditions were simply shown the man and the woman standing next to each other, or just one person standing alone. This was done to assess infants' intrinsic preference for looking at one vs. two people at the three ages tested. No preference was found for looking at both people or just one person. This is extremely striking, since the man and the woman were clearly featurally distinct. Infants do show a preference for looking at two inanimate objects of different kinds (e.g. Xu & Carey, 1996). Infants in the test conditions were shown a televised display with an opaque screen at the center. A man appeared from the left of the display and walked behind the screen and then a woman appeared, also from the left of the display, and walked behind the screen. The man and the woman emerged from the screen in alternation twice, always at the left of the display. The screen was then removed to reveal both the man and the woman, or just one of these two

people. Infants at all three ages showed no preference for the two person or the single person outcome, suggesting that they did not individuate the man and the woman in the experiment.

Although Wu (1997) claims that this procedure eliminates spatiotemporal information and hence is a test of infants' ability to individuate people on the basis of featural differences alone, there is as much *spatiotemporal* information in this procedure as there is in the procedure of her first experiment: once the man enters the display and walked behind the screen, the entrance of the woman from a different location than the man's actual location constitutes evidence of a second individual, *if the scene is construed as one involving physical objects*, since one object cannot be in two places at once. The fact that infants in Wu's first experiment were able to individuate the two people, but the infants in her third experiment were not, suggests that infants are not making use of the positional information to individuate the two people, but are individuating on the basis of some other information. This suggests that infants' ability to use positional information together with property differences among people to individuate people is limited. There is some evidence of similar limits on infants' ability to use positional information to individuate inanimate objects. Uller, Carey, Huntley-Fenner, and Klatt (in press) found that 8-month-old infants are unable to individuate two identical inanimate cone-shaped objects if the objects are lowered one at a time behind a screen from the same invisible location above the screen. Infants of this age can individuate the objects if one object is introduced into the display before the screen is raised to occlude the object's actual location (see also Wynn, 1992). Apparently, there are constraints on 7- to 8-month-old infants' to reason about distinct locations. Of the conditions required for infants to reason about two locations, one is that the locations must be specified by sufficient distance in space, such as the two opposite edges of a display, and by the placement of an object at a location in full view of the infant before occluding it and introducing a second object. If these conditions are met, then infants are able to construe the display as involving distinct, cohesive, continuously moving and continuously existing objects.

There are important differences between the inanimate object case and the person case, however. The first is that whereas the evidence reviewed above shows that infants as young as four months can use certain positional information alone to individuate inanimate objects (Spelke & Kestenbaum, 1986; Spelke *et al.*, 1995a; Uller *et al.*, in press; Wynn, 1992; Xu & Carey, 1996), there is

no evidence that 7-month-old infants can use positional information alone to individuate two people. Indeed, as described above, Wu (1997) found that even 11-month-old infants were not consistently able to use positional information together with featural differences between two people (i.e. a man and a woman) to individuate the people. In contrast, by 10 months, infants are able to individuate two featurally identical inanimate objects even if they are lowered behind a single screen one at a time from the same invisible location (Uller *et al.*, in press). These findings suggest that there are differences in infants' ability to use positional and featural information to individuate people and to individuate inanimate objects.

One possible reason for the difference in infants' ability to use positional information to individuate two people or to individuate two inanimate objects is that infants may not conceive of people as physical bodies subject to spatiotemporal principles. This is consistent with the work by Woodward *et al.*, (1993) reviewed above which suggests that 7-month-olds suspend the principle of contact when reasoning about people, but it leaves unexplained the finding that infants of this age can individuate two people under some conditions (e.g. when a man and a woman appear from opposite edges of a television monitor before being occluded by a central occluder). An alternative to the possibility that infants do not conceive of people as spatiotemporal bodies is that the televised displays themselves lead infants to construe the televised people as non-physical. That is, perhaps the appearance of people from the edges of a television monitor is perceived as discontinuous motion and leads infants to conclude that the televised people are not physical bodies, even though infants may construe actual people as physical bodies. Again, Wu's experiment in which infants individuated two people when they appeared from different sides of the monitor suggests that infants are able to construe the people as physical bodies under some conditions, even if the people are televised. Also the Woodward *et al.*, (1993) condition with inanimate objects provides further evidence that the appearance of objects from the edge of a television screen is not problematic, as does the study by Sabbagh and Baldwin (1997). Infants were able to use the principle of contact to reason about televised inanimate objects which appeared from the edge of a television screen, suggesting that they construed the display as one involving physical bodies. To put this potential problem to completely to rest, however, it would be necessary to either replicate Wu's experiment with

live people, or to test infants in a televised version of the events involving inanimate objects.

Another possibility which may account for the differences in infants' ability to individuate inanimate objects as compared to people is that infants construe both inanimate objects and people as members of the kind physical object but may have more difficulty deploying this concept in the case of people. Inanimate objects are easy to predict, because they do not tend to move on their own or change shape, whereas people are constantly in motion and are constantly undergoing shape changes (e.g. sitting, standing, walking, etc.) As a result, positional criteria alone may be sufficient for infants to judge that they are in the presence of two physical objects, but for people, much more information is needed. In particular, people must be clearly distinct featurally and must appear from clearly different locations before infants can judge that they are in the presence of two objects. In the absence of this information, infants presumably judge that they are in the presence of one object. Importantly, on this possibility, infants represent inanimate objects and people as the same kind of entity, namely physical object, but their ability to deploy the concept in individuating two people is dependent on clear positional and featural information.

A final possibility which may account for the differences in infants' ability to individuate inanimate objects as compared to people may result from infants' deployment of different sortals. The behavior and appearance of inanimate objects may invoke the concept of physical object, whereas the behavior and appearance of people under certain conditions may invoke the sortal person or animate entity. Infants may be able to individuate both members of the kind physical object and members of the kind person or animate entity, and may even be able to individuate a member of one kind and a member of the other, but the conditions under which these sortals are evoked differ. Under many conditions, positional information alone may be sufficient for the sortal physical object to be evoked, but, importantly, positional information is not needed for the sortal person or animal entity to be evoked. Rather, on this possibility, featural differences together with behavioral differences are what are necessary. Recall that Meltzoff and Moore (1992, 1994, 1995, 1998) suggested that imitation behavior by infants may help them to establish the identity of the person by attempting to communicate with the person and ask if he/she is the same one as seen before. A related possibility is that the distinct behavior and appearance of two different people are necessary for person individuation. This sort of

information was only provided in Wu's condition in which a man and a woman, that is two featurally distinct people, behaved differently, that is the man walked into view from the left (potentially construed as a goal of going to and the woman walked into view from the right. In the experiment with the identical twins, although the twins behaved differently (i.e. walking into view from different parts of the display), they did not differ featurally. And in the experiment with the man and the woman walking into the display from the left hand side only, the people differed featurally, but they behaved in the same manner. Thus the sortal person or animate entity was evoked in the first experiment, leading to individuation, but not in the latter two experiments.

If 11-month-old infants represent people simply as belonging to the kind physical object, then infants presumably would not be able to individuate people on the basis of featural information alone, since they are not able to individuate inanimate objects on the basis of this information. Alternatively, if infants represent the sortal person or animate entity, infants may well be able to individuate two people in the absence of spatiotemporal information if presented with two featurally distinct people who behave differently. This would be consistent with work by Sabbagh and Baldwin (1997) described in section 2.2.1 in which infants were able to use the form-correlated motion of two inanimate objects to individuate the objects. Adapting to people the procedure which Xu and Carey (1996) used to investigate infants' ability to individuate inanimate objects would permit a test of the above-mentioned possibilities as regards person individuation. That is, infants could be presented with a man and a woman (i.e. two featurally distinct people) emerging from opposite ends of a central occluder (i.e. the people behave differently), and then the occluder could be removed to reveal one or two people. If infants require spatiotemporal information of a certain kind together with featural information to individuate two people (i.e. if they construe people as members of the kind physical object), then infants should not find the single person outcome unexpected. On the other hand, if infants find the single person outcome unexpected, this would suggest that they are able to individuate two people on the basis of featural and behavioral differences between them. This would be consistent with the possibility that spatiotemporal information is not necessary to individuate people, and it would provide support for the possibility that infants of 10 or 11 months, or even younger, have the sortal person or animate entity.

2.2.3 Individuating a Person and an Inanimate Object

2.2.3.1 Individuating a Doll's Head and an Inanimate Object

Bonatti, Frot, and Mehler (1998) conducted an experiment designed to investigate 10-month-olds' ability to individuate a person and an inanimate object. Bonatti *et al.* used a similar procedure to the one used by Xu and Carey (1996) to investigate infants' ability to individuate two inanimate objects. The stimuli used were a series of doll's heads with life-like features and a series of inanimate objects such as a car and a hole-punch. The doll's heads were a few centimeters wide and each head was placed on a wheeled platform 7 centimeters high. The platform was draped in fabric to give the appearance of a complete doll with a long dress. The inanimate objects were placed on a platform of equal height, without coverings. Infants' baseline preference for a single doll or a single inanimate object and their preference for a doll and an inanimate object together was first assessed using pairs of objects drawn from the set of dolls and inanimate objects. An occluder was then introduced into the display and a new doll was wheeled out from one side of the screen and then wheeled back behind the screen. A new inanimate object was then wheeled out from the other side of the screen and wheeled back. This was repeated a number of times and then the screen was removed to reveal both objects, or just one of the two objects. Whereas infants clearly preferred the two object display during the baseline phase, their interest in a single object increased during the test phase, and their interest in two objects diminished (see Figure 3). When the experiment was repeated using just the inanimate objects, infants showed no preference for either the single object outcome or the two object outcome in either the baseline or the test phases of the experiment (see Figure 4). Bonatti, *et al.* interpret these results as suggesting that 10-month-olds are able to use the distinction between a doll's head and an inanimate object to individuate the two objects. Infants of this age are not able to use the differences between two inanimate objects to individuate them when one of these is not a doll's head, consistent with the results of Xu and Carey (1996).

It is possible that the positive evidence that 10-month-olds can individuate a doll's head and an inanimate object on the basis of featural information alone found by Bonatti, *et al.*, rather than reflecting infants' ability to individuate a person and an inanimate object, may instead reflect yet another

set of conditions under which 9- to 11-month-old infants can individuate two inanimate objects (c.f. Sabbagh & Baldwin, 1997; Xu & Carey, 1996; Xu, 1998). The infants in Bonatti *et al.*'s experiment found the doll's head and the inanimate object highly interesting, as seen from their baseline preference for two objects. They may have noted that the doll's head and the inanimate object differed along more dimensions than are typical of two inanimate objects. But rather than infants actually representing the doll as an instance of the kind person, they may have represented the doll as an object of one inanimate kind while representing the other object as an object of a different inanimate kind. This then allowed them to individuate the objects.

These two interpretations of Bonatti *et al.*'s, (1998) results, that by 10 months infants have a sortal other than physical object, and that infants were able to construct two sortals during the experiment due to the large number of property differences between the two objects, could be teased apart by testing infants of this age with two highly interesting inanimate objects. If infants again show evidence of individuating the two objects, this would suggest that infants are constructing the two sortals during the experiment. Bonatti *et al.*'s results would thus contribute to the understanding of the conditions under which infants between 9 and 11 months are able to individuate inanimate objects. In addition to form-correlated motion (Sabbagh & Baldwin, 1997) and the use of a specific count noun to highlight kind differences (Balaban & Waxman, 1995; Xu, 1998), the presentation of two inanimate objects with very different features from each other may highlight kind differences. Alternatively, if infants are unable to individuate just any two inanimate objects which are highly interesting, then this would provide evidence that it is the doll's features which are important in this task. In turn, this would suggest that 10-month-old infants genuinely do have a sortal other than physical object. Further research would be needed to uncover whether this sortal is the sortal person, animate entity, animal, etc. If infants only show evidence of having a sortal such as animate entity, this would continue to provide evidence that children do not have sortals at a more specific level than physical object, while it would suggest that physical object is not the only sortal infants of 10 months have. On the other hand, if infants of this age are able to individuate a person and another animal, such as a dog, this would suggest that infants of this age do have sortals more specific than physical object, for example sortals such as person and dog, or person and non-human animal.

2.2.3.2 Individuating a Live Person and an Inanimate Object

Fei Xu, Susan Carey and I conducted an experiment to assess 10-month-olds' ability to individuate a person and an inanimate object using a live person as a stimulus (Sorrentino, Xu, & Carey, 1996). The person who served as the stimulus in the experiment was a female undergraduate. We presented infants with only the person's head and did not show them the rest of the person's body, which was concealed in the testing apparatus. The latter was the size of a small table, about four feet long and two feet wide, with a blue top edged with black curtains. The top of the apparatus had a long narrow slit in it running the length of the apparatus. The slit was wide enough for the person's neck, but widened in the middle to permit the person to lift her head out of the apparatus, and to lift out the inanimate stimuli. The inanimate object contrasted with the head was a colorful toy clock of similar size. The apparatus was placed in at one end of a small room and the space around and above the apparatus was concealed with black curtains. Infants sat the opposite end of the room from the apparatus, five feet away. This arrangement roughly equated the visual angle of the display with the visual angle of the displays commonly used in infant studies.

Forty-eight 10-month-old infants participated in the experiment, sixteen in each of the three conditions. Infants in the Baseline condition were first tested in an unrelated study using the same apparatus. This was done because a pilot study revealed that infants in the baseline had significantly longer looking times than infants in the test conditions, and also infants in the baseline condition showed a very marked preference for looking at a person and an inanimate object. After participating in the unrelated experiment, infants in the Baseline condition were simply shown the person's head and the clock together, or just one of the two objects. In all conditions, whenever the head was visible, the person fixated a spot on the wall behind the infant and had a smiling expression. Infants in the Property/Kind condition were shown a screen lowered into the empty display. The person's head then appeared to one side of the screen and returned behind it and then the clock appeared from the other side of the screen and returned behind it. Infants were then shown each object emerge one at a time. Each object was left in full view until the infant turned away, and then the other object emerged and was left in full view until the infant turned away. This was repeated until the infants habituated (see Figure 5). After habituation, the objects were briefly shown again, one at a time, and then the screen was removed to

reveal both the head and the clock, or just one of these objects. Infants in the Spatiotemporal condition saw the two objects briefly emerge simultaneously, one on either side of the screen prior to habituation (see Figure 6). They were then fully habituated in the same manner as infants in the Property/Kind condition. After habituation, infants were again briefly shown the two objects simultaneously. The screen was then removed to reveal both objects or just one of them.

As shown in Figure 7, infant looking to the test outcomes in the Property/Kind and Spatiotemporal conditions mirrored looking in the Baseline condition. A two-way ANOVA with condition (Baseline, Property/Kind, Spatiotemporal) and number of objects (One, Two) revealed an effect of number. Infants looked longer overall at the two object outcome (11.9 seconds) compared to the one object outcome (7.3 seconds), $F(1,45) = 17.984, p < .001$. There was no effect of condition and no interaction between condition and number (both F 's < 1.0 and both p 's $> .5$). These results suggest that infants did not individuate the person and the clock either on the basis of featural information alone or on the basis of spatiotemporal information coupled with featural information, because they simply looked longer at the two object outcome in all three conditions.

In a follow up experiment, we attempted to replicate the Spatiotemporal condition of Xu and Carey (1996, Experiment 4) with 10-month-olds using our larger display. Twenty-two infants were tested in the experiment. Each infant served as his or her own baseline. The stimuli used were a toy plane, a toy truck, a fake flower in a pot, a large colored bottle, and two nonsense objects of different colors and shapes from the other objects. All the stimuli were roughly the same size as the clock and the person's head. These stimuli were several times larger than the stimuli used by Xu and Carey (1996) and at least twice as large as the stimuli used by Bonatti *et al.*, (1998). Infants' baseline preferences were measured using two pairs of objects from the stimulus set. This was followed by a full habituation and test procedure which unfolded exactly like the Spatiotemporal condition in the first experiment. As with the Property/Kind and Spatiotemporal conditions involving a person and a clock in the first experiment, infants showed the same preference for two objects in the test events as they did in the baseline (see Figure 8). A two-way ANOVA with condition (Baseline, Test) and number of objects (One, Two) as within subject factors revealed an effect of number. Infants looked longer overall at the Two object outcome (9.4 seconds) compared to the One object outcome (7.2 seconds), $F(1,21) = 13.515, p < .01$. There

was no effect of condition (Baseline, 9.6 seconds, Test, 7.0 seconds), $F(1,21) = 2.938$, $p = 0.101$, and no interaction between condition and number, $F(1,21) = 0.176$, $p > 0.1$. These results suggest that infants did not individuate two large inanimate objects on the basis of spatiotemporal information, a finding which constitutes a failure to replicate Xu and Carey (1996) using large inanimate objects.

Why did infants fail to individuate two large inanimate objects when given both featural and spatiotemporal information that there were two objects behind an occluding screen? Since the procedure used in the experiment was virtually identical in all points with the Xu and Carey (1996) procedure, the change in size of the objects and apparatus in our experiment relative to the size of the objects and apparatus used in most studies may have resulted in one of two problems. One possible problem is that infants may not be able to reason about physical objects regardless of scale, be they persons or inanimate objects. Rather, early on in conceptual development, infants may only be able to apply their knowledge of physical objects to the objects they are most familiar with, namely small manipulable objects. Another possible problem is that the change in scale placed greater attentional and processing demands on the infants, preventing them either from fully encoding the two objects during habituation, or from fully encoding the test trial outcomes of one vs. two objects. I return to the discussion of these possibilities in section 2.2.3.3.

Because our primary interest was the investigation of infants' ability to individuate a person and an inanimate object, we decided to bracket the various possibilities regarding infants' failure to individuate two large inanimate objects. In our final experiment, we scaled the testing apparatus up once again to permit the presentation of an entire person as a stimulus. We did this because the design of the experiment just described and the failure to find evidence that infants can individuate a person and an inanimate object do not permit us to distinguish the possibility that infants fail to individuate a person and an inanimate object and the possibility that infants only track the continued presence of the person in the experiment. On this second possibility, infants may realize that people's heads are connected to their bodies. If this is so, then infants in the experiment may have represented the continued existence of the person and failed to evince interest at the person's disappearance when they saw just the clock by itself. That is, infants may have assumed the person's head was inside the apparatus where the person's body had been while the head was visible. While this possibility does not explain infants' failure to individuate two large

objects, it does argue for a change of procedure in probing infants' person and inanimate object individuation abilities further. To eliminate this problem, we constructed a room-sized apparatus with a false wall (see Figure 9). A screen large enough to conceal a person and a large inanimate objects was suspended on pulleys and used as an occluder. Invisible nylon wire was tied to the screen to permit it to be turned to reveal the outcomes. A concealed door permitted objects to be surreptitiously introduced into the room and removed from the room from behind the screen. Infants were seated at the opposite end of the room from the display to allow them to more easily see the entire display. It was not possible to equate visual angle with displays usually used in the study of infant cognition given the size of the space available to us.

We adapted the procedure of Wilcox and Baillargeon (in press) for this experiment. This procedure has the advantage of allowing the presentation of purely featural information that there are two objects behind an occluder, without the problem that infants must overcome their intrinsic preference for looking at two objects during the test outcome. In this procedure the same object is used during all the test trials in all the conditions. Fifty-five ten-month-old infants were tested in the experiment, twenty in the Box-Only condition, twenty in the Box-Object condition and fifteen in the Box-Person condition. In the Box-Only condition, infants were shown a large, colorful box on wheels emerge from behind the screen and return behind it and then the box emerge from behind the other side of the screen and return behind it (see Figure 10). Infants were then habituated to alternating emergences of the box. On each habituation trial, the box emerged and remained stationary in full view until infants turned away. The box then returned behind the occluder and appeared on the other side, stationary and in full view. After habituation, the box briefly emerged from each side of the screen, and then the screen was turned to reveal the box. In the Box-Person condition, infants were shown the same events, except that a live person alternated with the box (see Figure 11). One of two women served as stimuli in the course of the experiment. A given infant saw only one person and there were no differences in the results as a function of which woman served as the person stimulus. As in the head study, when the person was visible to the infant, she fixated a spot on the wall behind the infant and had a smiling expression. After habituation, infants were briefly shown the person emerge from behind one side of the screen and return behind it and the box emerge from behind the other side of the screen and return behind it. The screen was then turned to reveal a single

object, namely the box. In the Box-Object condition, two inanimate objects were used (see Figure 12). One object was the same box as was used in the two other conditions and the other object was a distinct triangular object of roughly the same size as the box but with different markings and colors. Before habituation, infants were briefly given spatiotemporal information that there were two objects behind the screen. That is, the objects were shown simultaneously appearing from behind the screen, one on each side, and then returned behind the screen. After habituation to the alternating stationary objects, infants were again briefly shown the two objects simultaneously, and then the screen was turned to reveal a single object, namely the box.

Figure 13 shows the mean looking times in the three conditions for the last four trials of habituation and the four test trials. To examine the extent to which infants in the Box-Only and the Box-Object conditions habituated to the box stimulus, the mean looking times to the box stimulus during the last two habituation trials in these two conditions for which the box was the stimulus were examined. The looking times in the Box-Only condition were yoked to the looking times in the Box-Object condition, such that each condition contained an equal number of looking times from the last and third to last trial of habituation and an equal number from the second to last and fourth to last trial of habituation. A one-way ANOVA was conducted on these times and revealed that there was no difference in looking times between the two conditions (Box-Only, 4.7 seconds; Box-Object, 5.0 seconds), $F(1,38) = 0.083, p > .10$. A one-way ANOVA was then conducted on the mean looking times during the test trials for these two conditions. This revealed that infants in the Box-Object condition looked significantly longer at the box during the test trials (3.5 seconds) than did infants in the Box-Only condition (2.6 seconds), $F(1,38) = 5.657, p < 0.05$. This pattern suggests that infants in the Box-Object condition found the single object display unexpected because they were able to individuate the box and the other inanimate object on the basis of spatiotemporal information. This replicates previous work on individuation of small inanimate objects (Spelke & Kestenbaum, 1986; Spelke *et al.*, 1995a; Xu & Carey, 1996).

To examine the extent to which infants in the Box-Only and the Box-Person conditions habituated to the box stimulus, the mean looking times to the box stimulus during the last two habituation trials in these two conditions for which the box was the stimulus were examined. The looking times in the Box-Only condition were yoked to the looking times in the Box-Person condition,

however since only fifteen infants were tested in the latter condition, and twenty were tested in the Box-Only condition, the trial orderings for the remaining five infants in the Box-Only condition were semi-randomly chosen so that there were an equal number of trials in the two orderings. A one-way ANOVA on these times revealed that there was a significant difference in looking to the box at the end of habituation. Infants in the Box-Person condition looked longer overall (6.5 seconds) compared to infants in the Box-Only condition (4.5 seconds), $F(1,33) = 5.170, p < .05$. A one-way ANOVA revealed that this difference between the conditions was also present during the test trials (Box-Person, 3.9; Box-Object, 2.6), $F(1,33) = 7.748, p < .01$. This pattern allows no clear interpretation of infants' ability to individuate a person and an inanimate object. On the one hand, the heightened attention of infants in the Box-Person condition at the end of habituation may have been carried over to the test trials without infants actually having individuated the person and the box. Alternatively, in addition to showing heightened attention to the box in the Box-Person conditions, infants may further have genuinely individuated the person and the box.

2.2.3.3 Discussion of Research on Infants' Ability to Individuate a Person and an Inanimate Object

In one experiment we failed to find evidence that 10-month-old infants can individuate a live person's head and an inanimate object of similar size on the basis of featural differences between them alone and we also failed to find evidence that infants were able to individuate two inanimate objects of similar size to the person's head and the inanimate object when given clear spatiotemporal information that there were two objects. In a second experiment using a much larger apparatus, we found some evidence that infants of this age can individuate a large box and an inanimate object on the basis of spatiotemporal cues, but we were unable to make conclusions about whether they can individuate a person and an inanimate object on the basis of featural differences alone. Two possible reasons were given above for infants' failure to individuate inanimate objects roughly the size of a person's head. One of these was a possible problem of scale: perhaps infants of this age are unable to reason about objects that are larger than the small, manipulable objects that have been used in previous studies of inanimate object individuation in infants. The results of the large room experiment argue against this possibility, since some

evidence was found that infants are able to individuate even larger inanimate objects than the head-sized ones. The second possible reason for the failure to find evidence of individuation of head-sized inanimate objects which was suggested above is that the increased size of the object and apparatus increased the attentional demands on the infants and that this may have interfered with the encoding of the objects either during the habituation phase of the experiment or during the test phase. The results of the experiment with the larger apparatus and inanimate objects suggests that the problem was not with the habituation phase, since the type of information presented was the same in the two experiments. Rather, infants' ability to individuate the objects in the larger display suggests that the problem was with the test outcomes. The two experiments differ in one important respect: the head-sized object study involved test outcomes with one or two objects, whereas the large object study involved test outcomes with only one large object. Thus while the increased scale increased infants' attention to the display during habituation, once this phase of the experiment was over, the attentional demands on the infants were presumably too great to encode a two object outcome. Presenting a single object outcome in the larger object display circumvented this problem and revealed that infants can indeed individuate large inanimate objects.

We found no clear evidence that 10-month-old infants are able to individuate a live person and an inanimate object. This is consistent with a number of possibilities as regards the infants' conceptual state. The first is that the kind differences between the person and the inanimate object are not sufficient to individuate the two objects. On one version of this possibility, infants simply do not have a sortal more specific than physical object. This sortal includes people as well as inanimate objects. On a second version of this possibility, infants do have a concept person, but it is not a sortal. Rather, it subsumes the sophisticated knowledge that infants have about people, such as the knowledge that people engage in goal-directed behavior, without supporting individuation and identity. Another possibility, mentioned above, is that infants are in fact able to individuate the person and the inanimate object in the large object experiment, but this was obscured by infants' heightened attention to the box at the end of habituation in the Box-Person condition.

While more research is needed to untangle these possibilities, it is worth bearing in mind that whereas several attempts have been made to uncover evidence of person individuation in infancy, firm evidence has been difficult to

gather. While work by Bonatti, *et al.* provided clear evidence of individuation of a doll's head and an inanimate object by 10-month-olds, it has the interpretive problem that infants may construe the doll as a very interesting inanimate object, rather than as a person. As just discussed, our large person experiment with 10-month-old infants is inconclusive. Work by Meltzoff and Moore (1992) suggests that six-week-old infants do not individuate two people if they are not given clear positional and featural information and work by Wu (1997) suggests that this continues to be true of infants as old as 11 months. Together, the results of these studies may indicate that infants may not individuate people until they are a year old or older.

2.3 Conclusion

The research described in this chapter suggests that 5- to 12- month-old infants' ability to distinguish animate and inanimate objects and engage in domain specific reasoning may be distinct from 7- to 11-month-old infants' ability to individuate people or to individuate a person and an inanimate object. How are people represented by infants? Infants' differential ability to reason about people as social entities which behave in a contingent manner, have goals etc. on the one hand, and people as physical objects (i.e. Wu's (1997) finding that infants can individuate two featurally distinct people under some circumstances) on the other, reflects the dual aspects of people. People are both social entities engaging in interactions with others, and physical entities subject to the effects of gravity and inertia. For the moment, it is not clear which sortal or sortals infants deploy when reasoning about people. The possibilities considered were the following. (a) Infants 7- to 11- months of age do not think of people as physical bodies subject to spatiotemporal constraints. (b) Infants 7- to 11- months of age construe both people and inanimate objects as belonging to the kind physical object, but the criteria required to invoke this concept differ for the two, with spatiotemporal information being sufficient for inanimate objects, but featural information together with clear spatiotemporal information being required for people. On this possibility, infants do not have sortals other than physical object. (c) Infants have two sortals at the same level of specificity, physical object and animate entity. (d) Infants have the sortal physical object and may have more specific sortals, but only in the domain of animals (e.g. person, and dog). A good deal more research is needed to sort out these possibilities, and to this end, a

number of experiments were proposed above. Further research will contribute to the discovery of how infants' ability to reason about animate and inanimate entities relates to their ability to individuate animate and inanimate entities, and to the understanding of the development of concepts such as physical object, intentional entity, person, and animate entity.

It is worth considering whether infants initially individuate people as intentional entities and then later reconceptualize people as physical objects. The evidence reviewed in this chapter leaves open the possibility that infants reason about people as intentional entities before they reason about them as physical objects. Infants' ability to trace the identity of people may well have its origin in infants' ability to individuate intentional entities. Once they have candidate intentional individuals, infants may then learn that these individuals have particular properties, such as a characteristic physical appearance and being subject to spatiotemporal constraints. Evidence from Wu (1997) reviewed above could be taken to suggest that this possibility does not actually obtain, since infants as young as 7 months seem able to use certain kinds of spatiotemporal information and along with featural differences between people to individuate them. However, this possibility may be true for younger infants, and by 7 months infants may be in the process of reanalyzing people as physical objects. Although this possibility is an interesting conceptual one, the methods used for assessing infants' ability to individuate physical objects are not appropriate for addressing how infants individuate and identify intentional entities, and unfortunately no other method is an obvious candidate for exploring this possibility.

The evidence presented in this chapter bears on children's representation of the referents of their first proper names. Children begin to produce words which appear to be proper names for important individuals in their environment in the first year to year and a half of life. These typically include names for parents and other caretakers, siblings and family pets. It is often difficult to determine if children's earliest words are being used by children to refer to entities in the world in an adult-like manner, or if they are simply producing words which they have heard repeatedly and learned to associate with highly familiar entities. As outlined in Chapter 1, proper name representation depends on the ability to individuate and identify named individuals over time. But without clear evidence that infants are able to individuate and identify people in the first year of life, two possibilities regarding the reference of children's first proper names are left open. On the first, if proper name

production precedes person (and animal) individuation and identity, this would suggest that children's first proper names are associated with highly familiar people and animals without referring to people and animals as individuals. Children presumably later reanalyze proper names as referring to individuals. On the second possibility, proper name production by a given child may coincide with the development of the child's ability to individuate and identify people and other animals. More research is needed to uncover how children's proper name learning relates to their ability to individuate people and trace their identity over time.

Property/Kind Condition

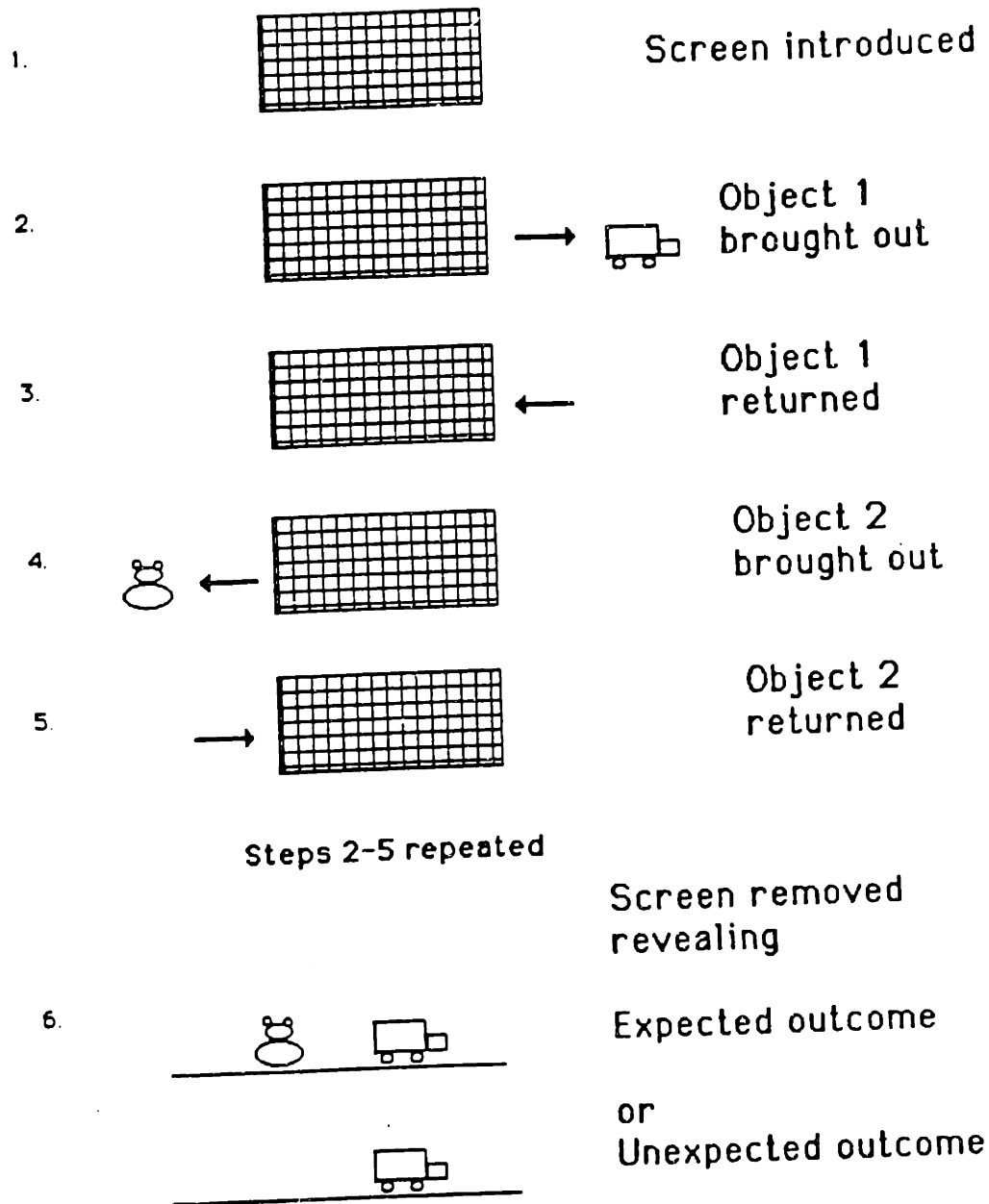


Figure 1. Depiction of the Procedure Used by Xu & Carey (1996) to Evaluate 10-month-old Infants' Ability to Individuate Objects on the Basis of Featural Differences alone(after Xu & Carey, 1996)

Figure 2. Mean Looking Times to the One Object and Two Object Outcomes by 10-month-olds in the Three Condition Involving Small Inanimate Objects (after Xu & Carey, 1996).

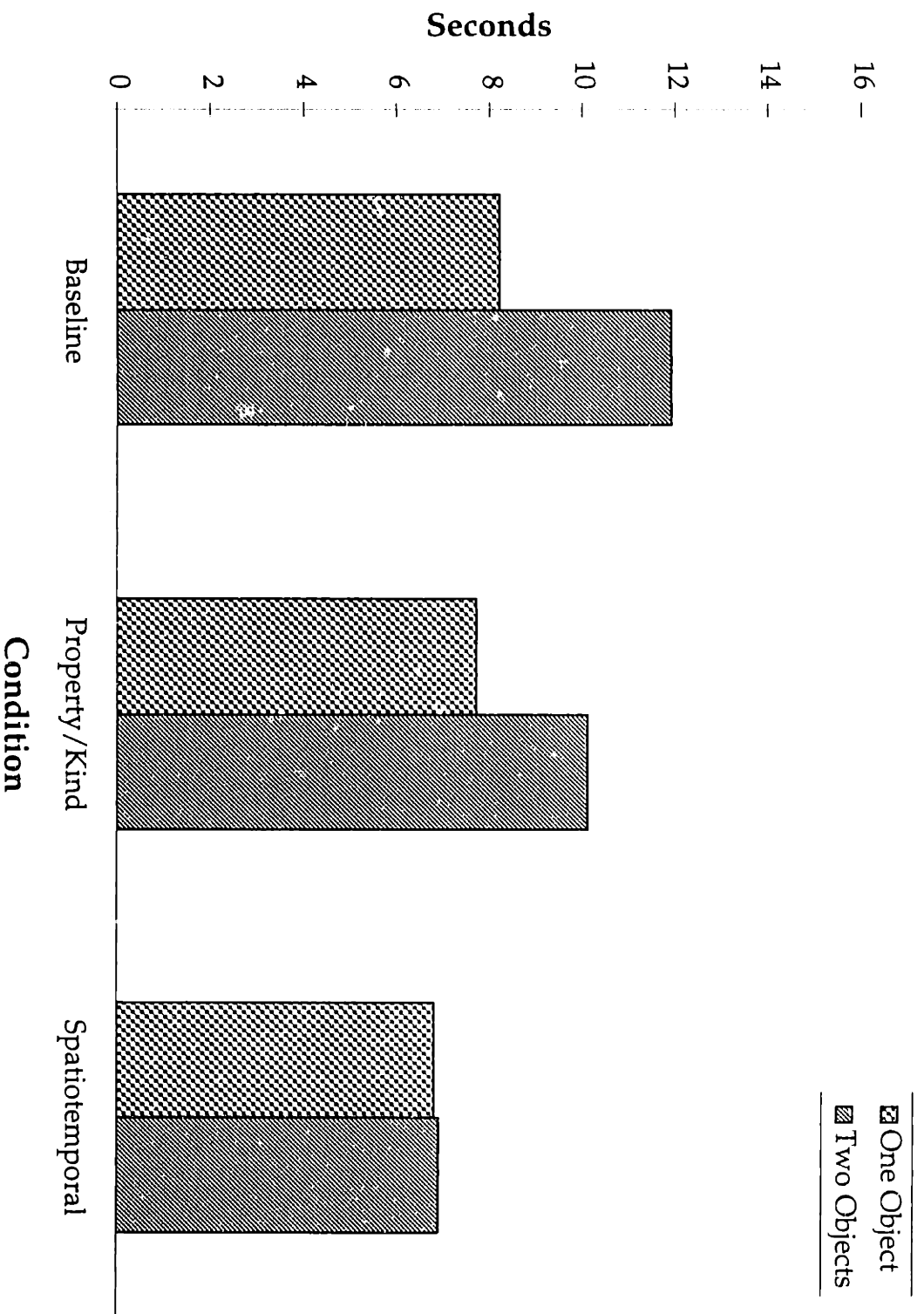


Figure 3. Mean Looking Times by 10-month-olds to the One Object and Two Object Outcomes Involving a Doll's Head and an Inanimate Object (after Bonatti, Frot, & Mehler, 1998).

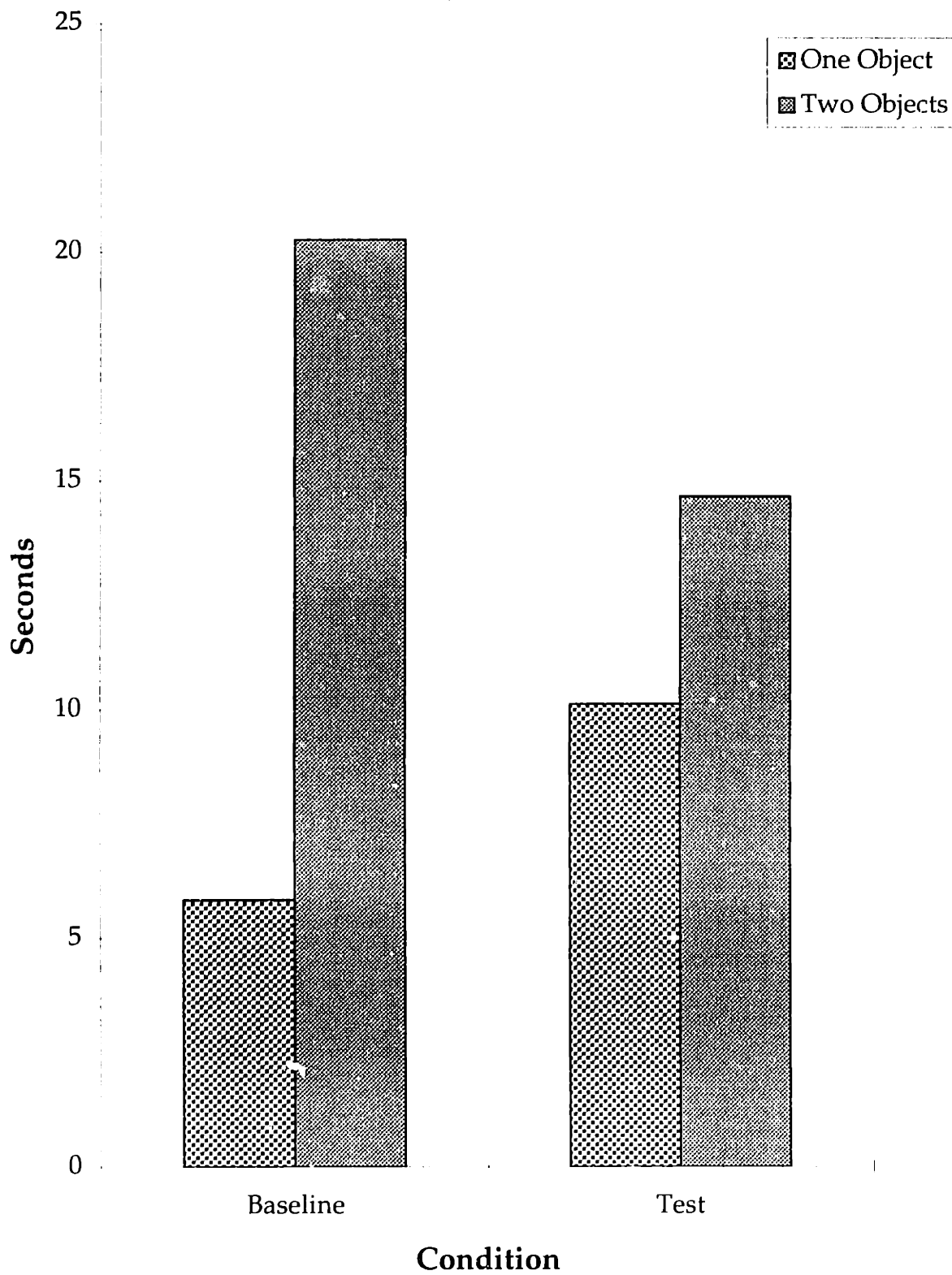


Figure 4. Mean Looking Times by 10-month-olds to the One Object and Two Object Outcomes Involving Two Inanimate Objects (after Bonatti, Frot, & Mehler, 1998).

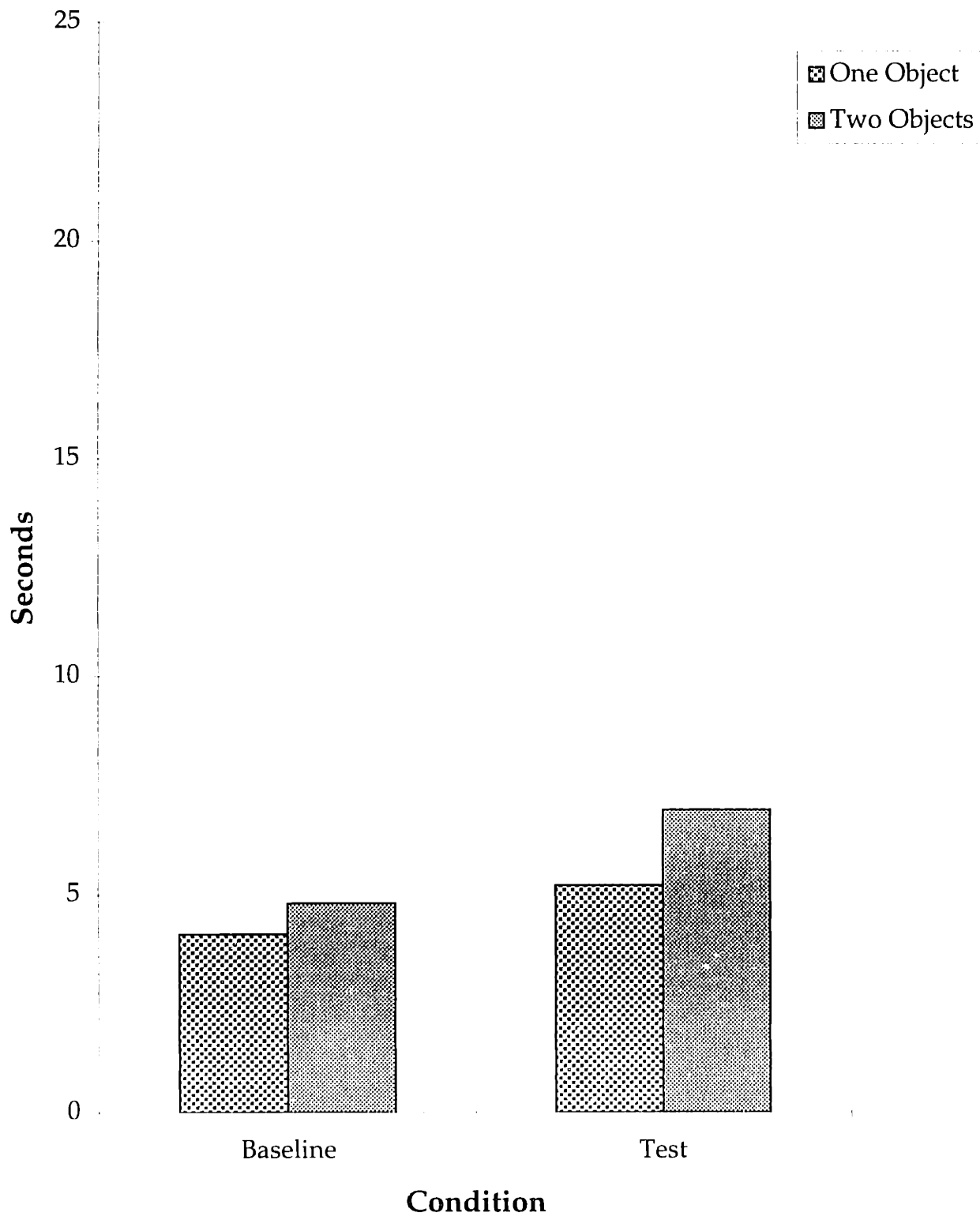


Figure 5. Depiction of the Procedure Used to Evaluate 10-month-old Infants' Ability to Individuate a Person's Head and an Inanimate Objects on the Basis of Featural Differences alone

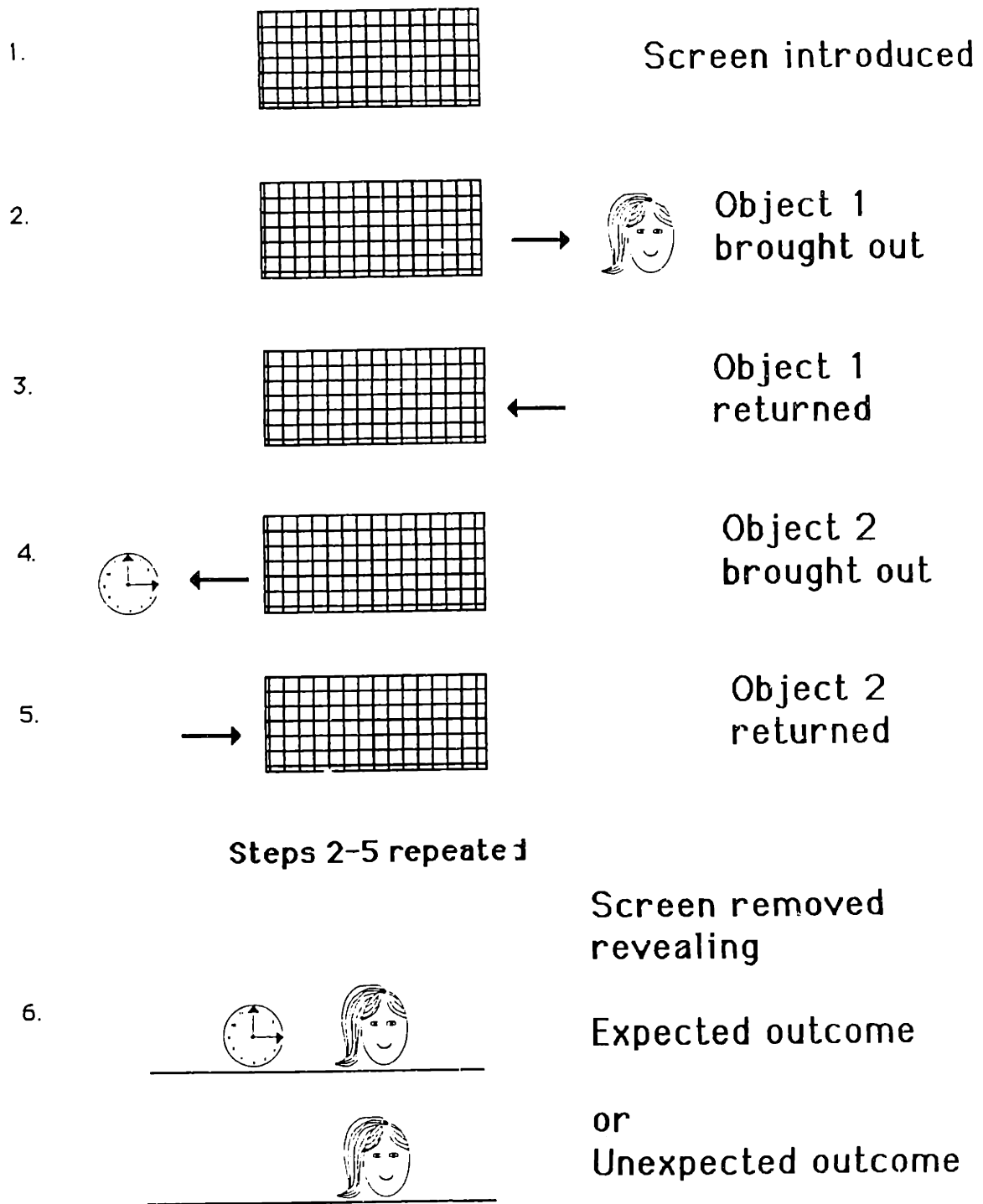


Figure 6. Depiction of the Procedure Used to Evaluate 10-month-old Infants' Ability to Individuate a Person's Head and an Inanimate Objects on the Basis of Spatiotemporal and Featural Information

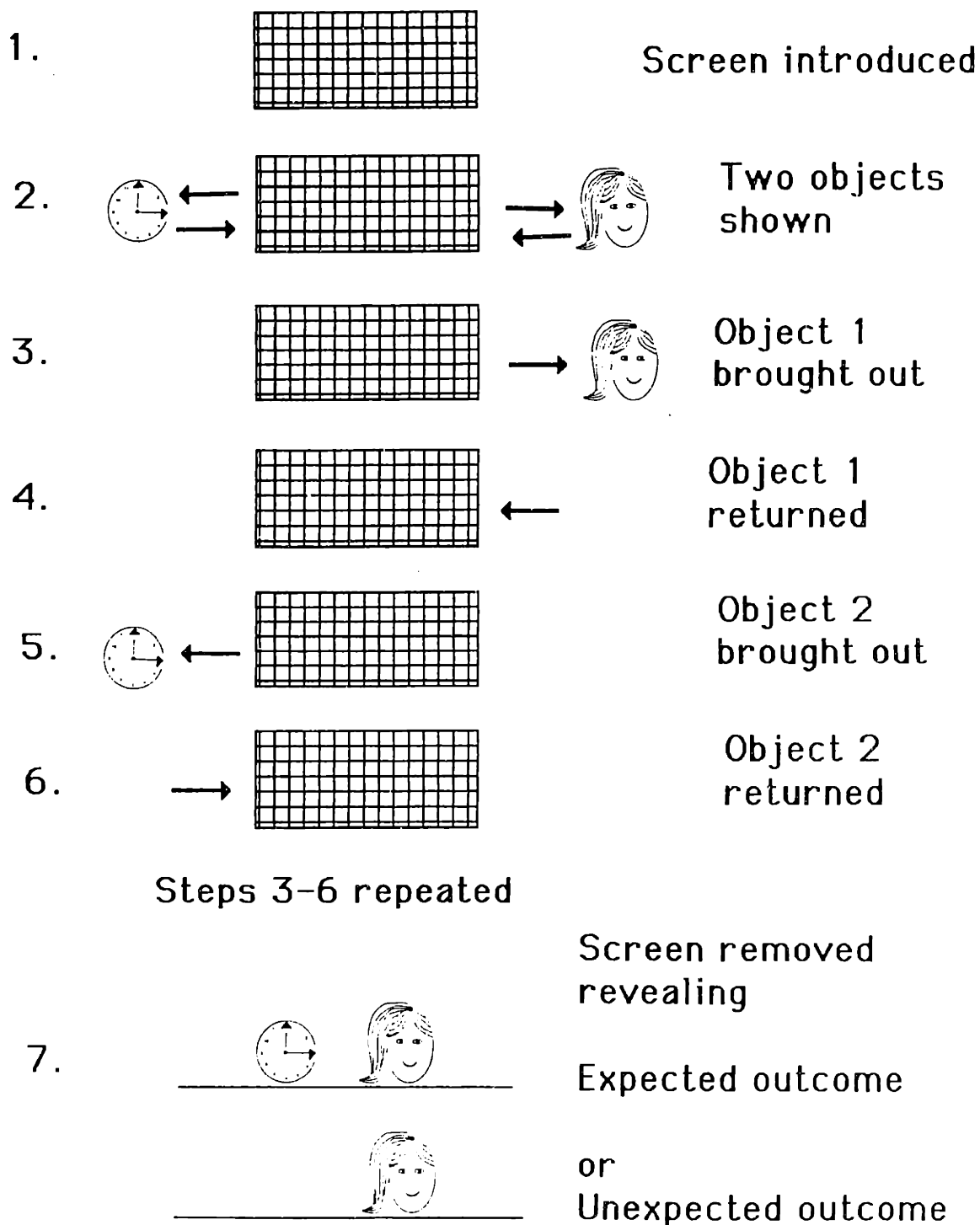


Figure 7. Mean Looking Times to the One and the Two Object Outcomes by 10-month-olds in Sorrentino, Xu, & Carey's Experiment on Infants' Ability to Individuate a Person's Head and an Inanimate Object.

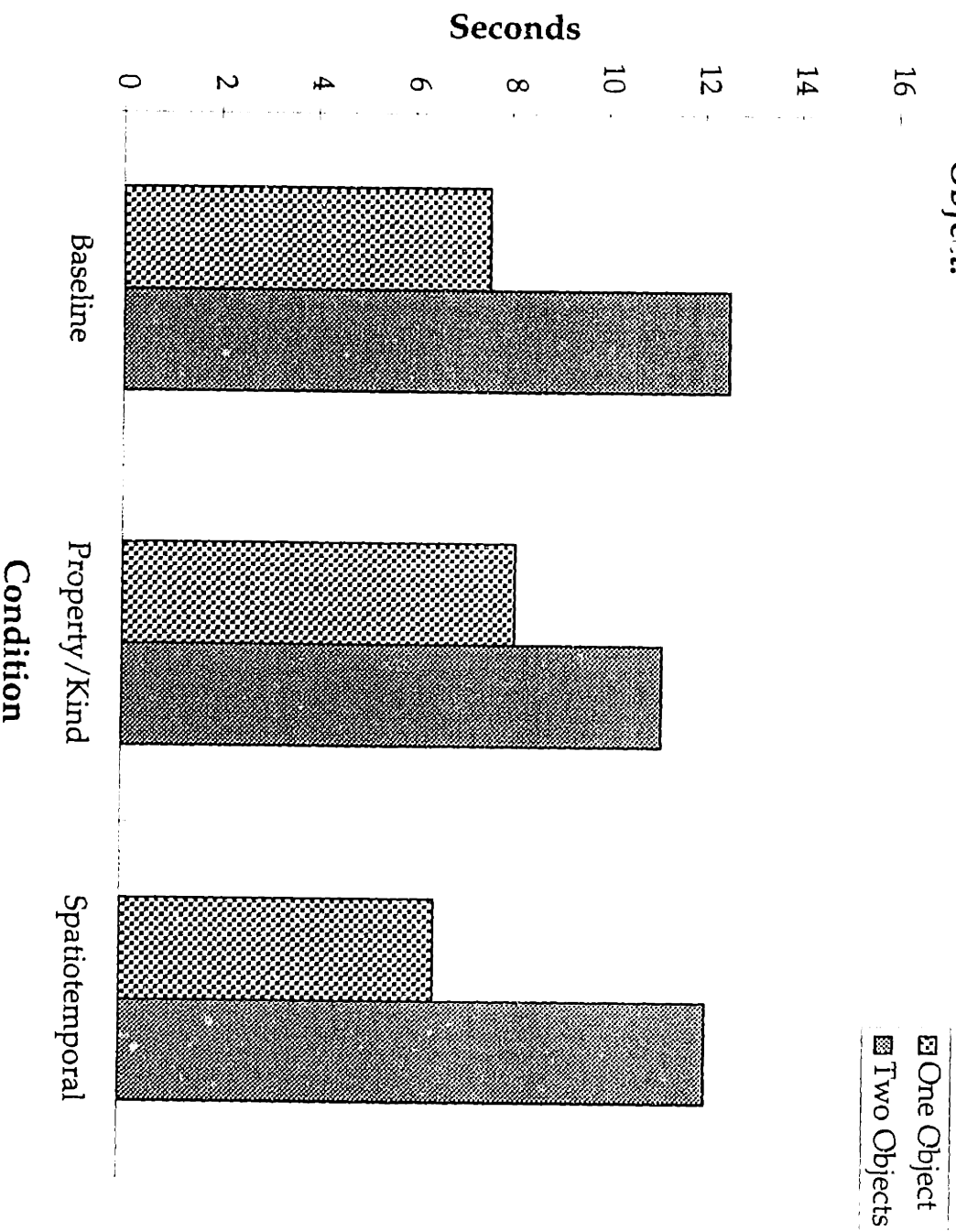
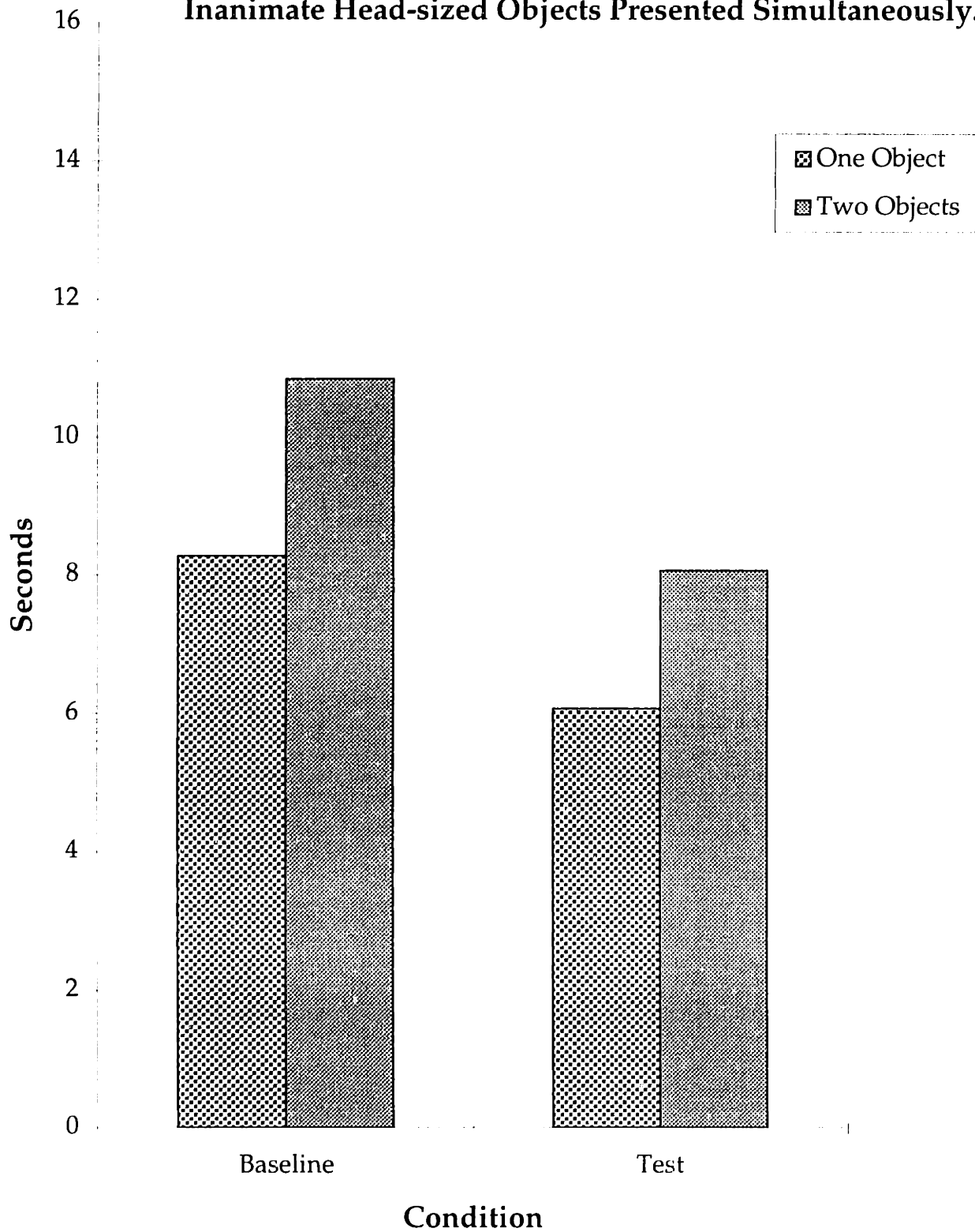


Figure 8. Mean Looking Times to the One and the Two Object Outcomes by 10-month-olds in Sorrentino, Xu, & Carey's Experiment on Infants' Ability to Individuate Two Inanimate Head-sized Objects Presented Simultaneously.



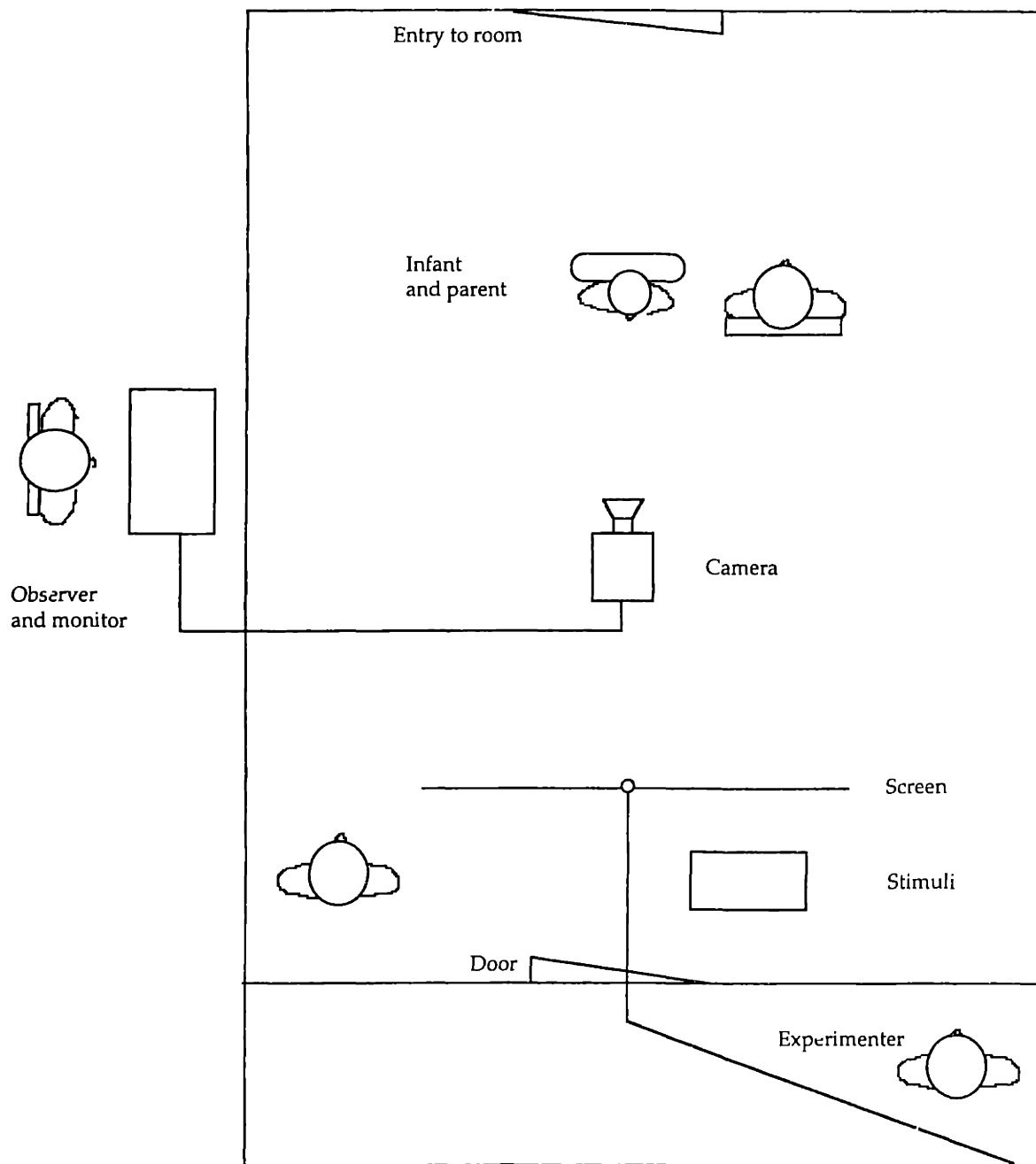
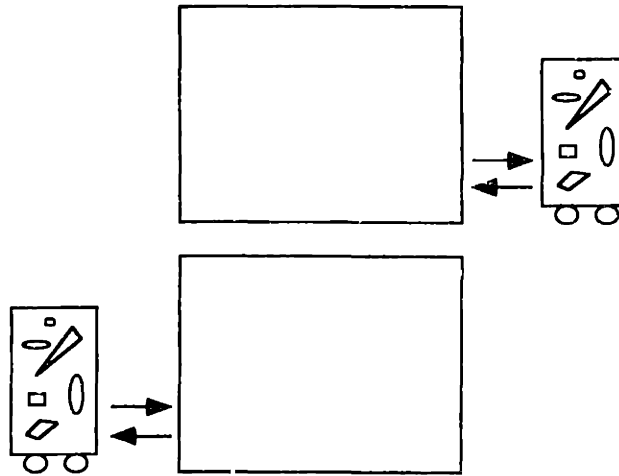
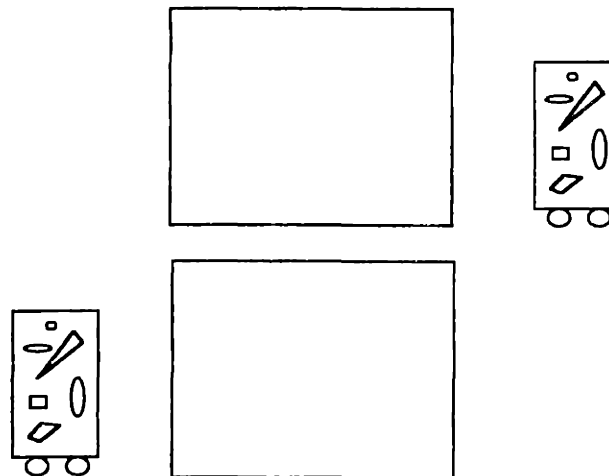


Figure 9. Lay-out of the Room-sized Apparatus Used to Evaluate 10-month-old Infants' Ability to Individuate a Live Person and an Inanimate Object on the Basis of Featural Differences alone

Brief presentation
of box on both
sides of screen



Full habituation
to stationary box
on alternating
side of screen



Brief presentation
of box on both
sides of screen

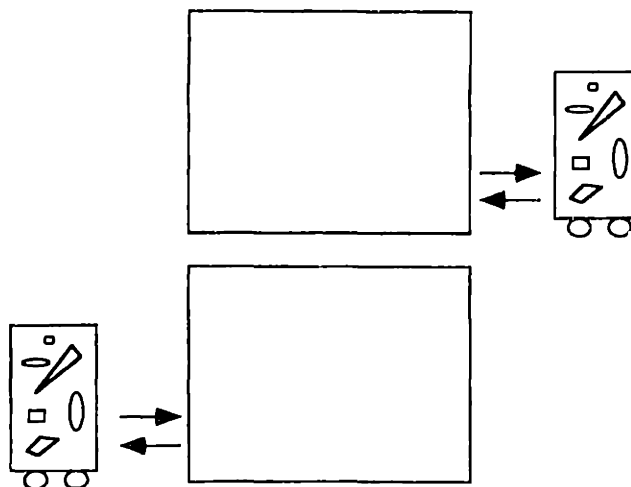
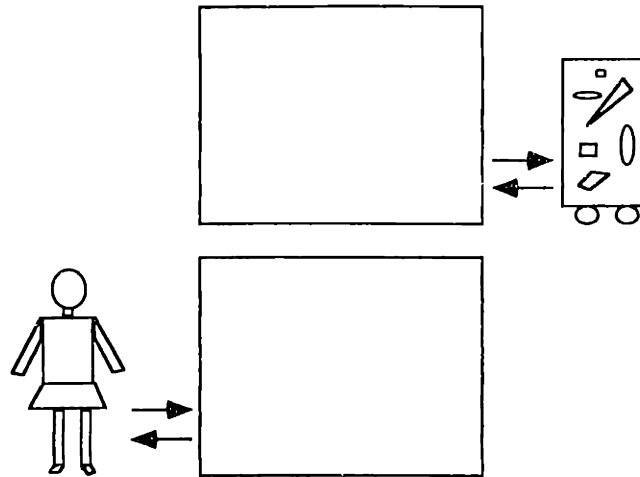
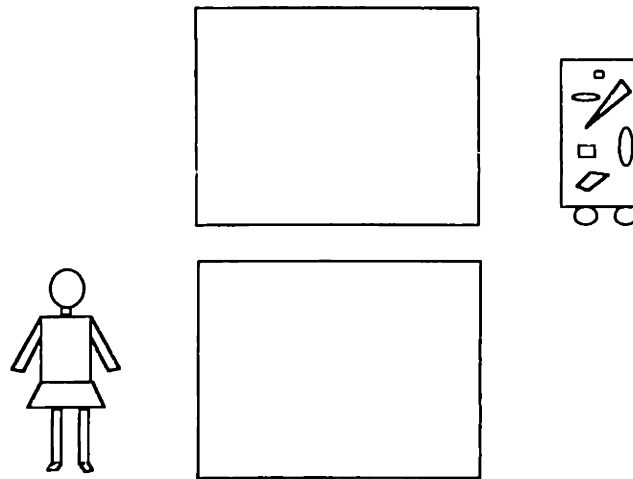


Figure 10. Depiction of the Box-Only Procedure (after Sorrentino, Xu, & Carey, 1996)

Brief presentation
of person and box,
one at a time



Full habituation
to stationary person
alternating with
stationary box



Prior to revealing outcome,
brief presentation of person
and box again, one at a time

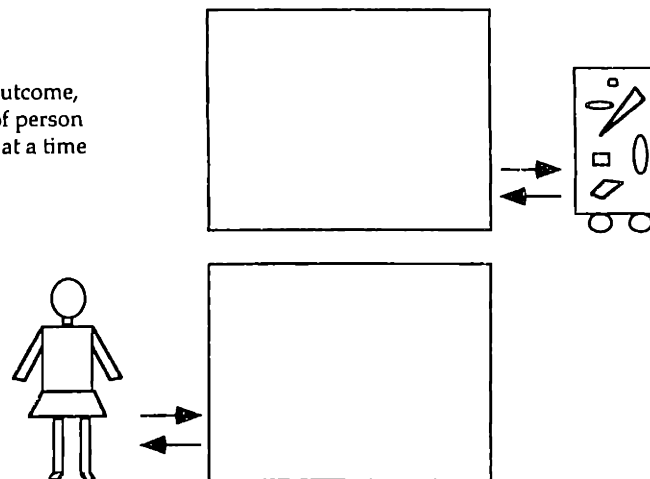
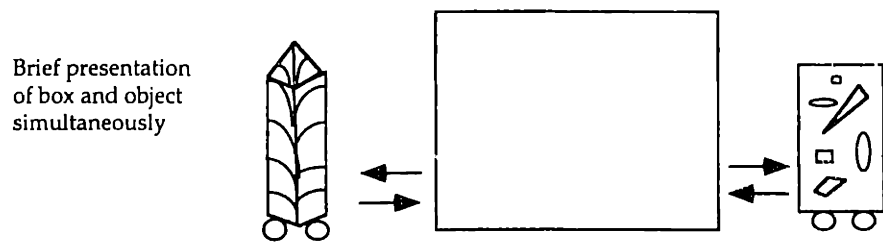
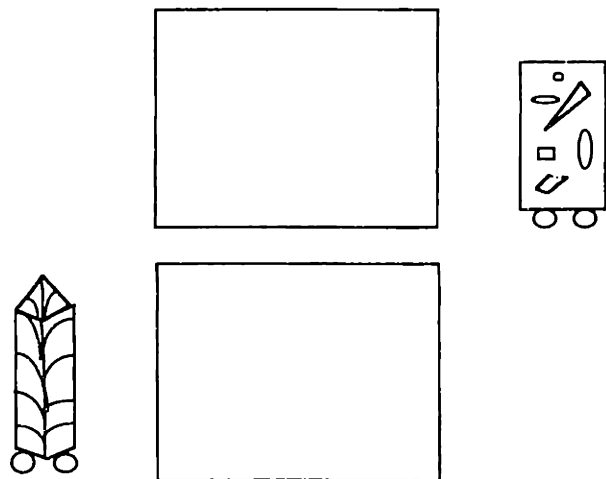


Figure 11. Depiction of the Box-Person Procedure (after Sorrentino, Xu, & Carey, 1996)



Full habituation
to stationary box
alternating with
stationary object

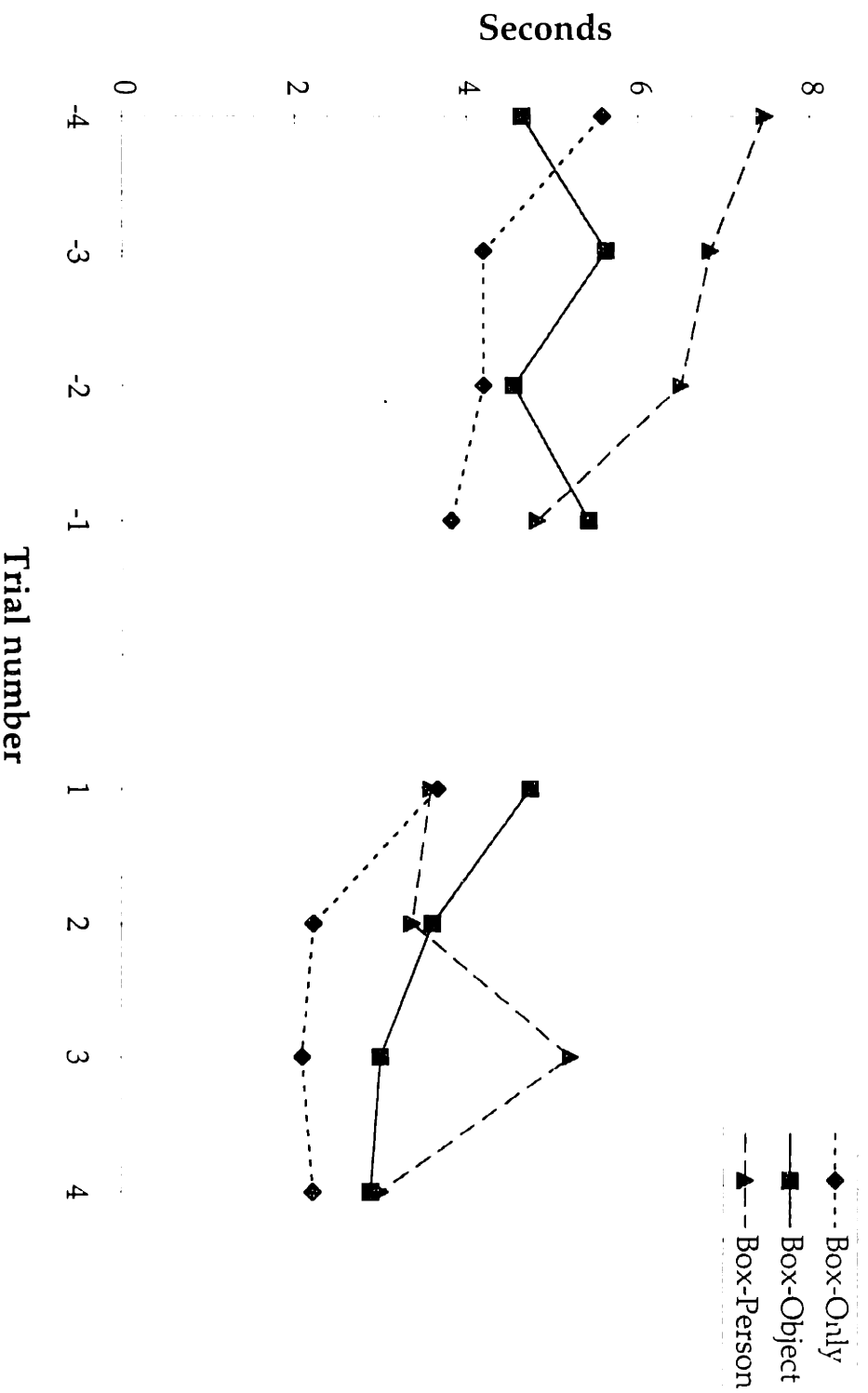


Prior to revealing outcome,
brief presentation of box
and object simultaneously



Figure 12. Depiction of the Box-Object Procedure (after Sorrentino, Xu, & Carey, 1996)

Figure 13. Mean Looking Times to the Box by 10-month-olds during the Last Four Trials of Habituation and the Four Test Trials in Sorrentino, Xu, & Carey's Experiment on Infants' Ability to Individuate a Person and an Inanimate Object.



CHAPTER 3

Children and Adults Interpret Proper Names as Referring to Unique Individuals

3.0 Introduction

The representation of the distinction between object kinds (e.g. table, dog) and individuals within a kind (e.g. my kitchen table, my pet dog) is a fundamental one in cognition. The individuality of the members of some kinds seems to be more important than the individuality of members of others, as can be noted from the fact that members of some kinds are natural referents for a proper name while members of other kinds are not. For example, my dog has a name, *Max*, whereas my kitchen table does not. The syntax of English supports the distinction between kinds of objects and named individuals via the distinction between count nouns such as *dog* and proper names such as *Max*. However, the criteria for which entities are proper namable come from outside of syntax (Bloom, 1996).

Children seem to grasp the contrast between count nouns, proper names and their referents from the outset of word learning. Their first words invariably include proper names for important individuals—their own names and names for family members, friends and pets—along with a preponderance of count nouns for common objects like cups and books (Bloom, Tinker, & Margolis, 1993; Nelson, Hampson, & Shaw, 1993). By and large, children apply the words in their vocabulary appropriately. They use proper names in the presence of individuals named by the name and not in the presence of other individuals, and they use count nouns in the presence of members of the kinds referred to by the nouns and not in the presence of members of other kinds (Macnamara, 1982).

Studies of preschoolers' proper name learning and application are also consistent with the idea that children grasp the distinction between count nouns, proper names, and their referents. Children's earliest word combinations respect the syntactic distinction between count nouns and proper names. For example, children readily produce expressions like *big dog* but almost never produce expressions like *big Fred* (Bloom, 1990b). By about two years of age, children show sensitivity to the syntactic cues that a word is a count noun or a proper name in learning new words. They apparently interpret a new word as a count noun if it is preceded by a determiner and as a proper name if it is not preceded by a

determiner and if it is used in the presence of an appropriate individual (Gelman & Taylor, 1984; Katz, Baker & Macnamara, 1974). That is, children select referents of the same kind as the named object if the word is modeled as a count noun, but they select only the named individual if the word is modeled as a proper name. Until at least age four, children seem to assume that the appropriate referents of proper names are people, other animals and their surrogates, avoiding a proper name interpretation of words for individual objects of other kinds (Gelman & Taylor, 1984; Hall, 1994; Katz, *et al.*, 1974).

While children's use of proper names in natural settings and children's performance in studies of proper name learning are consistent with the possibility that children, like adults, interpret proper names as referring to unique individuals, their behavior is also consistent with at least two related alternative interpretations of words modeled by adults as proper names. One of these alternatives is laid out by Carey (1992) who gives an account of how children's behavior with respect to the referents of object kinds and proper names can be subsumed under Quine's (1960, 1969) view. Quine argued that children do not have the quantificational resources to represent individuals as unique objects which persist in space and time until they master the quantificational syntax of their language. On this view, until children have mastered the relevant syntax, they represent the world in terms of a sensory quality space which clusters similar experiences together. Adults represent count nouns such as *dog* as referring to object kinds whose members share certain obvious and non-obvious features (e.g. having a dog-like appearance, giving birth to dogs, etc.) in virtue of being members of the kind. On Quine's view however, young children represent the referents of count nouns such as *dog* as referring to *experiences with* objects belonging to the kind referred to by the count noun. Children apply the word *dog* to those experiences which fall into a similarity space just wide enough to include experiences with dogs but not with other objects. Their behavior thus seems adult-like. Children's apparently adult-like behavior in proper name use reflects an equally non-adult-like conception of the referents of proper names. Children have noted that proper name experiences are special since they hear the words used in a much more restricted set of experiences than words like *dog*. As a result, children represent proper names as referring to highly similar experiences, namely experiences with what adults would think of as the named individual.

There is evidence against Quine's proposal that children are unable to represent objects as enduring in space and time before they master the quantificational syntax of their language. For example, even four-month-old infants are able to use spatiotemporal principles such as that one object cannot be in two places at once to infer that there are two objects behind two occluding screens (Spelke & Kestenbaum, 1986; see Carey, 1992 for further evidence that young children's conceptual system is less impoverished than Quine argues). However, Quine's view can be modified to incorporate children's ability to represent objects on the basis of spatiotemporal principles, while still denying both that young children represent object kinds in an adult-like manner and that they represent proper names as referring to unique individuals. On this alternative, children apply the word *dog* to those *objects* which fall into a similarity space just wide enough to include objects that are dogs but not other objects. Also, children have noted that a given proper name is used to refer to a much more restricted set of objects, and assume that proper names refer to those objects which an adult would represent as highly similar animals. That is, children represent proper names as referring to objects which fall into a restricted similarity space.

A second alternative to the proposal that children interpret proper names in an adult-like manner as referring to individuals grants that children have the conceptual resources to represent kinds of objects (*contra* Quine), but denies that children represent proper names as referring to unique individuals. On this view, children realize that there is some distinction to be made between proper names and their referents on the one hand, and count nouns and their referents on the other. For example, the two classes of words have different syntax, and, at least in children's earliest experience, count nouns are applied to objects of all kinds, but proper names are only applied to objects of certain kinds (usually people, other animals, and their surrogates such as toys). Like adults, children interpret count nouns as referring to kinds of animate and inanimate individuals, individuals which share certain obvious and non-obvious features such that they are members of the same kind. But unlike adults, children initially construe the distinction between the referents of proper names and the referents of count nouns as a difference of degree: both refer to kinds, but proper names refer to more narrowly specified kinds, kinds whose extensions consist of highly similar, animate individuals. Thus, children do not initially realize that it is the contrast between reference to an individual and reference to a kind which

is key to the distinction between proper name and count noun reference. Rather, children acquire this adult distinction at some point during development and go on to reanalyze proper names from referring to restricted kinds to referring to unique individuals. (The possibility that proper names refer to restricted kinds is also raised by Hall, 1994, 1996, and Liittschwager and Markman, 1993).¹⁰

An example of candidate restricted kinds or objects in a restricted similarity space which proper names might refer to are identical twins in the case of people or animals, or identical toy animals in the case of toys. Identical twins rarely show up in natural settings, and people rarely have identical pets, or buy their children sets of identical toys, hence children's behavior generally would not indicate that they interpret proper names as referring to restricted kinds or to objects in a restricted similarity space. And children are not readily given evidence that proper names in fact refer to unique individuals.

The experiments reported in this paper do not tease apart which of the two alternatives accurately characterize children's representations of proper names and their referents, that is whether children interpret proper names as referring to objects in a restricted similarity space or whether children interpret proper names as referring to restricted kinds of animate objects. However, the two alternatives make the same prediction about children's behavior, namely that children should extend words which are modeled as proper names to objects sufficiently similar to the named object. As a result, the experiments are designed to rule out both alternatives simultaneously. I will call the two alternative characterizations of children's proper name representations jointly the *Restricted Kind/Similarity Space Hypothesis*. The hypothesis only applies to animate referents. This is because young children rarely produce proper names for individuals which are not people, animals and their surrogates such as animal toys, and as mentioned earlier, children in studies of proper name learning resist making a proper name interpretation of a word for a non-animal artifact (Gelman & Taylor, 1984; Hall, 1994; Katz, *et al.*, 1974). When the referent of a word modeled as a proper name is a non-animal, children presumably do not entertain a proper name interpretation of the word, preferring to interpret the

¹⁰ A third alternative is that children represent object kinds, but interpret proper names as referring to highly similar animals without assuming that the animals belong to a restricted kind. It seems unlikely that children would fail to construe such highly similar animals as belonging to a kind if they have the resources to represent kinds, since animals sharing enough properties to be identical would make good candidates for a restricted kind of animal. Indeed, the biological concept clone is an example of such a kind.

word as an adjective or as a count noun (although see Chapter 4 for evidence that two- and three-year-old children may interpret a word for a non-animal referent as a proper name if given evidence that the object is important as an individual).

Research on children's use of proper names does not rule out the Restricted Kind/Similarity Space Hypothesis. Bloom (1990b) considers the possibility that children initially categorize proper names as standard count nouns which they later reanalyze as proper nouns based on syntactic cues. He rules out this possibility on the basis of evidence that children respect the syntactic distinction between count nouns and proper names in their earliest word combinations, suggesting that they have correctly analyzed proper names syntactically as distinct from count nouns. However, although children grasp proper name syntax, they may nonetheless represent proper names semantically as referring to restricted kinds or to highly similar objects. After all, pronouns such as *he* have the same syntax as proper names, yet have a distinct semantics. Even in adult language pronouns do not refer to unique individuals unlike proper names. Proper name syntax itself does not inform children of the correct semantic representation of proper names as referring to individuals.

Research on children's proper name learning also does not rule out the Restricted Kind/Similarity Space hypothesis. In one study, Katz *et al.*, (1974) showed young two-year-old children a doll with blond hair and a doll with brown hair. The dolls were identical in dress and other features. One of the dolls was described with sentences like "This is zav. Look at Zav. Let's put Zav over here." Children were then asked to perform actions such as giving Zav to their mother or father. The girls in the study selected the labeled doll on the majority of the trials, whereas the boys selected each doll equally often. Katz *et al.* interpreted the girls' behavior as indicating that they interpreted *zav* as a proper name referring to a unique individual. However, the girls' behavior is consistent with their having interpreted *zav* as referring to a restricted kind or an object in a restricted similarity space. Since the two dolls were not identical, the girls were not faced with two members of the same restricted kind or two objects within the same restricted similarity space. The children were not given an opportunity to generalize *zav* to dolls sufficiently similar to the named doll and so they chose only the named doll in this study. Gelman and Taylor (1984) replicated and extended the results of Katz *et al.* Like Katz *et al.*, the animal toys used by Gelman and Taylor were readily distinguishable from each other, with hair and clothes

which differed in color. Thus children may not have judged the two animal toys as being members of the same restricted kind, or they may not have construed the two toys falling within the same restricted similarity space. As a result, children chose only the labeled toy.

Hall (1991) examined the ease with which two-year-old children learn proper names for unfamiliar animals (e.g. a toy monster) as compared to familiar animals (e.g. a toy cat). Hall presented children with an array of four animal toys. For children learning a name for an unfamiliar animal, the array of toys consisted of two very similar monsters, and two distracters, a rabbit and a distinct monster. For children learning a name for a familiar animal, the array consisted of two very similar cats, and the two distracters. Hall taught a proper name for one of the animals (e.g. "This is Zav. Look at Zav. etc.") and then asked children to perform various actions with Zav. Children who were taught a name for a familiar animal selected the named animal on almost every trial, whereas children who were taught a name for an unfamiliar animal selected the named toy significantly less often, on about 65% of the trials. Hall concluded that children taught a proper name for a familiar animal tended to interpret the word as a proper name and children taught a proper name for an unfamiliar animal tended to interpret the word as a count noun for the animal kind.

While children may have made contrasting interpretations of the word in the two conditions as Hall concludes, children's performance is consistent with the possibility that they interpreted the word in the unfamiliar animal case as referring to the kind of animal, and interpreted the word in the familiar animal case as referring to a restricted kind which includes only the named animal and animals highly similar to it. Or, on the similarity space alternative, children may have interpreted the word in the unfamiliar animal case as referring to objects falling within a similarity metric wide enough to include monster toys but not other toys, while interpreting the word in the familiar animal case as referring to objects within a similarity metric narrow enough to include only the named animal and animals very similar to it. Although the target toy animals used by Hall were identical (that is, the two monsters were identical and the two cats were identical), the toys were dressed in distinct hooded outfits and could thus be construed as belonging to different restricted kinds or falling into different similarity spaces. The children who were taught a proper name for one of the familiar animals were therefore not given the opportunity to choose between two animals of the same restricted kind or similarity space and performed as if

they took the word as referring to a unique individual. Thus the performance of the children in the familiar animal condition does not rule out the Restricted Kind/Similarity Space Hypothesis.

Hall (1994) probed three- and four-year-old children's tendency to make a proper name or adjective interpretation of a novel word in an ambiguous sentence frame (e.g. "This is zavy"; the sentence is ambiguous because it can be interpreted as a proper name, or as an adjective like *striped*). Hall varied whether the word was introduced in the context of a picture of an animal or a picture of an artifact. Children who saw pictures of animals were shown a picture of the target animal with a salient property, such as a bird covered in multicolored fluorescent circles and told, "This is zavy". Children were then shown four pictures in addition to the named picture: a distinct bird of the same subordinate kind as the original bird, but without the salient property, a bird of another subordinate kind also without the property, a bottle with the same salient property as the original object, and a distracter such as an apple without the salient property. Children who saw pictures of artifacts were shown a picture of the target artifact with a salient property, such as a shoe covered in multicolored fluorescent circles and told, "This is zavy". In addition to the named picture, children were then shown a distinct shoe of the same subordinate kind as the original shoe, but without the salient property, a shoe of another subordinate kind also without the property, and the same property match and distracter as the children shown pictures of animals. Children who were shown a picture of an animal behaved as if they made a proper name interpretation of the label, responding "yes" when asked, "Is this zavy?", only when shown the labeled drawing. On the other hand, children who were shown a picture of an artifact behaved as if they interpreted the label as an adjective akin to *decorated*. They tended to respond "yes" when asked, "Is this zavy?", when shown both the target shoe and the bottle with the same salient property. However, since Hall (1994) did not show the children in the animal condition multiple pictures of animals from the same restricted kind or falling into the same similarity space (e.g. two or more birds with multicolored fluorescent circles), his results do not rule out the Restricted Kind/Similarity Space Hypothesis.

Liittschwager and Markman (1993; Liittschwager, 1994) attempted an explicit test of the possibility that children interpret proper names as referring to restricted kinds, however they adopted a procedure which did not in fact test the hypothesis. Liittschwager and Markman showed three-year-old children either a

non-animal artifact with a distinctive marker (e.g. a bottle with a distinctive cap) or a toy animal with a distinctive marker (e.g. a stuffed bear with a large bib) and said "See, this is x" (see Figure 14). The object was then moved to a new location and the distinctive marker was removed from it. An identical object without the marker was brought out and placed at the location where the original object had been introduced with x. The children were then asked "Where's x?" Children in the animal condition selected the original referent on the majority of trials, consistent with the possibility that children interpret proper names as referring to unique individuals. Children in the artifact condition selected the named object on only about 40% of the trials, consistent with previous work showing that children refrain from making a proper name interpretation of a word for a non-animal object. Liittschwager and Markman interpreted these results as suggesting that children do not in fact interpret proper names as referring to restricted kinds of objects.

Despite their conclusion, Liittschwager and Markman's task fails to rule out the Restricted Kind/Similarity Space Hypothesis. By removing the object marker from the named toy in the animal condition, Liittschwager and Markman may well have changed the object's status as a member of the restricted kind referred to by the proper name or changed the object's appearance to the point that it was no longer sufficiently similar to objects referred to by the word. Children were thus faced with two identical animals, neither of which belonged to the restricted kind or falling into the same restricted similarity space referred to by the word. As noted above, even very young infants are able to track objects through spatiotemporal displacements, thus the three-year-olds in the experiment were able to track which object had been referred to with the word despite the change in the object's location and appearance. Since children have noted that animals are the typical referents of proper names and are treated as important, they may have adopted a conservative response strategy in the face of a difficult situation. That is, children may have chosen the originally labeled animal solely on the grounds that it was the only one of the two toys to which the word had been applied. On this possibility, rather than reflecting children's interpretation of proper names as referring to individuals, this response pattern may reflect children's best guess as to which object they thought the word could refer to. As for the children in the Artifact condition, as noted earlier, they presumably did not entertain a proper name interpretation of the word since the referents were not animal surrogates. However, children may have made an

adjective interpretation of the word such as *decorated*, or a subkind interpretation, such as that the word is referred to objects with the marker on them. These interpretations could not be revealed during the test trials since the object marker was removed. As a result, children's interpretation of the word is unclear since their response pattern is consistent with a count noun interpretation of the word like *bottle*, an adjective interpretation of the word such as *bottle-shaped*, a mass noun interpretation like *plastic*, or random responding reflecting no interpretation at all. Importantly, we cannot know how children would have interpreted the novel word in this condition or in the animal condition if the object marker had not been removed.

Although the research reviewed thus far does not rule out the Restricted Kind/Similarity Space Hypothesis, there are at least two studies which provide some evidence against it and in favor of the hypothesis that children interpret proper names as referring to unique individuals. One study was carried out by Hall (1996). Hall reasoned that if children represent proper names as referring to unique individuals, they should be able to use this knowledge to guide their word learning. In particular, if a new word presented in an ambiguous sentence frame (e.g. "This is zavy") is applied to a single animal referent with a salient property (such as a cat covered in multicolored, fluorescent circles), children should be inclined to make a proper name interpretation of the word. On the other hand, if the word in the ambiguous sentence frame is applied to two animals who share the salient property, children should be less likely to interpret the word as a proper name if they assume that proper names designate single referents. Children should instead make some other interpretation of the word, such as that it is an adjective referring to the salient property. Consistent with his hypothesis, Hall found that 13 out of 15 four-year-old children who were shown a single cat with a salient property and told "This cat is zavy" behaved as if they interpreted *zavy* as a proper name, selecting only the named referent from a set of pictures which included distinct cats lacking the salient property and an artifact with the salient property. On the other hand, children who heard the ambiguous sentence applied to each of two cats with the salient property did not behave as if they interpreted the word as a proper name. Eight of these fifteen children selected the named cats and the artifact with the same salient property as the cats, as if they made an adjective interpretation of the word. Of the remaining children, three selected only the named cats, as if they took the word as a proper name for each cat, three selected all of the cats in the picture set, as if

they interpreted the word as a basic-level noun, and one child gave a random response pattern.

The response of the children in the condition in which two cats were referred to with "This cat is zavy" provides indirect evidence against the Restricted Kind/Similarity Space Hypothesis. It is understandable that half the children apparently made an adjective interpretation of the word, since there were three pictures with the salient property: the two cats and a bottle. This is one more picture than in the condition in which only a single cat had the salient property. It is the responses of the remaining children which are revealing. If children genuinely interpret proper names as referring to restricted kinds of objects or as referring to objects within a restricted similarity space, then we would expect a majority of the remaining children to affirm that only the two cats are referents of *zavy* as if making a proper name interpretation of the word. Only three of the seven children who did not make an adjective interpretation showed this pattern of responses. It is possible, of course, that the addition of a second cat with the salient property in this condition caused the children greater confusion and made the resolution of the ambiguity more difficult. An adjective interpretation was made more plausible by this addition, as was a basic level noun interpretation, both of which may have conflicted with a proper name interpretation. There is another important point, however. The three children who selected only the named cats had an inherently ambiguous response pattern. By affirming that only the named cats are zavy, it is unclear whether these children are affirming that *zavy* refers to each animal as a unique individual, or whether they are affirming that each cat is a member of the restricted kind or is an object which falls within the same restricted similarity space referred to by the word. As a result, even if more children had selected only the named animals in this condition, their responses would not have provided clear evidence for or against the Restricted Kind/Similarity Space Hypothesis. Nonetheless, the fact that relatively few children selected only the named animals is suggestive evidence that children assume that proper names designate unique referents.

The second study which provides evidence against the Restricted Kind/Similarity Space Hypothesis was carried out by Kim, Marcus, Pinker, Hollander, & Coppola (1994). In one experiment, Kim *et al.* investigated four-year-olds' grammatical representation of nouns, showing that children are sensitive to the origin of a noun in deriving the noun's plural form. For

example, if an experimenter shows children of this age a set of colored teeth, tells them, "This tooth is red. But this is a purple tooth", and then points to another purple tooth, children tend to complete the sentence, "There are two __", with "There are two teeth." However, if the experimenter shows the children a large tooth-like figure with a face on it, tells them "This is Mr. Tooth", and then brings out another Mr. Tooth figure, children tend to complete the sentence, "There are two __" with "There are two Mr. Toths." Kim *et al.* argue that in the first example, children represent the noun *tooth* as one which has an irregular plural form, *teeth*. In the second example, however, children must convert a proper name *Mr. Tooth* into a count noun. But this count noun is not the sort of entity that the name usually refers to, since proper names refer to unique individuals. Proper name semantics do not normally permit the name to be pluralized and children do not confuse the "tooth" in Mr. Tooth with the familiar noun *tooth*, so they do not pluralize *Mr. Tooth* to *Mr. Teeth*. Instead, children resolve the situation by applying their default pluralization rule of adding -s. This pattern of results suggests that at least by age four, children represent proper names as referring to individuals.

In sum, although studies of proper name learning and use have assumed that young children interpret proper names as referring to unique individuals, there is relatively little evidence against the hypothesis that children represent proper names as referring to restricted kinds of animals or to highly similar objects. Work by Bloom (1990b), Katz *et al.*, (1974), Gelman and Taylor (1984), and Hall (1991, 1994) is consistent with the Restricted Kind/Similarity Space Hypothesis, whereas work by Hall (1996) and Kim *et al.*, (1994) provides some evidence against it. The present studies were designed to provide direct evidence against the Restricted Kind/Similarity Space Hypothesis by explicitly pitting an interpretation of proper names as referring to restricted kinds or to highly similar objects against an interpretation of proper names as referring to individuals. This was done by making a critical modification to the experimental procedure of Liittschwager and Markman (1993): once the originally introduced object was named and moved to a new location, the object marker was removed and placed on the newly introduced, otherwise identical object. If children interpret proper names as referring to restricted kinds or to highly similar objects, then children who are taught the new word in the context of an animal toy should assume that the newly introduced animal toy is the appropriate choice of referent, since it is identical in appearance to the original animal at the

time that the novel word was introduced. That is, the newly introduced animal is the most likely of the two to belong to the restricted kind referred to by the proper name, or to fall into the similarity space of objects referred to by the proper name, making the newly introduced toy the appropriate choice in the task. On the other hand, if children interpret proper names as referring to unique individuals, they should select the original referent of the novel word in the task, despite the similarity of the other animal toy to the original animal's appearance at the time of naming. As for children who are taught the word in the context of a non-animal artifact, they should select the newly introduced object if they interpret the novel word as an adjective like *decorated* or a subkind for an object with the object marker. On the other hand, children should select randomly if they interpret the word as an adjective like *bottle-shaped*, as a count noun like *bottle*, as a mass noun like *plastic*, or if they make no interpretation of the word at all.

We began by testing adults in the task in Experiment 1. This was done for two reasons. The first of these was to validate the task as a test of making a proper name interpretation of the word in the condition in which the word is used to refer to an animal. We expected that adults would primarily choose the originally labeled animal in this condition if the task genuinely measures proper name interpretations of the novel word, since adults interpret proper names as referring to unique individuals. The second reason was that testing adults permitted us to explicitly ask them for their interpretation of the novel words using direct questions and a sentence rating task. This provided a means of disambiguating the pointing responses in the two conditions. For example, if adults selected either of the two objects across trials, their verbal responses could help us distinguish adjective, mass noun or count noun interpretations. Experiment 2 was conducted with three-year-old children to test the Restricted Kind/Similarity Space Hypothesis.

3.1 Experiment 1

3.1.1 Method

Participants

Twenty-four adult volunteers in the Boston area participated in the experiment, twelve women and twelve men (mean age 26;0, range from 19;0 to

40;9). Adults were either undergraduates or graduate students at MIT or were employed in the Boston area. All adults were of middle or upper-middle socioeconomic backgrounds. Participants were randomly assigned to one of two conditions, with twelve participants (six women and six men) in each condition.

Materials

Four pairs of identical objects were used as stimuli in the experiment. Two pairs were animal toys and two pairs were non-animal artifacts. The animal toys were two identical dolls and two identical stuffed bears. The dolls were about 12 inches long and 4 inches wide at the shoulders with blue eyes, blonde braided hair, identical pink and white dresses and white shoes. The bears were about 12 inches long and 6 inches wide at the stomach, brown and furry with brown eyes and black noses. The object marker for the dolls was a green cloth clip-on cape, and for the bears it was a pink and white bib. The non-animal artifacts were two identical, empty 1 liter clear plastic bottles manufactured to hold spring water, and two identical (i.e. both left foot) women's blue canvas shoes, with rubber sole, size 8. The object marker for the bottles was a fuchsia cloth bottle jacket which slipped over the bottom half of the bottle, and for the shoes it was a shoe clip made of multicolored pipe cleaners looped into a flower shape. A yellow "sticky" note with an "X" drawn on it was used as a place marker in the task.

Procedure

Animal Condition. The experimenter brought out one of the animal toys, for example the doll with the cape, and placed the object on the yellow place marker (see Figure 15). The experimenter then said, "See, this is zavy. Can you say zavy? That's right, this is zavy. That's what I wanted to tell you, that this is zavy. Uhuh, this is zavy." The experimenter then said, "Are you watching?", moved the doll off the place holder, and removed the cape. The experimenter then brought out the other identical doll, placed the cape on the doll, and placed the doll on the place marker. The participant was then asked "Which one is zavy?"¹¹ The procedure was repeated with a new word using the other objects

¹¹ Liittschwager and Markman probed children with "Where's \underline{x} ?" However, this question is only felicitous on a proper name interpretation of \underline{x} ("Where's Max?"). It is ungrammatical if \underline{x} is an adjective ("Where's decorated?"), a consideration which might discourage children from interpreting the word as an adjective, especially in the Non-animal Artifact condition. We thus replaced the probe question used by Liittschwager and Markman with "Which one's \underline{x} ?" because \underline{x} can felicitously be interpreted in this sentence as either a proper name (e.g. "Which one's Max?") or

and object marker, thus each adult learned two words. The words used were drawn from *zavy*, *daxy*, *feppy*, and *piffy*. The order of presentation of the bear and the doll was counterbalanced across participants, as were the words used.

After the participant's interpretation of each word had been assessed through his or her pointing responses, participants were asked three verbal questions in a fixed order to assess their interpretation of one of the words. The questions were: "What do you think *zavy* means?", "Can you use *zavy* in a sentence?", and "Can you think of a synonym for *zavy* or a word like it?" Participants were then given five sentences to rate to measure the participant's tendency to make one of five interpretations of the novel word:

- (1). Zavy is sitting on the ground.
- (2). This doll/bottle has a zavy on it.
- (3). This doll/bottle is made of zavy.
- (4). This doll/bottle is very zavy.
- (5). This doll/bottle likes to zavy.

These sentences use the word as (1) a proper name, (2) a count noun for the object marker, (3) a mass noun, (4) an adjective, and (5) a verb. Participants were asked to rate the sentences on a scale of 1 to 7 according to how well the sentences reflected how the word could be used, given the meaning the participant thought the word had. Participants were instructed to rate the sentence "7", if they thought it sounded "perfectly fine" and "1" if the sentence reflected a use of the word which the participant did not think was possible given what they thought the word meant. Participants were told to use the intermediate values for sentences for which they thought the word *might* be used in the manner given.

Participants were then asked the three questions about the other word and they were then given a set of sentences to rate which used this word in the same ways as the first word. The order in which each word was assessed was counterbalanced across participants, and the order of presentation of each set of sentences to be rated was counterbalanced both across and within participants.

Artifact Condition. This procedure unfolded in the same way as the procedure in the Animal condition, except that the non-animal artifacts were

as an adjective (e.g. "Which one's decorated?").

used. The experimenter brought out one of the artifacts, for example the shoe with the clip, and placed the object on the yellow place marker. The experimenter then introduced the new word in the same way as in the Animal condition. The experimenter then said, "Are you watching?", moved the shoe off the place marker, and removed the clip. The experimenter then brought out the other identical shoe, placed the clip on the shoe, and placed the shoe on the place marker. The participant was then asked "Which one is zavy?" After the participant made a response, the procedure was repeated with the other objects and object marker. The same labels were used as in the Animal condition. The order of presentation of the bottle and shoe was counterbalanced across participants, as were the words used. As in the Animal condition, after the participant's interpretation of each word had been assessed through his or her pointing responses, participants were asked the verbal questions and given sentences to rate to verbally probe their interpretation of each word. The counterbalancing procedure was the same as for the Animal condition.

3.1.2 Results

Pointing responses

To examine adults' tendency to make a proper name interpretation of the new word in the two conditions, each adult's pointing responses in answer to "Which one is zavy?" were coded as "2" if the adult pointed to the originally labeled object on both trials, "1" if the adult pointed to the originally labeled object on one trial, and "0" if the adult pointed to the second object on both trials, that is, to the object most similar in appearance to the original object at the time the word was introduced (see Figure 16). No participant selected both objects on a given trial. Adult selections in the Animal and Artifact conditions were examined by submitting the pointing scores to a one way ANOVA with condition (Animal, Artifact) as a between subjects factor. There was a main effect of condition, $F(1, 22) = 7.746, p < .05$. Adults in the Animal condition had a mean pointing score of 1.91, because 11 of the 12 adults selected the named object on both trials, and the remaining adult selected the named object on one trial. Adults in the Artifact condition had a mean pointing score of 1.08, because six of the twelve adults selected the named object on both trials, one selected the named object on one of the trials, and five selected the other object on both trials. Adult's responses in both conditions were examined to assess if they departed

from chance, which was assumed to be 50%. A Binomial Test showed that adults in the Animal condition selected the named toy significantly more often than expected by chance, $p < .01$. However, a Binomial Test showed that adults in the Artifact condition did not differ from chance in their selection of the named toy, $p > .05$. The pointing responses suggest that adults in the Animal condition made a proper name interpretation of each word, but adults in the Artifact condition did not.

Sentence Ratings

The mean ratings of the sentences of each of the five types in the Animal and Artifact conditions are presented in Figure 17. To examine the extent to which adults found acceptable the sentences using the word in the five manners probed, adult ratings of the sentences were submitted to a two way ANOVA, with Condition (Animal, Artifact) as a between subjects factor, and Word Type (Proper Name, Count Noun, Adjective, Mass Noun, Verb) as a within subjects factor. There was a significant effect of Word Type, $F(4, 88) = 24.23, p < .001$. Participants rated sentences using the words as a proper name (5.22) higher than the sentences using the words in other manners (Count Noun, 2.10; Adjective, 2.56; Mass Noun, 1.90; Verb, 1.25). There was also a significant Condition by Word Type interaction, $F(4, 88) = 5.84, p < .001$. Participants rated the sentences using the word as a proper name higher in the Animal condition (6.67) than in the Artifact condition (3.79). A follow up t test revealed this difference to be significant, $t(22) = 3.661, p < .01$, one-tailed. Adults but did not seem to differ in the extent to which they interpreted the word as a count noun, an adjective, a mass noun or a verb in the two conditions (Animal Count Noun, 1.75; Artifact Count Noun, 2.45; Animal Adjective, 2.12; Artifact Adjective, 3.0; Animal Mass Noun, 1.91; Artifact Mass Noun, 1.87; Animal Verb, 1.29; Artifact Verb, 1.21). There was no effect of Condition, $F(1, 22) = 0.983$, ns. These results suggest that overall adults were more likely to find acceptable sentences which used the word as a proper name than to find acceptable sentences which used the word as either a count noun, an adjective, a mass noun or a verb, regardless of the type of referent. On the other hand, consistent with adult pointing responses, adults were more likely to find acceptable sentences which used the word as a proper name if the referent was an animal surrogate than if the referent was a non-animal artifact.

To further examine the acceptability of each word type, the rating for each sentence was classed into one of three ranges: 5-7 (High), 3-4 (Medium), and 1-2 (Low). The number of sentences in the Animal and Artifact conditions classed into the three ranges for each word type are presented in Table 1. In the Animal condition, 22 of the 24 Proper Name sentences fell in the High rating range, contrasted with only 9 of the 24 Proper Name sentences in the Artifact condition. Although adults in this latter condition pointed to the originally labeled object on just over half of the pointing trials as if making a proper name interpretation of the word, only a subset of those adults found a proper name interpretation of the word highly acceptable, in contrast to adults in the Animal condition.

The pattern of ratings for the sentences which used the word as a count noun, an adjective, a mass noun or a verb did not seem to differ between the Animal and Artifact condition. In both conditions, adults did not find the verb interpretation acceptable. All but one of the 48 sentences fell in the Low rating range. The remaining sentence fell in the Medium range. Adults in both conditions had some tendency to judge acceptable sentences which used the words as a count noun, as an adjective, or as a mass noun (see Table 1). Apparently, adults processed the ambiguous sentence frame with which the word was taught (i.e. "This is zavy") to the point of ruling out a verb interpretation but not a count noun interpretation. The sentence syntax was consistent with an adjective or mass noun interpretation. Nonetheless, adults' tendency to find acceptable sentences using the word as a count noun, an adjective, or a mass noun was not very strong overall, since at least two thirds of all the sentence ratings for these three word types fell into the Low range.

The sentence ratings suggest that adults as a group did not make a clear interpretation of the new word in the Artifact condition. Over half of the ratings for the proper name sentences fell into the Medium or Low rating range, and no clear preference for an interpretation of the word as a count noun, an adjective, a mass noun or a verb was evident. This contrasts with the ratings in the Animal condition. All but one adult judged the proper name sentence as highly acceptable, while the ratings for the other sentence types suggest that adults found other interpretations of the word only somewhat acceptable, or not acceptable at all in the case of the verb sentence.

Answers to Direct Questions

Adult answers to the three direct questions (i.e. "What does *zavy* mean?",

"Can you use *zavy* in a sentence?", and "Can you think of a synonym for *zavy* or a word like it?") probing their interpretation of each word were grouped into one of three categories: Proper Name, Unambiguously Not Proper Name and Ambiguous. Some examples of responses of each type for the three direct questions in the Animal and Artifact condition are given in the Appendix. Answers were coded as Proper Name if the participant gave an unambiguous proper name response to the direct question on both trials, and Not Proper Name if the participant gave a response that was clearly not a proper name response on both trials. Other response patterns were coded Ambiguous, including failure to give a response.¹² Table 3 shows the number of responses of each type for the three direct questions in the Animal and Artifact conditions. A proportion of adults in both conditions gave Ambiguous responses to the direct questions. One reason for this is that the meanings of words in the sentences produced by participants were ambiguous. For example, one adult in the Animal condition produced the sentence "Mattie would eat daxxy" (Mattie being, as it turned out, a dog). In this sentence, *daxxy* could syntactically be a proper name or a mass noun, although, given the context, the word was probably intended as a proper name. An adult in the Non-animal Artifact condition produced the sentence "I drank water out of zavy" (*zavy* was a bottle). This sentence is syntactically consistent with a proper name interpretation, but the word is probably intended as a count noun like bottle. Another reason that adults may have produced ambiguous responses is that they may have found the direct questions difficult to answer. Indeed, a number of adults in both conditions were not able to generate responses to the direct questions. For adults in the Artifact condition, this could have been because adults did not make a clear interpretation of the word, making it difficult for them to state what the word meant. As for the adults in the Animal condition, the majority of their failures to produce a response occurred when they were asked to produce a synonym. As noted in Chapter 1, it has been argued that proper names do not have meaning (Kripke, 1972, 1980). This may be why adults are not able to readily generate another proper name as a synonym for a proper name.

¹² For the question, "What does *zavy* mean?", one participant in the Animal condition answered that *zavy* was either a name for the original object or an adjective describing the object with the property. This indicates that the participant was aware of the ambiguous structure of the sentence. However, the participant's responses were consistent with a proper name response—he chose the originally labeled object on both trials—hence his verbal responses to this question were coded as being proper name responses.

As Table 3 shows, for each of these questions, at least twice as many adults in the Animal condition gave a proper name response than did adults in the Artifact condition. Also, for each direct question, at least twice as many adults in the Artifact condition gave responses which were unambiguously not proper name responses compared to adults in the Animal condition. Adults in the two conditions did not seem to differ in the extent to which they gave Ambiguous responses. The Proper Name and Not Proper Name dissociation between the two conditions strongly suggests that adults interpreted the words differently in the two conditions, bolstering the pointing and sentence rating results.

The responses to the direct questions were also analyzed to assess the extent to which each adult in the two conditions gave a proper name response to each of the direct questions. Table 3 shows the number of adults in each condition who on both trials answered that the word was a proper name for all three direct questions or who on both trials answered that the word was a proper name for any two of the three direct questions. Consistency was evaluated using the more lax criterion of giving a proper name response to two or more of the questions for two reasons. First, the number of Ambiguous responses to the direct questions suggest that generating responses to direct questions might be a more demanding task for adults than pointing or rating sentences. Second, the relatively low number of adults (i.e. six) who produced a proper name in response to the synonym question could reflect that this is not a good means of eliciting a proper name response from adults, because as suggested above, it is not clear that proper names have synonyms. Nine adults in the Animal condition answered that the word was a proper name on two of three direct questions for both trials as compared to three of the adults in the Artifact condition. This difference was significant by a Fisher Exact Test, $p < .05$, one-tailed. This provides further evidence that more adults in the Animal condition genuinely interpreted the word as a proper name, since they were more likely than adults in the Artifact condition to consistently give a proper name response when probed with different direct questions about the word's interpretation.

Consistency Among Pointing Responses, Sentence Ratings, and Answers to Direct Questions

Adults in the Animal condition gave highly consistent pointing responses, sentence ratings and answers to direct questions. On all these measures, adults gave evidence of interpreting the words as proper names.

However, the performance of the adults as a group in the Artifact condition was not consistent. In a final qualitative analysis, each individual adult's response in the Artifact condition was examined across the three measures to assess the extent to which a given adult made a consistent interpretation of the words. To anticipate, this analysis revealed that ten of the twelve adults showed considerable consistency across the three measures, and the final two adults had inconsistent response patterns. Four of the twelve participants showed very consistent response patterns. Two of these adults clearly interpreted the words as proper names, a third adult interpreted the words as count nouns for the object markers, and the final adult interpreted the words as adjectives. The first two adults pointed to the originally named object on both trials, rated the proper name sentences in the High or Medium range, but rated all the other sentences in the Low range, and gave proper name answers to the direct questions (one adult on one trial gave a count noun response). The third adult pointed to the new object on both trials, rated the count noun sentences in the High range and all the other sentences in the Low range, and gave responses to the direct questions that indicated that the word was a count noun for the object marker. The final adult pointed to the new object on both trials, rated the adjective sentences in the High range and the remaining sentences in the Low range, and gave adjective responses to the direct questions.

Four adults had very consistent responses on two of the measures, but showed variability on the third. Three of these adults made a proper name interpretation of the word and the fourth made an adjective interpretation. Two adults pointed to the named object, and rated the proper name sentences in the High range while rating the rest in the Low range as if making a proper name interpretation. But these adults also gave a mixture of count noun and proper name responses to the direct questions. The other two adults had a consistent pattern in pointing and responding to the direct questions, but showed variability in the rating responses. One adult pointed to the originally named object on both trials and gave clear proper name responses to all the direct questions. However, this adult, while rating the proper name sentences in the High range, also rated the count noun and mass noun sentences in the Medium range. The final adult pointed to the new object on both trials and gave clear adjective responses to the direct questions. This adult also rated the adjective sentences in the High range, but then gave a rating in the High range for one of

the count noun sentences and a rating in the Medium range for one of the proper name sentences.

Two adults appear to have made an interpretation of the words as referring to the kind of artifact, namely an artifact with the object marker on it. One adult made this interpretation for both words, and the other adult made this interpretation for one of the words and appeared to make no consistent interpretation of the other word. This subkind interpretation was not probed in the sentence ratings, which no doubt contributed to a semblance of inconsistency in the adults' responses. Evidence that the adults made this interpretation comes from the fact that adults pointed to the new object when taught the word. Also, these adults gave answers to the direct questions which suggest that they interpreted the word as a subkind, even though in some instances the syntax used was proper name syntax. For example, in response to "What does *feppy* mean?", one adult said "A shoe with a ribbon of that sort on it"; in response to "Can you use *feppy* in a sentence?", the adult replied, "I prefer penny loafers to *feppy*"; in response to "Can you think of a synonym for *feppy* or a word like it?", the adult responded "tassel shoes".

The remaining two adults did not make a consistent interpretation of the words. One adult pointed to the named object on both trials, but then gave a mixture of proper name and count noun responses to the direct questions and rated all the sentences in the Low range. The final adult pointed to the new object on both trials, gave a mixture of proper name and count noun responses to the direct questions, and then rated the count noun, adjective and mass noun sentences in a range between High and Low, while rating proper name and verb sentences in the Low range. Together, this qualitative analysis suggests that although adults as a group made no consistent interpretation of the word, individual adults tended to make a consistent interpretation of the word. Five adults made proper name interpretations of the words, three adults made count noun interpretations of the word—one of these adults interpreted the words as count nouns for the object markers, and the other two adults interpreted the words as count nouns for the a subkind defined by the object with the marker—and two adults interpreted the words as adjectives describing the object with the marker. Adult pointing responses were very consistent, however adult ratings and answers to direct questions showed some variation in the extent to which they indicated that adults made a categorical interpretation of the word. That is, it is unclear if adults decided that a word belonged to one category, such as proper

name, and not to any other category. Four adults were completely consistent across all three measures, but six adults gave ratings or answers to direct questions which, suggested that their interpretation was not entirely categorical. For example, some adults produced answers to direct questions which used the same word with proper name syntax or count noun syntax. And adults gave sentence ratings which were not completely consistent with their direct question and pointing responses or gave direct question responses which were not completely consistent with their sentence ratings and pointing responses. Finally, two adults did not seem to make a clear interpretation of the word at all.

3.1.3 Discussion

The results of Experiment 1 show that adults interpret a word in an ambiguous sentence frame ("This is zavy") as a proper name referring to a unique individual if the referent is an animal surrogate, but do not make a proper name interpretation if the referent is a non-animal artifact. When asked "Which one is zavy?" of two animal surrogate referents, one of which has been referred to with the word, adults overwhelmingly point to the object which was named, but when asked this of two non-animal artifact referents, adults select the named object only half of the time. Adult ratings of sentences using the new word in different ways provide further evidence that adults interpret the word as a proper name when the referent is an animal surrogate more so than when the referent is an artifact. Adults rate sentences with a proper name interpretation of the word consistently high only when the referent is an animal surrogate. The ratings also suggest that adults as a group do not make a clear interpretation of a word in an ambiguous sentence frame when the referent is a non-animal artifact such as a bottle with a colorful cover or a shoe with a colorful clip. Finally, adult responses to the three direct questions provide further evidence that adults tend to interpret the word as a proper name if the referent is an animal toy, but not if the referent is a non-animal artifact. Adults who are taught a word for an animal toy tend to give unambiguous proper name responses to the questions, but adults taught a word for a non-animal artifact tend to give responses which are unambiguously not proper name responses. Adults who are taught the word for an animal toy also tend to be more consistent in giving a proper name response across the direct questions than are adults taught the word for a non-animal artifact. However, when adult response patterns are examined individually,

adults who are taught the word for a non-animal artifact do tend to make a consistent interpretation of the word.

Whereas adults made a clear proper name interpretation of the word when the referent was an animal toy, adults as a group did not seem to make a clear interpretation of the word when the referent was a non-animal artifact. Four alternative interpretations of the word were probed via ratings of sentences using the word in different ways. These interpretations were as a count noun for the object marker, an adjective, a mass noun, and a verb. The ambiguous syntax of the sentence with which the word was introduced was consistent with an adjective or mass noun interpretation, but very few adults made either of these. Adults could have interpreted the word as an adjective like *bottle-shaped*, but may have been discouraged in doing so the probe question, "Which one is zavy?", since the property of being bottle-shaped was true of both objects. Also, this interpretation may not occur to adults without more explicit evidence. Consistent with this, Prasada (1995), has shown that children are more likely to interpret adjectives as referring to a dimension of contrast within a kind (e.g. two bottles which differ in color) rather than to a dimension of similarity within a kind (e.g. two bottles which have the same shape). However this in turn suggests that adults could have made an interpretation of the word such as *decorated*. It is possible that the presence of the object marker was not a property sufficiently salient to lead a significant number of adults to interpret the word as an adjective like *decorated*. This may be because having the object marker placed on it was a temporary property of the object, in contrast to properties inherent to an object such as its color or other markings (c.f. Hall, 1994). Although the introducing sentence was consistent with a mass noun interpretation of the word like *plastic*, very few adults made this interpretation. As was the case with an adjective interpretation like *decorated*, it is possible that a mass noun interpretation was discouraged by the probe sentence in the test trial, "Which one is zavy?", since it implied that only one object was zavy, yet both objects could have been described with a mass noun such as plastic. Alternatively, the kind of substance an object is made of may be less salient to adults than the object kind or some of the properties of the object. It is possible that adults require a clear indicator that the word refers to the substance kind, such as the locution *made of*, before they will interpret a new word as referring to a kind of substance.

No adult made a verb interpretation of the word, presumably because the inconsistent syntax of the introducing sentence frame failed to invoke this

interpretation. In order for the word to be a verb, it should have had the progressive suffix *-ing* as in "This is running", along with a candidate action. In contrast, a number of adults showed evidence of making a count noun interpretation, yet in order for the word to be a count noun, it should have been introduced with a determiner such as *a*. There is evidence from research on children's word learning that children will make a count noun interpretation of a word introduced without a quantifier or determiner in some cases (Gelman & Taylor, 1984; Katz *et al.*, 1974). Evidently, adults, like children, will also make a count noun interpretation of a word presented without a determiner under some circumstances. As seen from the responses to the direct questions, adults will produce sentences which use the same word with proper name syntax or with count noun syntax. This was particularly true in the Artifact condition. Nonetheless, adults made few count noun interpretations overall.

Although adults as a group did not make a clear interpretation of the word in the Artifact condition, an analysis of the individual pattern of responses across the three measures suggest that almost all adults made a consistent interpretation of the word, which included proper name, count noun for the object marker, count noun for the object subkind, and adjective interpretations. The results of Experiment 1 suggest, then, that adults taught a word in an appropriate sentence frame tend to interpret the word as a proper name for the named object if the referent is an animal toy, but tend to make one of a number of interpretations of the word if the toy is a non-animal artifact.

3.2 Experiment 2

Experiment 1 validates the use of our word learning procedure as a test for a proper name interpretation of a new word. The manipulation of changing the appearance of a referent can reveal whether a word is interpreted as a proper name for a unique individual or in some other manner. Adults make a proper name interpretation when the referent is an animal toy, but do not tend to do so when the referent is a non-animal artifact. In Experiment 2, we presented three-year-old children with the task to test the Restricted Kind/Similarity Space Hypothesis. We analyzed pointing responses to test the hypothesis that children interpret proper names as referring to a restricted kind or to highly similar objects.

3.2.1 Method

Participants

Twenty-four three-year-old children from Boston area preschools and daycares were included in the experiment, twelve girls and twelve boys (mean age 3;6, range from 2;11 to 4;0). Children were randomly assigned to one of two conditions, with twelve children in each condition. Children were from a variety of socio-economic backgrounds ranging from lower to upper. All children were tested in a quiet corner of their preschool or daycare. Three additional children were not included in the experiment. Two were distracted by other children during testing, and one child did not complete testing.

Materials and Procedure

The same materials were used as were used in Experiment 1, with the exception of the small yellow “sticky” note, which was replaced with a rectangle of light blue paper. Children were taught two new words either for the animal toys or for the non-animal artifacts using the same procedure as used in the Animal and Artifact conditions in Experiment 1. However, unlike the adults, children were not asked explicit questions about the meanings of the words, nor given sentences to rate.

3.2.2 Results

To examine children's tendency to make a proper name interpretation of the new word in the two conditions, each child's pointing responses in answer to “Which one is zavy?” was coded as “2” if the child pointed to the originally labeled object on both trials, “1” if the child pointed to the originally labeled object on one trial, and “0” if the child pointed to the second object (see Figure 16). No child selected both objects. Children's selections in the Animal and Artifact conditions were examined by submitting the pointing scores to a one way ANOVA with condition (Animal, Artifact) as a between subjects factor. There was a main effect of condition, $F(1, 22) = 26.714, p < .001$. Children in the Animal condition had a mean pointing score of 1.91, because 11 of the 12 children selected the named object on both trials, and the remaining child selected the named object on one trial. Children in the Artifact condition had a mean pointing score of 0.50 because three children selected the named object on

both trials, and the remaining nine selected the other object on both trials. This suggests that children in the Animal condition made a proper name interpretation of each word, but children in the Artifact condition did not.

Children's responses in both conditions were examined to assess if they departed from chance, which was assumed to be 50%. Eleven of the twelve children in the Animal condition selected the named toy on both trials. This was significantly different from chance by a Binomial Test, $p < .01$, suggesting that children in this condition interpreted the word as a proper name. Although nine of the twelve children in the Artifact condition selected the newly introduced object on both trials, this did not reach significance by a Binomial Test, $p > .05$. This suggests that, like adults, children as a whole in the Artifact condition did not tend to make an adjective or restricted kind interpretation of the word.

To directly compare children's and adults' performance on the task, children's and adults' pointing responses were submitted to a two way ANOVA with Group (Adult, Children) and Condition as between subjects factors. There was no effect of Group, $F(1, 44) = 2.065$, ns. Children and adults had similar pointing responses in the task. There was a significant effect of Condition, $F(1, 44) = 30.724$, $p < .001$. Children and adults both tended to select the named toy in the Animal condition (Children, 1.91; Adults, 1.91) than in the Artifact condition (Children, 0.50; Adults, 1.08). Importantly, there was no interaction of Age and Condition, $F(1, 44) = 2.065$, ns.

3.2.3 Discussion

Children's pattern of responses provides evidence against the Restricted Kind/Similarity Space Hypothesis: children interpret a novel label as a proper name referring to a unique individual when the label is presented in a manner syntactically consistent with a proper name interpretation and when it is applied to an animal toy. Children's and adults' responses were remarkably similar, providing further evidence that children make an adult-like interpretation of proper names as referring to unique individuals. Children do not predominantly choose the originally labeled object if the referent is a non-animal artifact, consistent with previous work (Katz *et al.*, 1984; Gelman & Taylor, 1984; Hall, 1994, 1996). Although no verbal responses were elicited from children, the consistency of their pointing responses together with the consistency of adult verbal and pointing responses in the same task suggests that children interpret

the word as a proper name as do adults. Children's pointing responses revealed no clear interpretation of the word when the referent was a non-animal artifact. This contrasts with work by Hall (1996) in which children of this age made an adjective interpretation of the word when it was introduced in the same sentence frame and applied to a picture of a non-animal artifact with a salient inherent property. As discussed above in the case of adults, there was presumably no property which children took to be a candidate referent for an adjective, preventing them from making such an interpretation. Since we were not able to elicit verbal responses from children, it is not possible to determine if individual children made a consistent interpretation of the word in this condition.

3.3 Conclusion

The results reported here provide the first direct evidence that children, like adults, interpret proper names as referring to unique individuals. Children and adults were shown an animal toy with a salient property, such as a bear with a colorful bib, and heard the ambiguous sentence "This is zavy". The animal was then moved, the object marker was removed, and a second, otherwise identical animal toy was introduced at the old location. The object marker was placed on the new toy. When asked, "Which one is zavy?", both children and adults overwhelmingly selected the originally named animal. This pattern of responses runs directly counter to the Restricted Kind/Similarity Space hypothesis, which predicts that children should select the toy most similar in appearance to the named object at the time of naming. These results strengthen the conclusion drawn from naturalistic observations and from studies of children's proper name use and learning that children interpret proper names as referring to unique individuals (Bloom, 1990b; Gelman & Taylor, 1984; Hall, 1991, 1994, 1996; Katz *et al.*, 1974; Kim *et al.*, 1994; Liittschwager & Markman, 1993).

The finding that adults, like children, take animals to be better referents for proper names than simple artifacts, at least when the proper name is introduced in an ambiguous sentence frame, is a new one. This may indicate that people and animals are the prototypical namable entity for both children and adults (or alternatively, it may be that just people are the prototypical namable entities, and animals happen to be similar to people. *c.f.* Carey, 1985). One possible reason that people are unwilling to make a proper name interpretation of a word for a simple artifact is that simple artifacts do not physically resemble

people and animals. Also, people and animals are complex in non-obvious ways, such as having mental states like thoughts and desires, whereas simple artifacts are not complex in this way. Adults are willing to give proper names to complex artifacts such as boats and cars, and this could be because boats and cars, while they do not physically resemble people, do tend to have a complex appearance and do have complex internal states in virtue of their mechanics. The individuality of people, animals and complex artifacts such as cars and boats makes them unique and not readily interchangeable. In contrast, simple artifacts are highly interchangeable and their individuality is often unimportant or difficult to detect. These differences between people, animals and complex artifacts on the one hand and simple artifacts on the other could account for the fact that the former receive proper names, but the latter are not obvious candidates for proper names. In future research, it would be of interest to probe the properties of objects which lead to proper name attribution by children and adults.

As a group, adults, and possibly children, do not make a consistent interpretation of a word introduced with syntax ambiguous between a proper name, an adjective or a mass noun interpretation and applied to a non-animal artifact with a salient temporary property. Individual adults do tend to make an interpretation of a word introduced in this manner, however it is unclear if adults' interpretation is categorical. Some adults show clear evidence that their interpretation is categorical, because their behavior across different measures of their interpretation of the word is consistent, while other adults may not assign the new word to a fixed category, since their behavior across the different measures is not consistent. Adult performance may be a function of the learning situation. The syntax of the introducing sentence only partially constrains the word meaning (for example, it strongly suggests the word is not a verb, but leaves open the possibility that the word is an adjective or a mass noun), and few other cues are given to disambiguate the word's meaning further. Thus adults may not make a decisive interpretation of a word taught under these circumstances. Alternatively, adults may tend to answer inconsistently even when given a series of measures assessing their interpretation of familiar words. This bears further study.

Although children and adults tended to refrain from making a proper name interpretation of a word for a simple artifact, they might have been more inclined to make such an interpretation if the introducing sentence made it clear

that the word was intended as a proper name, by using unambiguous syntax or other linguistic cues. For example, in one condition, Hall (1996) gave explicit information that a word for a pictured cat was a proper name, saying "This cat's *name* is zavy". That is, while the properties the referent to which a word is applied play a role in proper name attribution, syntax and other linguistic cues are also likely to play a role in the interpretation of a word as a proper name. As noted earlier, children younger than three years of age actually ignore proper name syntax when the referent of a word is not an animal (Gelman & Taylor, 1984; Katz *et al.*, 1974). However older children and adults may be able to use syntax and other linguistic cues to interpret a word as a proper name even if the referent is not a typical referent of a proper name. This possibility merits further research.

The two experiments reported here also make a methodological contribution to the study of proper name learning. A number of these studies rely on children taking stuffed animals and dolls to be appropriate candidates for proper names, presumably because they are surrogates for people and animals. Unfortunately for these studies, toys are importantly different from people in that they are artifacts which can readily be mass produced. For example, there are thousands and thousands of Mickey Mouse dolls of all kinds, raising the possibility that children do not think that names such as *Mickey Mouse* are proper names at all. Even if this is not the case for children, because they may not have had much exposure to the mass production of toys by age three, it is nonetheless a real possibility for adults. The present findings weigh against this possibility and suggest that the use of toys as stimuli in these studies does not interfere with the validity of the studies as measures of proper name learning. Children and adults are able to construe a particular animal toy as a unique, namable individual.

The ability to use proper names depends critically on the ability to trace personal identity. After all, a proper name tracks the same individual through time, space and changes of appearance. A child is given a name at birth and bears the name throughout life. Indeed, long after people have died, they may be referred to by name. The two experiments reported here were not explicitly designed to assess children's and adults' ability to trace personal identity, however the manipulation in the experiments depended on at least some ability to do so. In order to respond appropriately to the question "Which one is zavy?", participants needed to trace the toy animal through a change in location and a

change in appearance, which they successfully did, at least in the Animal condition. Work by Liittschwager (1994) suggests that children are able to trace identity under much more radical transformations than these. Children in Liittschwager's experiments were willing to attribute the same name to a rabbit which had previously been a boy but which had been transformed via a special machine, suggesting that they traced the identity of the name's referent. This ability may contrast with children's ability to trace the identity of an artifact, such as a toy plane which undergoes various transformations (Hall, in press). Children's and adults' ability to trace personal identity is little studied in the scientific literature, although it has been the topic of philosophical investigation for some time. The understanding of personal identity is of interest both in its own right, in its relationship to proper name representation, and in its relationship to the understanding of identity of entities other than people.

The present work does not address whether children begin word learning with the assumption that proper names refer to unique individuals. It is possible that the Restricted Kind/Similarity Space Hypothesis is true of younger children, but that by age 3, children have restructured their representations of proper names and their referents to match those of adults'. Other alternatives are also possible. For example, a notion of individual object (animate or inanimate) could precede a notion of kind of object very early in conceptual development. Children might then construct a notion of kind of object and over-apply it in their early proper name learning. Alternatively, children may make a distinction between individuals and kinds from the outset of conceptual development. Another dimension in this space of possibilities relates to whether children conceive of animate individuals and inanimate individuals in the same manner in early development (e.g. Sorrentino, 1995; Spelke, Breinlinger, Macomber, & Jacobsen, 1992; Spelke *et al.*, 1995b; Xu & Carey, 1996). Examining proper name learning in younger children could shed light on some of these possibilities, together with studies of individuation and identity of animate and inanimate objects in infancy.

Table 1. Number of Sentences in the Animal and Artifact Conditions Classed into the High, Medium or Low Rating Range for Each of the Five Word Types

Condition	Rating Range	Proper Name	Count Noun	Adjective	Mass Noun	Verb
Animal	High	22	2	2	1	0
	Medium	2	3	6	6	1
	Low	0	19	16	17	23
Artifact	High	9	4	7	2	0
	Medium	5	3	0	2	0
	Low	10	17	17	20	24

Note: N = 24 in each condition; High = rating of 5-7; Medium = rating of 3-4; Low = rating of 1-2.

Table 2. Number of Participants in the Animal and Artifact Conditions who Gave a Proper Name Response, a Response which was Unambiguously Not a Proper Name Response, or a Response which was Ambiguous for Each of the Three Direct Questions in Experiment 1 of Chapter 3

Condition	Direct Question	Proper Name	Not Proper Name	Ambiguous
Animal	Means	10	2	0
	Sentence	8	0	4
	Synonym	5	3	4
Artifact	Means	5	4	3
	Sentence	4	3	5
	Synonym	1	9	2

Note: N = 12 in each condition; Means = “What does x mean?”; Sentence = “Can you use x in a sentence?”; Synonym = “Can think of a synonym for x or a word like it?”

Table 3. Number of Participants in the Animal and Artifact Conditions who Consistently Gave Proper Name Responses to All the Explicit Questions or At Least Two of Them in Experiment 1 of Chapter 3

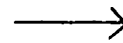
Condition	All Three Questions	At Least Two Questions
<hr/>		
Animal	5	9
Artifact	1	3

Note: N = 12 in each condition.

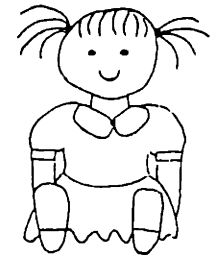
(1) An object is put on a place holder and labeled: "This is x"



(2) The object is moved to a new location.



(3) The object marker is removed from the object.



(4) A second object is put on the place holder: "Where's x?"

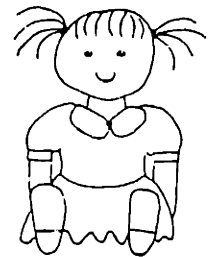
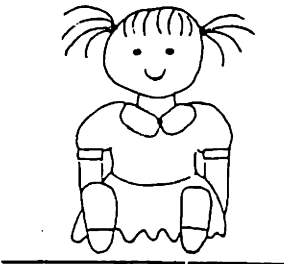
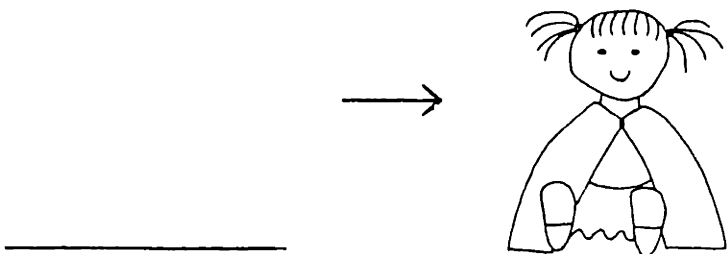


Figure 14. A depiction of the procedure used by Liittschwager and Markman (1996).

(1) An object is put on a place holder and labeled: "This is x"



(2) The object is moved to a new location.



(3) The object marker is removed from the object.



(4) The object marker is put on second object and the object is put on the place holder: "Which one is x?"



Figure 15. A depiction of the procedure used in Experiments 1 and 2.

Figure 16. Number of Participants who Selected the Named Object on Both Trials, the Object Most Similar to the Named Object at Naming on Both Trials, or Each Object Once on Each Trial in the Animal and Artifact Conditions of Experiment 1 and 2.

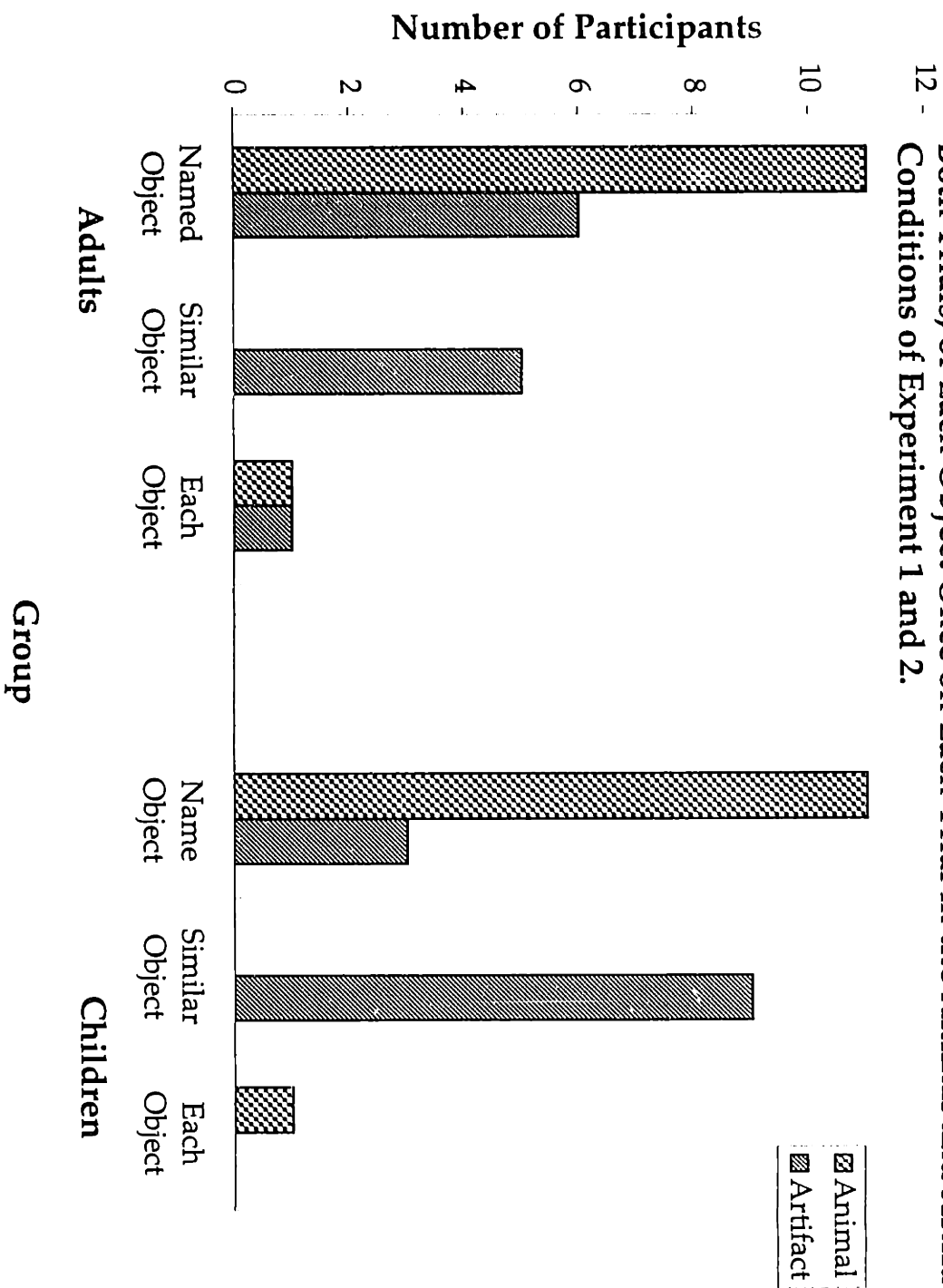
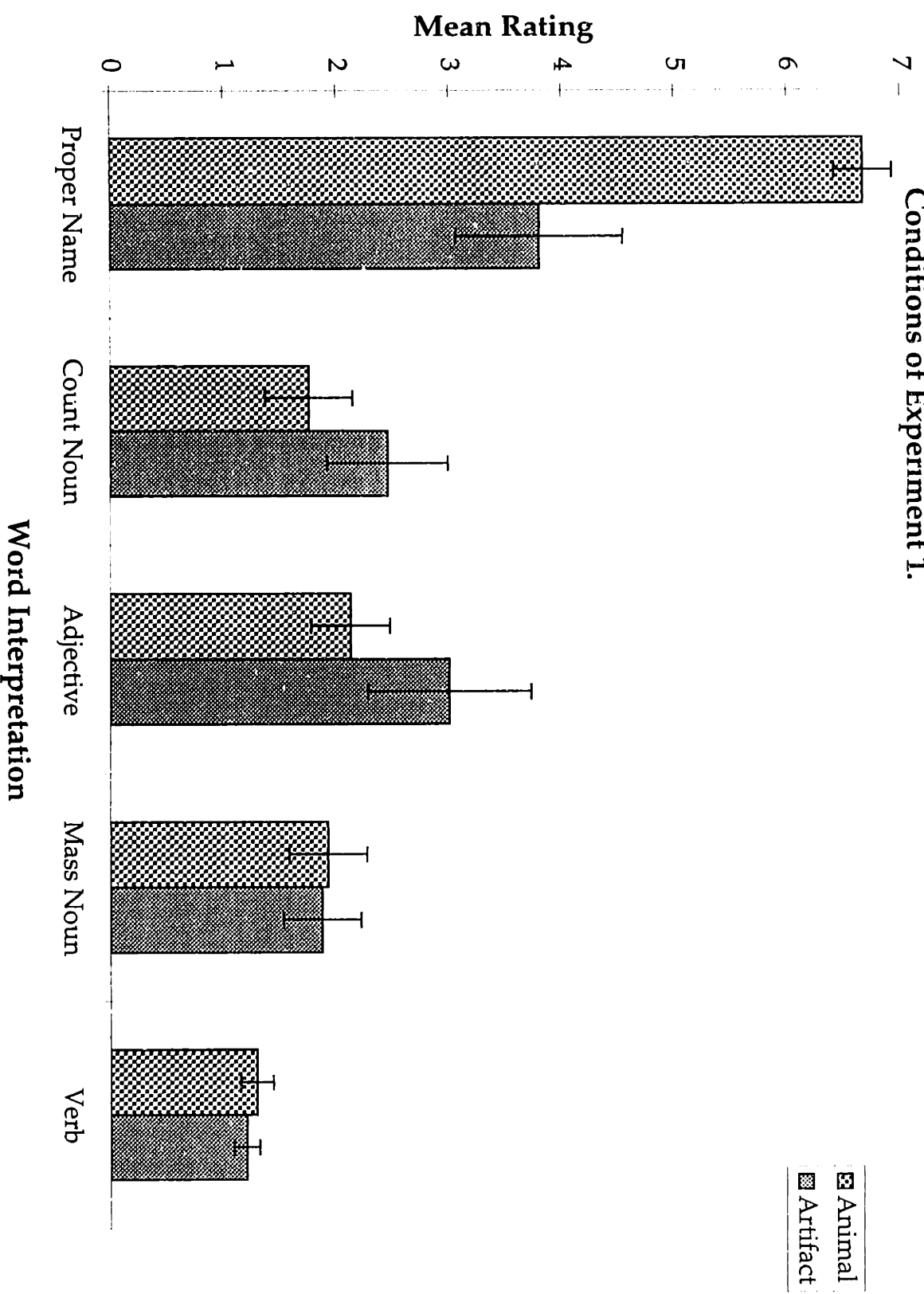


Figure 17. Mean Ratings of the Five Sentence Types in the Animal and Artifact Conditions of Experiment 1.



CHAPTER 4

Beyond Names for Animals: The Role of Syntax, Pragmatics, and Mental State Attribution on Preschoolers' Proper Name Learning

4.0 Introduction

As mentioned in Chapter 1, proper names have a number of referential and grammatical properties which children must master in the course of language acquisition. A proper name refers to a unique individual and is used to pick out the individual through the individual's existence. Proper name reference is supported by sortals such as person, since sortals provide criteria of individuation, which specify the boundaries of individuals, and criteria of identity, which allow an individual to be traced through time (Macnamara, 1986; Macnamara & Reyes, 1994). For example, person provides criteria which individuate one person from another and allows a proper name such as *Aristotle* to refer to a particular person, namely Aristotle, from birth to old age, despite myriads of changes in Aristotle's appearance and behavior. English syntax distinguishes proper names from count nouns (e.g. *dog*). Unlike count nouns, proper names may not be pluralized and do not take a determiner or quantifiers.

Even very young children have at least a partial grasp of the reference and grammar of proper names. Bloom (1990b) found that one- to two-year-olds use proper names in a syntactically appropriate manner. For example, they rarely produce utterances such as *Big Fred* or *Big he* in keeping with the syntactic constraint that proper names are not preceded by adjectives. Macnamara (1982) found that children use proper names in a referentially appropriate manner, by and large applying the name in the presence of individuals named by the name and not in the presence of other individuals (e.g. *Daddy*).

The research presented in Chapter 3 showed that by at least age 3, children have mastered a critical component of proper name semantics, namely that they refer to unique individuals. Children did not differ from adults in their interpretation of the words taught in the experiment. The individuals which both children and adults accepted as appropriate candidates for a proper name were surrogates for people and animals (i.e., a

doll and a stuffed bear). Neither children nor adults accepted a bottle or a shoe as a candidate bearer of a proper name. However, as noted in Chapter 1, adults naturally name a wide range of entities, including places, institutions and media products. Clearly there are non-animal individuals which adults accept as candidates for a proper name. The reason for which adults did not interpret a word for a simple artifact as a proper name is presumably due to factors other than the object's non-animal status, such as the possibility that simple artifacts are not readily perceived as unique. Will children accept individuals which do not physically resemble people, animals or their surrogates as referents for proper names?

As noted in Chapter 3, research in cognitive development suggests that preschool children are biased to accept only people, animals and their surrogates as candidate bearers of proper names (Gelman & Taylor, 1984; Hall, 1994; Katz, *et al.*, 1974). How profound is this bias? One possibility is that the bias represents a genuine difference between preschoolers and adults. Whereas adults accept a range of individuals as candidates for a proper name, preschoolers only accept animate individuals as proper name bearers. A second possibility is that children will accept a range of individuals as proper namable, but this competence has not emerged in studies of proper name learning because the set of stimuli used and the information with which the proper names were introduced were too impoverished for children to interpret the word as a proper name for a non-animal artifact. These two possibilities make different predictions. On the first, no amount of embellishment of stimuli or of teaching information should influence children's bias to take people, animals and their surrogates as namable individuals. On the second possibility, presenting children with more complex non-animals than used in previous work, and introducing a word with information conducive to a proper name interpretation should lead children to make a proper name interpretation of a word presented with proper name syntax and used to refer to the object.

4.1 Preschooler's Use of Linguistic and Non-linguistic Cues to Learn Proper Names

In order to make a proper name interpretation of a word, as opposed to some other interpretation, children must make use of whatever information

is made available to them which bears on the word's possible meaning, whether non-linguistic information, such as the features of the referent, or linguistic information, such as syntax. A number of studies document children's ability to use their knowledge of proper name reference and grammar to interpret linguistic and non-linguistic cues that a word is a proper name. Work by Katz *et al.*, (1974) suggests that 17-month-old girls can use the presence or absence of a determiner to make a proper name or count noun interpretation of a new word for an animal toy. Children do not make this interpretation if the toy is a non-animal toy such as a wooden block. By their mid-twos, both boys and girls can make use of syntactic cues to learn proper names (Gelman & Taylor, 1984).

There is also evidence that children can use non-linguistic cues to make a proper name interpretation of a new word. One of these cues is the set of perceptible properties of the object being referred to. For example, some of the girls in the Katz *et al.*, (1974) studies were taught a proper name (e.g. *This is zav*) or a count noun (*This is a zav*) for a wooden block. The girls made a count noun interpretation of the new word, regardless of whether there was a determiner preceding the word or not. Girls who heard the proper name favored the non-linguistic information and attended to the properties of the referent—wooden blocks are not typical referents of proper names, unlike people, animals and their surrogates, such as dolls. These girls thus made a count noun interpretation of the word, in contrast to the girls who heard the same sentence frame applied to an object with the appropriate properties, a doll. By their mid-twos, both boys and girls show sensitivity to the object properties of the referent in making a proper name interpretation of a word (Gelman & Taylor, 1984). As suggested above, if children are willing to accept non-animals as bearers of proper names, then they might have favored the linguistic cue in these experiments if the non-animal had been a more complex artifact than a wooden block.

Children's ability to use the perceptible properties of the referent of a word to make a proper name interpretation of the word is affected by the familiarity of the referent. As described in Chapter 3, Hall (1991) taught two-year-olds either a proper name for a familiar toy animal for which they knew a basic level count noun (i.e. a stuffed cat) or he taught them a proper name for an unfamiliar toy animal for which they did not know a basic-level count noun (i.e. a monster). Children presented with the familiar animal were

more likely to make a proper name interpretation of the new word than the children presented with the unfamiliar animal. Further analysis showed that some of the children who were taught the word in the presence of the unfamiliar animal ignored the linguistic cues that the word was a proper name and made a count noun interpretation of the word. This behavior is consistent with the *object kind* bias, namely, the tendency for young children to take a new word applied to an unfamiliar object to refer to the object kind (Markman & Hutchinson, 1984). The children presented with the familiar animal presumably did not make an object kind interpretation of the new word because they already knew a basic level count noun for the object kind of the referent. This behavior is consistent with the principle of *mutual exclusivity*: each kind has only one label, and a label can refer to only one kind (Markman, 1989; Markman & Wachtel, 1988; Taylor & Gelman, 1988).

Children's ability to use the perceptible properties of the referent of a word to make a proper name interpretation of the word is also affected by the extent to which animate referents of the word are typical pets. Furthermore, children's ability to use object properties to make a proper name interpretation of a word is not affected by the extent to which inanimate referents of the word are simple or complex. Hall (1994) presented a new word to 3- to 4-year-old children in a sentence frame which was ambiguous between a proper name interpretation and an adjective interpretation (i.e. *This is zavy* in which *zavy* can be interpreted either as a proper name or as an adjective such as *striped*). In one experiment, Hall presented children with an array of five drawings. The target for the children in the Animal condition was a drawing of a typical pet such as a dog covered with multicolored fluorescent circles. The other stimuli were a drawing of a plain dog of the same subordinate class as the target, a drawing of a plain dog of a different subordinate class, a drawing of a bottle with the multicolored fluorescent circles and a plain apple. The target for the children in the Artifact condition was a drawing of a simple artifact such as a shoe covered with multicolored fluorescent circles. The other stimuli were a drawing of a plain shoe of the same subordinate class, a drawing of a plain shoe of a different subordinate class, a drawing of a bottle with the multicolored fluorescent circles and a plain apple. Children were taught a word for the target picture using the sentence frame: *This dog [shoe] is zavy*. Children in the Animal condition tended to affirm that only the target was zavy, as if they interpreted the word

as a proper name. Children in the Artifact condition tended to affirm that both the target and the bottle with the same property were zavy, as if they interpreted the word as an adjective. These results suggest that when faced with a syntactic ambiguity, children can use the perceptible properties of a typical pet to resolve the ambiguity and make a proper name interpretation of a new word. When the target is a simple artifact however, children do not do this and instead seek another interpretation of the word, such as an adjective interpretation.

In another experiment, Hall (1994) examined 3- to 4-year-old children's ability to resolve syntactic ambiguity when the referents were atypical pets such as caterpillars and bees, or complex artifacts such as boats and cars. The stimulus sets were very similar to those described above. For children in the Animal condition, the target was a drawing of an atypical pet covered in multicolored fluorescent circles, a drawing of a plain atypical pet of the same subordinate-level kind, a drawing of a plain atypical pet of a different subordinate kind, the property match and the distracter. For children in the Artifact condition the target was a drawing of a complex artifact covered in multicolored fluorescent circles, a drawing of a plain complex artifact of the same subordinate level kind, a drawing of a plain complex artifact of a different subordinate-level kind, the property match and the distracter. The experimenter pointed to the target and said *This bee [car] is zavy* and children were then asked of each of the drawings if it was zavy. Children in the Animal condition were affected by the extent to which the target was a typical pet: only half the children made a proper name interpretation of the new word, affirming that only the target was zavy. This suggests that the children thought that the atypical pet was a less appropriate candidate for a proper name and so were less able to resolve the syntactic ambiguity than children who were presented with a typical pet. The other half of the children made an adjective interpretation, affirming that both the target and the bottle with the same property were zavy. On the other hand, the complexity of the artifact did not influence children's interpretation of the new word. As in the previous experiment, children in the Artifact condition tended to select the target and the bottle with the same property, suggesting that they made an adjective interpretation of the word rather than a proper name interpretation.

In a follow up experiment, Hall presented children with linguistic information which influenced children's interpretations of the word in the

atypical pet condition but not in the complex artifact condition. Hall reasoned that in the earlier study, children were unsure of the atypical pet's status as a pet and thus were ambivalent as a group about the object's status as a distinct, namable individual. He reasoned that introducing the animal with "This is my bee" would clarify the object's status and lead children to make a proper name interpretation of "zavy" in "This is zavy". At the same time, Hall suggested that animacy is necessary for proper name attribution and thus, he predicted that introducing the complex artifact with "This is my boat" would not lead to a proper name interpretation of "This is zavy". That is, he thought that possession alone would not be sufficient for proper name attribution by young children, despite the fact that many adults name certain objects that they own, such as boats. Hall found just the pattern of results that he predicted: children made a proper name interpretation of a word applied to a bee introduced as "my bee", but continued to make an adjective interpretation of a word applied to a boat introduced as "my boat". Thus children in the atypical pet condition were able to use the linguistic information that the referent was the experimenter's pet to disambiguate the utterance and make a proper name interpretation of the word. Children in the complex artifact condition, on the other hand, were not influenced by the linguistic information. They continued to be influenced by the object properties of the referent and resolved the ambiguity with an adjective interpretation of the word.

Hall's results are interpretable on both possibilities described in section 4.0. On the possibility that children only accept animate individuals as referents for proper names, the reason children did not make a proper name interpretation of a word for a simple or complex artifact is that these objects are not animals. The reason children did not initially interpret a word for a bee or as a proper name is that they are not sure if a bee is an animate individual. "My" increases children's certainty that the entity is an animal, since it suggests to them that it may be a pet and all pets are animals. On the second possibility, namely that children will name a range of individuals but the stimuli used and the information with which the word is presented may prevent children from doing so, children did not learn a proper name for the simple or complex artifact because the stimuli together with the ambiguous information were not conducive to such an interpretation. That is, the pictures of the simple and complex artifacts may not have highlighted the

individuality of the referents sufficiently to lead children to construe the pictured artifact as a namable individual. Moreover, the ambiguous sentence frame did not provide information that the word was intended as a proper name. Since children did not naturally construe the artifact as a namable individual, they did not resolve the ambiguity of the sentence by making a proper name interpretation of the word, but rather sought a different interpretation, in this case an interpretation of the word as an adjective. The same was true for the picture of the bee. Children did not naturally construe the bee as a namable individual, possibly because they have little familiarity with insects as individuals, in contrast to their experience with common pets such as dogs. Again, the ambiguous syntax did not give them further information, and so children failed to interpret the word as a proper name. When the experimenter introduced the bee with “my”, children were more inclined to view the bee as an namable individual, since it was presumably the experimenter's pet, and since pets are namable individuals (as attested by the fact that they are commonly given proper names).¹³

Another non-linguistic cue which children can use to make a proper name interpretation of a new word is the number of animals to which the word is applied. Hall (1996) showed that four-year-olds can use their knowledge that proper names refer to unique individuals to make a proper name interpretation of a word in an ambiguous sentence frame (e.g. *This is zavy*) if it is applied to one animal with a salient property, and an adjective interpretation of the word in the ambiguous sentence frame if it is applied to each of two animals with the salient property. Children's tendency to make a proper name or adjective interpretation of the word can be modified via linguistic cues to the word's status. For example, children who were shown two cats were able to make a proper name interpretation of the new word

¹³ Children's ability to use *my* to establish that the referent is namable only in the case of the animal does not mean that children are in principle unable to learn proper names for complex artifacts. Rather, the cue is simply a good means of establishing that the bee is an individual, because it suggests that the referent is a pet, whereas it is not a good means of establishing that the car is an individual since it does not suggest that the car is a pet. People do not own cars as pets. There may well be an interplay here of the extent to which an animal in general is more easily construed as an individual than a car. This may be why people own animals as pets and not cars, and it is also why children and adults are able to use animal features to resolve the syntactic ambiguity of *This is zavy* and make a proper name interpretation of the word in this case, but not in the case where the referent is a simple artifact. However, the question of interest is whether there is *any* way for children (and presumably also adults) to construe an artifact or other non-animal entity as namable.

when told for each cat, *This cat's name is zavy. This cat is called zavy;* children who were shown a single cat were able to make an adjective interpretation when told *This cat is very zavy. Look how zavy this cat is.*

The work reviewed above provides evidence that children are able to use their knowledge of proper name grammar and reference to interpret a variety of linguistic and non-linguistic cues in learning proper names. The linguistic cues that have been assessed are the syntax with which a new word is introduced (i.e. the absence of a determiner such as *a*), the use of the possessive *my* to highlight the fact that an atypical pet is indeed a pet, and the disambiguation of a proper name's grammatical class with sentences like *This cat's name is zavy*. The non-linguistic cues that have been assessed are the presence of perceptible animal properties of the word's referent, and the number of animal referents to which the word is applied. These results have been taken to suggest that preschool children assume that proper names refer to animate individuals because children in the studies reviewed above were only able to make use of the linguistic cues to a word's status as a proper name if the linguistic information was paired with particular non-linguistic information, namely the presence of an individual with perceptible animal features. However, if children assume that proper names can refer to individuals of either animate or inanimate kinds, children should be able to rely on linguistic information together with non-linguistic information in the form of an individual with properties other than animal properties to interpret a word as a proper name for the individual.

4.1.1 A Candidate Individual

As noted earlier, the non-animal stimuli used in studies of proper name learning may not have been sufficiently complex or salient for young children to make a proper name interpretation of a word applied to them. Dolls and stuffed animals standardly have separately moving parts such as arms, in addition to facial features. The wooden blocks used by Katz *et al.*, (1974) clearly did not have separately moving parts, and were a homogenous color. Gelman and Taylor (1984) used slightly more complex artifacts (a plastic toy which could be folded into different shapes) but these may simply not have been complex enough. Also, these toys were relatively small. Whereas this did not seem to affect proper name learning in the doll case, possibly

because children have a lot of experience with dolls being named, the small size of the non-animal artifact may have hindered children's tendency to perceive the object as a namable individual. Hall (1994) used pictures of highly complex artifacts, namely boats and cars. However, since these were pictured, children may not have been struck by the individuality of the represented artifact. This potential problem is easily remedied by the construction of interesting colorful non-animal artifacts with separately moving parts. Importantly, the stimuli should be unfamiliar to ensure that children do not have positive expectations that the non-animal artifact should not be named.

4.1.2 Pragmatics of Proper Name Introduction

Proper name syntax is a reliable cue that a word is a proper name, however it is not helpful as a cue without non-linguistic factors to support reference to an individual. To illustrate, imagine a person saying "This is Johnny" while vaguely gesturing in the direction of three men. It would be difficult for someone learning the name to determine which of the individuals is being referred to. Clearly, an unambiguous point or other gesture is needed, or Johnny could step forward at the mention of his name and remove the ambiguity from the situation. In the studies described above, the experimenters always singled out the to-be-named toy from a group of toys when referring to the object with the novel word. Nonetheless, since the word was novel, children could not determine that it was a proper name (unlike the example of *Johnny* just given). Also, it is possible that the pragmatics of the situation were not sufficient to invoke a proper name interpretation for a non-canonical namable individual. As seen in Chapter 3, adults will not necessarily make a proper name interpretation for an individual bottle or shoe. It is possible that even adults might not have made a proper name interpretation of the word in the experiments of Katz *et al.*, (1974) and Gelman and Taylor (1984) even though these studies used unambiguous proper name syntax. But even if adults were able to use the pragmatics of the above-mentioned procedures to make a proper name interpretation of the word, children may need even more pragmatic support than adults in learning a proper name for a non-canonical namable individual. To investigate preschoolers' ability to interpret a word for a non-

animal artifact as a proper name, then, in addition to singling out the to-be-named individual, it could be described at some length.

4.1.3 The Attribution of Mental States

It is possible that presenting children with a candidate non-canonical individual and good pragmatic cues is not enough for preschoolers to accept the individual as a candidate for a proper name. That is, although the range of entities for which children are willing to learn a proper name may be broader than the results of work by Katz *et al.*, (1974), Gelman and Taylor (1984) and Hall (1994) suggest, they may not be much broader. Perhaps in order to be namable individuals, objects have to have some animate properties, even if they do not resemble animals. A suggestion of this nature was described in Chapter 1. Recall that Turkel (1996) argues that people name objects which they are able to anthropomorphise.

One set of linguistic cues to an object's status as an animate entity or as a namable individual is the attribution of mental states to the object via mental verbs such as *want* and *hope*. Mental verbs are a cue to animacy because an integral part of mental verb semantics is that they are predicated of intentional entities such as people but not of non-intentional entities such as tables. Intentionality is an important component of animacy, and one that even very young children are sensitive to (Meltzoff, 1995; Leslie, 1994; Spelke, *et al.*, 1995b; Gergely *et al.*, 1995). Mental verbs are also a cue to individuality since they can be used to specify a distinct set of likes and dislikes. Individual personalities, which can be described at least in part with mental verbs, set one person apart from another and may be important in proper name representation. Children ubiquitously hear adults attribute mental states to people, the prototypical namable entities, and the prototypical entities possessing thoughts and desires. Mental states are commonly attributed to animals also. Although there is a substantial literature arguing that children do not have an adult-like theory of mind until they are in their mid-threes (Wimmer & Perner, 1983; Gopnik & Astington, 1988; Moses & Flavell, 1990; Perner *et al.*, 1987), by their mid-twos children actually produce mental verbs such as *want* and *hope* in contexts where it is clear that the verbs have an intentional sense, rather than being a mere communicative hedge (Bartsch & Wellman, 1995). It is thus possible that preschoolers can use the semantics of

mental verbs, a purely linguistic cue, to infer either that a non-animal object is indeed an animal or to infer that it is a namable individual

We tested preschooler's ability to use pragmatics alone or pragmatics together with mental state attribution to make a proper name interpretation of a new word for a non-animal artifact. In Experiment 1, we taught 2-year-old children a proper name for an unfamiliar object which did not resemble an animal, but which we either singled out from a set of toys and drew attention to it as an individual by referring to it, or which we singled out from a set of toys and drew attention to by attributing mental states to using mental verbs. We also taught the children a proper name for an unfamiliar animal toy using pragmatics alone or pragmatics together with mental state attribution. In Experiments 2 and 3, we taught 3-and 4-year-children a proper name for an unfamiliar, non-animal object using pragmatic information or pragmatics and mental state information to assess developmental differences in children's ability to use these cues in learning proper names for individuals of different kinds.

4.2 Experiment 1

4.2.1 Method

Participants

Seventy two-year-old children were included in the experiment (mean age 2;6, range from 2;4 to 2;10). The children were predominantly monolingual speakers of English. Children were recruited through Boston area birth records by means of letters and phone calls, and were primarily of middle socioeconomic status. Children were randomly assigned to one of five conditions with the constraint that there be fourteen children in each condition, seven girls and seven boys. Sixty-nine additional children were not included in the experiment. Of these, five were excluded due to experimenter error, twenty-six refused to respond to the experimenter's requests, and thirty-eight failed to pass the forced choice comprehension task for the kind label which was taught in the first part of the experiment (see below). Twenty-one of these thirty-eight children were boys and seventeen were girls. All children

received a small toy or a coloring book and pencils after participating in the study.

Design

A two factor experimental design was used which varied the type of referent to which the new word was applied, Animal and Non-animal, and the type of cue with which the proper name was introduced, pragmatic alone (henceforth *Pragmatic*) and pragmatic together with mental state attribution (henceforth *Mental*). This yielded four conditions: Non-animal/Mental, Non-animal/Pragmatic, Animal/Mental and Animal/Pragmatic. A fifth baseline condition was also included in which children were not taught any words for any of the toys. This condition was included to assess children's baseline preferences for playing with particular toys or toy kinds.

Materials

Four handmade soft toys designed to be unfamiliar and roughly equated for internal complexity were used as stimuli in the experiment. Each toy stood about 8 inches tall. Two of the toys resembled animals and two of the toys were neither animal-like nor typical artifacts (see Figure 18). The two animal toys most resembled a Martian squirrel without a tail or feet. One animal toy was pink with green pipe-cleaner antennae, green eyes, a blue button nose, a purple smiley mouth, a green stomach and purple fur down its back. The other animal toy was light blue with pink pipe-cleaner antennae, blue eyes, a pink button nose, a red smiley mouth, a purple stomach, and pink fur down its back. The non-animal toys were made of fabric-covered foam shapes: a rectangle topped by a foam cube topped by an upside-down foam cone. Four golf balls painted with abstract designs were hung on individual strings from the top of each toy. One non-animal toy was red with blue sequin stripes, blue velvet sections, green upholsterer's cord trimmings and sparkly green and blue painted balls. The other non-animal toy was yellow with orange sequin stripes, burgundy velvet sections, gold cord trimmings and sparkly pink and purple painted balls.

In addition to the four toys, a black felt bag and a blue cardboard box, both large enough to hold all the toys, were used during the experiment. A small foam sponge was also used for one of the actions (i.e. washing a toy).

Procedure

Children were tested in the lab accompanied by one of their parents. All children were tested by the author. To help the child feel at ease in a new setting, the experimenter encouraged the child to color in a coloring book, draw on a piece of paper or look through a children's book. When the child made a few spontaneous comments and seemed relaxed, the experimenter asked the child if he or she wanted to see the experimenter's toys with his or her mother or father. All children indicated that they did, at which point the experimenter led the parent and child into an adjoining room and the experiment proper began.

Baseline Condition. Children in the baseline condition were not taught a new word for any of the toys. Rather, the children were allowed to choose the toy with which to perform simple actions requested by the experimenter. At the start of the testing session, each toy was removed from the bag one at a time and placed in front of the child with a comment such as "Look what I have here" or "See this?" Children were asked to perform ten actions with a toy of their choice. The actions were drawn randomly from: put in the box, put on the bag, put in the bag, give to their parent, give to the experimenter, throw in the air, turn upside down, point to, touch, hold, push over/kick, wash, put on the child's head and put on the experimenter's head. These were the same actions which were used in the four word learning conditions. The order in which the toys were taken out of the bag was similar to the order in which the toys were removed from the bag in the four word learning conditions. That is, the two toys of one kind were pulled out one at a time and then the two toys of the other kind were pulled out one at a time. The object kind which the children saw first, as well as the individual toys within the kind which the children saw first, were counterbalanced.

Non-animal/Mental Condition. Before teaching the children a proper name for one of the non-animal toys, we taught them a count noun for the kind to which the toy belonged. This is because Hall (1991) showed that the familiarity of the object to which a proper name is applied plays a role in children's tendency to interpret the word as a proper name. As noted above, Hall argued that this is because children do not have a basic level kind term for the unfamiliar toy animal. Some of the children thus interpret the new

proper name as a count noun for the kind to which the unfamiliar animal belongs, consistent with the object kind bias (Markman & Hutchinson, 1984). Based on the principle of mutual exclusivity (Markman & Wachtel, 1988; Taylor & Gelman, 1988), we reasoned that if children know a noun for the kind of object being named, they should be less likely to interpret a new word modeled as a proper name as referring to the object kind. Instead, children should be free to make a proper name interpretation of a new word applied to the toy.

To teach the children a kind label for the non-animal toys, the experimenter took one of the non-animal toys out of the bag and said, "See, this is a zav. Can you say *zav*?" The experimenter then removed the second non-animal toy and said, "See, this is another zav. Two zavs! There's a zav over here (pointing to one non-animal toy) and there's a zav over there (pointing to the other non-animal toy). They're both zavs!". The experimenter then brought out the animal toys without naming them (i.e. "I have this too." and "Look, another one"). The kind labels used were the nonsense words *zav*, *dax*, *wug* and *shim*. The order of removal of the toys from the bag was counterbalanced across children. Children's interpretation of the kind label was then tested in a forced choice task involving two of the toys, an animal toy and a non-animal toy. The toys used in the forced choice task were counterbalanced across children. The other two toys were cleared out of the way. The child was asked to put the zav in the box or to give the zav to his or her mother or father. Children who chose the wrong toy or who chose both toys were not included in the study.

After children were taught a kind label for the two non-animal toys, the experimenter cleared away all of the toys except for the to-be-named toy. The experimenter then named the non-animal toy with a proper name and attributed mental states to the toy saying, "See? This is Toopa. Can you say *Toopa*? Toopa hopes you'll want to play. Toopa likes to be picked up and Toopa wants to have fun. But know what? Toopa is afraid of loud noises. Toopa hates loud noises." The names used were *Toopa*, *Baybo* and *Keeble*. The named non-animal was counterbalanced across children. To determine the child's interpretation of the novel proper name, the experimenter brought out the rest of the toys and asked the child to perform ten simple actions. Six of these trials were test trials during which the experimenter asked the child to carry out the action on Toopa (e.g. "Can you throw Toopa

in the box?"). The four remaining trials were distracter trials during which the experimenter indicated a toy and asked the child to perform an action with the toy (e.g. "Can you give this to Daddy?"). Children were never asked to perform more than two test actions in a row and the toys were always within easy reach of the child. All the toys except the named toy were used at least once as distracters. The purpose of the distracter trials was to avoid focusing on just one of the four toys and to give children a chance to handle the other toys. The ten actions were drawn from the same set as was used in the baseline.

Non-animal/Pragmatic Condition. This condition was identical to the Non-animal/Mental condition except that the experimenter drew attention to the toy while teaching the proper name in the following way: "See? This is Toopa. Can you say *Toopa*? Toopa is on the floor (the experimenter indicates the toy). Toopa is soft (the experimenter touches toy at the side) and Toopa is fuzzy on top (the experimenter touches the toy at the top). Look, Toopa is in my hand (the experimenter puts toy in her hand). Toopa is not very heavy though (the experimenter moves the toy up and down as if gauging its weight)."

Animal/Mental Condition. This condition was very similar to the Non-animal/Pragmatic condition except that the labeled stimuli were the animal toys, rather than the non-animal artifacts. When the experimenter took the toys out of the black felt bag one at a time, the first two toys removed from the bag were the two animal toys and the last two toys were the non-animal toys. The experimenter taught the kind label for the animal toys in the same way as for the non-animal toys. The non-animal toys were not labeled, but were introduced with "I have this too" and "Look, another one". The order of removal of the toys from the bag was counterbalanced. The same kind words were used as in the non-animal conditions and as with those conditions, children's interpretation of the kind label was tested in a forced choice task involving an animal toy and a non-animal toy. The toys used in the forced choice task were counterbalanced across children. Children were then taught a proper name for one of the animal toys using mental verbs as in the Non-animal/Mental condition. The novel proper names were the same as in the non-animal conditions. The named animal toy was

counterbalanced across children and children's interpretation of the novel proper name was examined in the same way as in the two non-animal conditions.

Animal/Pragmatic Condition. This condition was identical to the Animal/Mental condition except that the experimenter drew attention to the toy when introduced the new proper name, as in the Non-animal/Pragmatic condition.

The entire procedure for all four conditions was recorded on videotape and each child's responses were coded from the tape by the author.

4.2.2 Results

Baseline Condition. The performance of the children in the baseline group was examined first (see Figure 19). Preliminary analyses on the percentage of the trials for which the children selected a given toy did not reveal any sex differences hence this factor was not included in subsequent analyses. To assess any intrinsic preferences for choosing a particular toy, the percentage of the trials on which children chose a given toy was compared against a chance level of 25% (since there were four toys). Children were no more likely to choose three of the toys than expected by chance (red non-animal toy (mean = 29%), $t(13) = .776, p > .10$; yellow non-animal toy (mean = 27%), $t(13) = .187, p > .10$; fuchsia animal toy (mean = 26%), $t(13) = -.351, p > .10$; all tests were two-tailed); children tended to choose one of the animal toys less than expected by chance (blue animal toy mean = 18%, $t(13) = -2.128, p = .053$, two-tailed). To follow up this result, children's selection of the animal toy was compared to their selection of the three other toys. All three comparisons were not significant (blue animal toy vs. pink animal toy, $t(13) = 1.233, p > .10$; blue animal toy vs. yellow non-animal, $t(13) = -1.453, p > .10$; blue animal toy vs. red non-animal, $t(13) = -1.697, p > .10$; all tests were two-tailed). This suggests that children were not less likely to select the blue animal toy than any of the other toys. To assess children's intrinsic preferences for choosing toys from either of the toy kinds, the overall selection of the toys from each toy kind was compared to a chance level of 50%. Children were no more likely to choose toys from a given kind than

expected by chance (animal toys, (mean = 45%), $t(13) = -.872, p > .10$, two-tailed; non-animal toys, (mean = 55%), $t(13) = .864, p > .10$, two-tailed). To further assess children's preferences for choosing toys from either kind, the overall selection of the animal toys was compared to the overall selection of the non-animal toys. Children were no more likely to choose animal toys than they were to choose non-animal toys ($t(13) = .868, p > .10$, two-tailed). Together these analyses suggests that the children did not have any particular preferences for playing with any of the individual toys or for playing with the toys from either toy kind.

Percentage of Named Toy Selections. The percentage of the test trials on which children chose the named object in the four word learning conditions was examined next to determine if mental state attribution influenced children's tendency to make a proper name interpretation of a word applied to one of the toys. Preliminary analyses revealed sex differences in children's performance, thus sex was included as a factor in subsequent analyses. The percentage of children's named toy selections were submitted to a three-way ANOVA with toy type (Non-animal, Animal), information type (Pragmatic, Mental) and sex as between subject factors. There was a main effect of toy type, $F(1,48) = 8.306, p < .01$. Children chose the named toy a higher percentage of the time in the Animal conditions than in the Non-animal conditions, irrespective of the type of information heard (Animal mean, 68%; Non-animal mean, 46%). There was also an interaction between information type and sex, $F(1,48) = 6.925, p < .05$. Girls chose the named toy more overall when the new word was introduced in the context of mental information (70%) than when it was introduced in the context of pragmatic cues (39%). This difference was significant, $t(26) = 2.426, p < .05$, two-tailed. Boys, on the other hand, chose the named toy slightly more often when the word was introduced with pragmatic cues alone (64%) as compared to when it was introduced pragmatic cues along with mental state attribution (56%). However, this difference was not significant, $t(26) = -.708, p > .10$, two-tailed. Most importantly, there was a three way interaction between toy type, information type and sex, $F(1,48) = 13.643, p < .001$.

To examine the three-way interaction further, the performance of the children in the Non-animal and Animal conditions was examined separately. Figures 20 and 21 show the percentage of the trials on which the girls and boys

in the Non-animal conditions chose the named non-animal, the other non-animal, and the two animal toys. A two-way ANOVA was performed on these percentages with information type and sex as between subject factors. No main effects were found, however there was a significant interaction of information type and sex, $F(1,24) = 18.179, p < .001$. Girls chose the named toy on 74% of the trials in the Non-animal/Mental condition, but on only 13% of the trials in Non-animal/Pragmatic condition. A follow up t test on the girls' percentages revealed that the difference between the two information conditions was significant, $t(12) = 3.873, p < 0.01$, two-tailed. Boys chose the named toy on only 32% of the trials in the Non-animal/Mental condition, but on 67% of the trials in Non-Animal/Pragmatic condition. A follow up t test on the boys' percentages revealed that the difference between the two information conditions was also significant, $t(12) = -2.165, p = .051$, two-tailed. Thus girls were not able to use pragmatics alone to learn a proper name for a non-animal toy, but they were able to use pragmatics together with mental state attribution to make a proper name interpretation of the word. Boys, on the other hand, were able to use pragmatics alone to interpret a new word as a proper name for a non-animal toy, but surprisingly, they were not able to use pragmatics together with mental state attribution to learn a proper name for the toy.

Figures 22 and 23 show the percentage of the trials on which the girls and boys in the Animal conditions chose the named animal, the other animal, and the two non-animal toys. A two-way ANOVA was performed on these percentages, with information type and sex as between subject factors. There were no main effects and there was no interaction between information type and sex: girls in the Animal/Mental condition chose the named toy on 67% of the trials, girls in the Animal/Pragmatic condition chose the target on 64% of the trials, boys in the Animal/Mental condition chose the target on 80% of the trials and boys in the Animal/Pragmatic condition chose the target on 61% of the trials (all F 's < 1.5 and all p 's $> .10$). This suggests that pragmatic and mental state attribution together did not increase children's tendency to select the named toy in the Animal/Mental condition as compared to the Animal/Pragmatic condition. However, the means collapsed across sexes are in the direction which indicates that the children in the Animal/Mental condition (70%) had a greater tendency to select the named toy than the children in the Animal/Pragmatic condition.

Individual Pattern of Toy Selections. To further examine children's interpretation of the proper name in the four word learning conditions, each child's tendency to make a proper name interpretation was examined individually. The reason for coding children's responses this way is that unless the overall percentage of the trials on which children select the named toy is close to ceiling, suggesting that the majority of the children made a proper name interpretation of the word, the percentage collapses different interpretations of the word, such as a count noun interpretation. Children's interpretations of the word modeled as a proper name fell into six categories: Proper Name for the Named Toy, Count Noun for the Named Toy Kind, Proper Name for the Other Toy of the Same Kind, Proper Name for One of the Toys of the Unnamed Kind, Count Noun for the Toys of the Unnamed Kind, and Random Response Pattern. Table 4 shows the number of girls and boys who made interpretations of each type in the four word learning conditions. A child was scored as making a proper name interpretation if he or she chose a given toy on at least four of the six trials and chose the other object of the same kind no more than once during the other trials.¹⁴ This relatively lax criterion for proper name attribution was adopted because there was reason to think that children found the task of learning two new words for members of a set of unfamiliar objects relatively difficult. This is supported by the fact that a large number of children failed to pass the forced choice component of the experiment, and by the large number of children who failed to comply with the experimenter's requests. Children were categorized as making a count noun response if they chose one toy of a given kind on no more than four trials and the other toy of the same kind on at least two trials. Other response patterns were categorized as random.

An examination of Table 4 shows that there is no consistent pattern of alternatives to the interpretation of the word as a proper name for the named object, hence the six categories were collapsed into two categories, Proper Name for the Named Object and Other. The interpretations of the girls and the boys in the Non-animal/Mental and the Non-animal/Pragmatic

¹⁴ Only five children were categorized as making a proper name interpretation on the basis of four selections of the target and one selection of the other toy of the same kind. Two of these children were in the Non-animal/Pragmatic condition and the other three were in the Animal/Mental condition. Of these five, one of the two children in the Non-animal/Pragmatic condition showed this pattern in selecting one of the animal toys, whereas the other children showed this pattern in selecting one of the named non-animal.

condition were examined separately. Although more girls than boys made a proper name interpretation of the word in the Non-animal/Mental condition, this difference in patterns of interpretation did not reach significance by a Fisher exact test, $p = .103$, two-tailed. However, the difference in number of girls and boys making a proper name interpretation is in the direction that more girls than boys were able to use the pragmatic and mental information together to make a proper name interpretation of the word. More boys than girls made a proper name interpretation of the word in the Non-animal/Pragmatic condition. This difference was significant by a Fisher exact test, $p < .05$, two-tailed. This suggests that boys were more likely than girls to make a proper name interpretation of a word for the unfamiliar animal toy when they were given pragmatic cues alone.

In addition to the above analyses, the number of girls and boys in each condition who showed a proper name response was compared to the probability that such a number of proper name interpretations would occur if each child was responding randomly on each trial.¹⁵ The Non-animal/Mental scores were examined first. The probability of 5 girls showing a proper name response if the children were selecting the toys randomly is extremely low, and is significant by a Binomial test, $p < .000001$. On the other hand, the probability of 1 boy showing this pattern if the children were selecting the toys randomly is quite high and is not significant by a Binomial test, $p > .10$. As for the Non-animal/Pragmatic scores, the probability of 0 girls showing a proper name response if the children are responding at chance is high and not significant by a Binomial test, $p > .10$. The probability of 5 boys showing this pattern is extremely low, and is significant by a Binomial test, $p < .000001$. This analysis confirms that girls and boys are responding differently according to the type of cue they receive. Boys make more proper name responses when they are given pragmatic cues alone in the presence of a complex non-animal

¹⁵ To assess the probability that a given number of children would show a proper name response pattern if children were choosing toys randomly, the probability that any one child would show this pattern was first calculated. This is the sum of three probabilities, corresponding to the criteria for making a proper name response: the probability of choosing the name toy on 6/6 trials, the probability of choosing the toy on 5/6 trials, and the probability of choosing the toy on 4/6 trials corrected for the one instance where this would not count as proper name responding, namely the pattern in which a child chose the named toy on 4/6 trials and the other toy of the same kind on 2/6 trials (this would be count noun responding; the latter probability falls into a trinomial distribution). The calculated p value is 0.0339. This probability was then used to calculate the Binomial probability for the actual number of girls and boys in each condition who showed a proper name response pattern.

artifact, whereas girls make more proper name responses when they are given pragmatic and mental state cues together in the presence of the artifact.

The individual interpretations of the children in the Animal conditions were also examined. Twelve of the fourteen children in the Animal/Mental condition were categorized as making a proper name interpretation of the word. This contrasts with only six children in the Animal/Pragmatic condition. This pattern of interpretations was significantly different, $\chi^2(1, N = 28) = 3.889, p < .05$. Thus when examined individually, the pattern of interpretations of the children in the two Animal conditions suggests that mental state attribution increases children's tendency to make a proper name interpretation of a word for an unfamiliar animal. This finding is surprising given that the percentage of the trials on which children selected the named animal did not differ significantly for the two conditions, and this underscores the value of examining children's interpretations individually in assessing the extent to which children make a proper name interpretation of a word.

4.2.3 Discussion

The main finding of Experiment 1 is that both two-year-old girls and boys can use pragmatics and mental verb attribution to learn proper names: children are more likely to make a proper name interpretation of a word for an unfamiliar animal if the word is introduced in the context of mental verbs. However, boys and girls differ in the kind of information they use to construe a non-animal artifact as a namable individual. Boys are only able to use pragmatic cues, whereas girls are only able to use pragmatic cues together with mental state attribution.

These findings extend previous work on young children's ability to use linguistic and non-linguistic cues in learning proper names. Perceptible animal features are not necessary to proper name learning since children of both sexes were able to learn a proper name for a toy which did not resemble an animal. Nonetheless, the influence of perceptible animal features on children's proper name learning is evident from children's greater overall tendency to select the named animal toy as compared to their overall tendency to one of the non-animal toys as seen from the overall difference. This replicates previous work on proper name learning (Gelman & Taylor,

1984; Hall, 1994; Katz *et al.*, 1974). Moreover, the findings of Experiment 1 showed that children's sensitivity to perceptible animal features is enhanced by the use of mental verbs in teaching a proper name for an unfamiliar animal toy since children were more likely to make a proper name interpretation of a word introduced in this context than were children who were taught the word for an unfamiliar animal using non-mental verbs. Mental verb information presumably increases children's certainty that the object is an animal or a namable individual.

Both boys and girls were able to construe the non-animal artifact as a namable individual, but the conditions under which children of each sex did so differed, suggesting that boys and girls arrived at their construal of the object as a namable individual by different means. Boys were able to make a proper name interpretation of the word, when given pragmatic information alone. This suggests that the internal complexity of the artifact together with the attention drawn to it during naming was sufficient to highlight the object's individuality and render it namable. Girls were not able to make a proper name interpretation of the word under these conditions. The reason for this difference between the children may lie in sex differences in children's attention to toys of different kinds. There is evidence that boys prefer to play with non-animal toys such as blocks and toy cars when given a choice between toys of different kinds, and do so more than girls. Of 16 studies of toy preferences in children between the ages of 11 months and four years cited by Maccoby and Jacklin (1974), 11 studies found that boys preferred to play with toys of this type and did so more than girls, compared to one study in which girls were found to prefer toys of this type relative to boys. Although no preferences for either toy kind was found in the baseline for children of either sex, boys may still be more prepared to construe a complex non-animal artifact with articulated parts as an individual compared to girls.

Girls were able to learn a proper name for the non-animal artifact if they were given pragmatic cues along with mental state attribution. Boys were not able to make a proper name interpretation of the toy under these conditions. This is surprising, since mental state attribution is an addition to the pragmatics of singling out the toy and drawing attention to it. The reason for this difference in girls' and boys' ability to use mental state attribution to construe a non-animal as a namable individual may be due to an underlying difference in the way in which two-year-old boys and girls represent mental

verbs. Bartsch and Wellman (1995) examined children's speech about the mind. Their data reveal that girls in the study produced their first and third genuine desire verb utterance (e.g. *want*) about five months before boys, yet the groups had comparable mean length of utterance (MLU).¹⁶ The four girls in Bartsch and Wellman's (1995) study made their first desire verb utterance at an average age of 1;11 years, whereas the six boys in the study were 2;4 years. Girls were still ahead of boys in their third spontaneous desire verb utterance, with an average age of 2;0 years to boy's average of 2;5. The two-year-old girls in Experiment 1 had thus been using mental verbs for about 6 months, whereas the boys had been using mental verbs for only about one month. This difference in production of mental verbs suggests that young girls' have greater proficiency with these verbs than boys by the mid-twos. Because girls of this age have been producing these verbs for longer, they may be able to infer that an object is an animal or namable individual if they witness an adult attribute mental states to an object which does not resemble an animal. Boys on the other hand, are hindered in their proper name learning of a non-animal described as having mental states. This could be because boys' greater familiarity and interest in non-animal toys leads them to find the attribution of mental states to the toy highly anomalous and may result in their avoidance of the toy. That boys are able to use mental state attribution to learn a proper name under some circumstances can be seen from their performance in the Animal/Mental condition. The attribution of mental states to an animal is congruent with common use of such verbs, in contrast to the attribution of mental states to a non-animal toy.

Is there development in children's ability to use pragmatics and mental state attribution to learn proper names? Katz et. al (1974) found that girls as young as 17 months of age can use proper name syntax in conjunction with perceptible animal properties to learn new proper names, but that boys in their early twos are not able to do so. Gelman and Taylor (1984) found that by age two-and-a-half, both boys and girls can use proper name syntax in conjunction with perceptible animal features to learn proper names. Perhaps older girls are able to use pragmatics alone to learn a proper name for a non-animal toy and older boys are able to use mental verb semantics to learn a

¹⁶ What is more, Bartsch and Wellman (1995) found that MLU was uncorrelated with first genuine belief verb production, but the first genuine belief verb utterance was correlated with production of the first genuine desire verb utterance.

proper name for an object which does not have perceptible animal features. Experiment 2 was designed to test this possibility by teaching 3-year-old children a proper name for an unfamiliar non-animal object which was either simply singled out and drawn attention to, or which was singled out and drawn attention to by being described as having mental states. Older children were not taught a proper name for one of the animals on the assumption that they would be close to ceiling in making a proper name interpretation of a word for an animal toy even if the word was introduced with pragmatic information alone.

4.3 Experiment 2

4.3.1 Method

Participants

Twenty-eight three-year-old children (mean age 3;9, range from 3;2 to 4;0) from Boston area preschools and daycares were included in the experiment. Children were randomly assigned to either the Non-animal/Pragmatic condition or the Non-animal/Mental condition with the constraint that there be the same number of children of each age in each condition, and equal numbers of girls and boys. Four additional children were not included in the experiment. Two were excluded because they refused to respond to the experimenter's requests, and two were excluded because they failed to pass the kind label comprehension test.

Materials and Procedure

The same stimuli were used as were used in Experiment 1. Children were tested in a quiet corner of their preschool or daycare by the author using the same procedure and counterbalancing of stimuli as used in the Non-animal/Pragmatic and Non-animal/Mental conditions of Experiment 1. Children's responses were noted on a coding sheet.

4.3.2 Results and Discussion

Percentage of Named Toy Selections. Figures 24 and 25 show the percentage of three-year-old girls' and boys' selection of the named non-

animal, the other non-animal, and the two animals in the two information conditions. These percentages were submitted to a two-way ANOVA with information type (Pragmatic, Mental) and sex as between subject factors. There were no main effects, although there was a trend for children to choose the named toy a higher percentage of the time in the Pragmatic condition than in the Mental condition (Pragmatic mean, 74%; Mental mean, 47%), $F(1,24) = 3.814, p = .063$. There was an information by sex interaction, $F(1,24) = 5.234, p < .05$. Boys chose the named toy on 93% of the trials in the Pragmatic condition but on only 35% of the trials in the Mental condition. This difference was significant, $t(12) = -3.586, p < .01$. Girls on the other hand, chose the named toy on 60% of trials in the Mental condition, and on 55% of the trials in the Pragmatic condition. This suggests that three-year-old boys more readily made a proper name interpretation of the new word for a non-animal toy when it was introduced with pragmatic cues only. Three-year-old girls selected the named toy equally often in the two conditions, but it is unclear from their percentage choice of the toy if they made a proper name interpretation of the toy.

Individual Pattern of Toy Selections. Each child's tendency to make a proper name interpretation in the two conditions was examined individually. The children's interpretations of the new word fell into the same six categories as the interpretations of the two-year-olds in Experiment 1. Table 4 shows the number of girls and boys who made interpretations of each type in the two conditions. For comparison between the two experiments, children's interpretations were scored in the same way as the children in Experiment 1. As in Experiment 1, there was no consistent pattern of alternatives to the interpretation of the word as a proper name for the non-animal toy, hence the six categories were collapsed into Proper Name for the Named Toy and Other. The interpretations of the children in each condition were examined separately. Although more girls (4) than boys (2) made a proper name interpretation of the word in the Mental condition, this difference was not significant by a Fisher exact test, $p > .10$. And although more boys (6) than girls (3) made a proper name interpretation of the word in the Pragmatic condition, this difference was not significant by a Fisher exact test. This suggests that when children's interpretations of the word are examined individually, three-year-old boys and girls do not differ in the

influence of pragmatic cues or pragmatic cues and mental state information on their tendency to make a proper name interpretation of a word for a non-animal toy.

The number of girls and boys in each condition who showed a proper name response was compared to the probability that such a number of proper name interpretations would occur if each child was responding randomly on each trial. The Mental scores were examined first. The probability of 4 girls showing a proper name response if the children were selecting the toys randomly is extremely low, and is significant by a Binomial test, $p < .00001$. The probability of 2 boys showing this pattern if the children were selecting the toys randomly is also low and is significant by a Binomial test, $p < .05$. As for the Pragmatic scores, the probability of 3 girls showing a proper name response if the children are responding at chance is quite low and is significant by a Binomial test, $p < .0001$. The probability of 6 boys showing this pattern is extremely low, and is significant by a Binomial test, $p < .0000001$. These comparisons suggest that three-year-old girls and boys in both conditions are making a proper name interpretation of the word.

Comparison of Two-year-olds and Three-year-olds. To directly assess developmental changes in children's ability to use pragmatic information or pragmatic information together with mental state attribution, the percentage of the test trials on which two- and three-year-old children chose the named object in the two conditions was submitted to a three-way ANOVA with age, information type (Pragmatic, Mental) and sex as between subject factors. There were no main effects, but there was an interaction of age and information type, $F(1,48) = 4.895$, $p < .05$. Two-year-olds chose the named toy about more overall in the Mental condition than in the Pragmatic condition (Pragmatic, 40%, Mental, 53%), whereas three-year-olds chose the named toy a higher percentage of the time in the Pragmatic condition (74%) than in the Mental condition (47%). There was also an interaction of information type and sex, $F(1,48) = 19.843$, $p < .001$. Girls chose the named toy a higher percentage of the trials in the Mental condition (66%) than in the Pragmatic condition (34%) whereas boys chose the named toy a higher percentage of the trials in the Pragmatic condition (80%) than in the Mental condition (33%). Given that three-year-old girls did not differ in the percentage of trials on which they chose the named toy in the two conditions, this result is likely

due to the performance of the two-year-old girls. As for the boys at the two ages, their proportion of toy selections were very similar in the two conditions, leading to the difference when the percentages were combined.

To examine the age differences at the level of individual interpretations of the word, the performance of the two- and three-year-old children were compared for the two information conditions. Nine of the fourteen girls in the Mental condition were categorized as making a proper name interpretation of the word compared to only three boys. This pattern of interpretations was marginally significant, $\chi^2 (1, N = 28) = 3.646, p$ between .05 and .10. Whereas only three girls in the Pragmatic condition made a proper name interpretation, eleven of fourteen boys did so. This difference was significant, $\chi^2 (1, N = 28) = 3.646, p < .01$. When examined individually, the pattern of interpretations of the children at the two age groups is consistent with the results found when the percentage selection of the named toy was assessed for the children as a group.

Three- and four-year-old girls did not differ in the patterns of making a proper name interpretation of the word in the two conditions (Fisher exact test, both p 's $> .10$). Three- and four-year-old boys did not differ in their pattern of making a proper name interpretation of the word in the Pragmatic condition (Fisher exact test, $p > .10$). However, more four-year-old boys than three-year-old boys made a proper name interpretation of the word in the Mental condition. This difference was significant by a Fisher exact test, $p < .05$. This finding suggests that there is change with age in the influence of mental state attribution in proper name learning. Boys younger than four seem to be prevented in making a proper name interpretation of a word for an object without perceptible animal features which they find namable in the absence of this information. By age four, however, boys are able to make a proper name interpretation of a word for the object whether mental states are attributed to the object or not.

The results of Experiment 2 suggest that there may be changes with development in children's ability to use pragmatic cues alone or pragmatic cues and mental verb attribution to make a proper name interpretation of a word for a non-animal toy. Three-year-old girls did not differ in the percentage of trials they chose the named toy in the two conditions, and the overall percentage was close to 50. Three-year-old boys, on the other hand, showed a similar pattern to two-year-old boys in that they selected the named

toy a much higher percentage of the trials (93%) in the Pragmatic condition than in the Mental condition (35%). When the individual pattern of children's responses were examined, however, these apparent differences disappeared. Boys and girls did not differ from each other in their ability to use the information of the two types and the probability that the number of boys and girls who showed a proper name pattern of responding occurred by chance was very low. The differences reappeared when the data from the two experiments were combined. It is thus possible that children at age 3 are at a transitional point in their ability to use information of either type to construe a non-animal toy as an individual and learn a proper name for it. Given this possibility, four-year-old children were tested in the task to assess their ability to use pragmatic cues alone or pragmatic cues together with mental state attribution to make a proper name interpretation of a word for a non-animal toy.

4.4 Experiment 3

4.4.1 Method

Participants

Twenty-eight four-year-old children (mean age 4;9, range from 4;1 to 5;6) and from Boston area preschools and daycares were included in the experiment. Children were randomly assigned to either the Non-animal/Pragmatic condition or the Non-animal/Mental condition with the constraint that there be the same number of children of each age in each condition, and equal numbers of girls and boys. Two additional children were not included in the experiment because they refused to respond to the experimenter's requests.

Materials and Procedure

The same stimuli were used as were used in Experiments 1 and 2. Children were tested in a quiet corner of their preschool or daycare by the author using the same procedure and counterbalancing of stimuli as used in

the Non-animal/Pragmatic and Non-animal/Mental conditions of Experiments 1 and 2. Children's responses were noted on a coding sheet.

4.4.2 Results and Discussion

Figures 26 and 27 show the percentage of trials on which four-year-old girls' and boys' selected the named non-animal, the other non-animal, and the two animal toys in the two information conditions. The percentages were submitted to a two-way ANOVA with information type (Pragmatic, Mental) and sex as between subject factors. There were no main effects and there was no interaction effect (all F 's < 1.0 , all p 's $> .10$). Girls in the Pragmatic condition chose the named toy on 81% of the trials and boys chose the named toy on 76% of the trials. Girls in the Mental condition chose the named toy on 76% of the trials and boys in this condition chose the named toy on 81% of the trials.

The majority of four-year-olds in both experimental conditions (10 of 14 in the Pragmatic condition and 11 of 14 in the Mental condition) made a proper name interpretation of the word, as Table 6 shows.¹⁷ The probability that these numbers occurred given that children were responding randomly is very close to zero. Thus by age four, both boys and girls are able to use pragmatic cues alone or pragmatic cues and mental state attribution to construe a non-animal toy as an individual and learn a proper name for it.

4.5 Conclusion

The experiments reported in this chapter were designed to test the possibility that children are able to construe a complex non-animal toy as a namable individual if given only pragmatic cues, such as singling out the toy and drawing attention to it, or if given pragmatic cues together with mental state attribution, such as singling out the toy and describing it as having thoughts and wants. The findings of Experiment 1 suggest that two-year-olds are able to make use of both types of information under some conditions, although boys and girls differed in the conditions under which they were able

¹⁷ Only one child in the Pragmatic condition, was categorized as making a proper name interpretation on the basis of four selections of the target and one selection of the other toy of the same kind.

to use the two information types. Both boys and girls were able to use pragmatics together with mental state attribution to construe a toy animal as a namable individual over and above their normal tendency to do so. However, two-year-old boys are able to construe a complex non-animal toy as a namable individual if given pragmatic cues alone, but are hindered from doing so if given mental state information in addition to pragmatic cues. Two-year-old girls, on the other hand, are only able to make use of both types of information to construe a complex non-animal toy as a namable individual, and do not do so if given pragmatic information alone.

Three-year-old children seem to be at a transitional point in their ability to use the two information types. The children's percent selection of the named toy suggests that the sex differences are still present at this age, and combining the two- and three-year-old children's individual response patterns supports this. However, examination of the three-year-olds' individual pattern of responses does not reveal any such differences. Finally, four-year-old boys and girls do not differ in their ability to use the two information types. The majority of children in both conditions made a proper name response. These findings suggest at a minimum that children are able to construe a toy which lacks any perceptible animal features as being a namable individual, and may suggest that children do not interpret proper names as referring to animate individuals, but just as referring to individuals. These findings also shed light on the linguistic and non-linguistic cues which children are able to use in learning proper names.

The finding that children are able to learn a proper name for a non-animal toy bears on Hall's (1994) finding that three- and four-year-old children can use the animacy of a (typical pet) referent to disambiguate the meaning of a word introduced in an ambiguous sentence frame (i.e. *This is zavy*). Together what these experimental results suggest is that animals are important individuals which children are prepared to learn proper names for, so much so that children find a proper name interpretation highly plausible when presented with an ambiguous sentence. Nonetheless, children of this age are able to learn proper names for referents which do not resemble animals if given syntactic information that the word is a proper name along with sufficient information to determine that the object is a namable individual.

The performance of the two-year-old children in the two Animal conditions of Experiment 1 bears on Hall's (1991) conclusions about the role of familiarity in learning a proper name for an animal. Recall that Hall (1991) found that children were more likely to make a proper name interpretation of a word for an unfamiliar animal if the animal was of a familiar kind, such as a cat, than when it was of an unfamiliar kind, such as a monster. Since children knew a basic-level count noun for the familiar animals, but did not know a basic-level count noun for the unfamiliar animals, Hall (1991) concluded that the difference between the familiar and unfamiliar animal conditions in his experiments was due to the fact that some of the children in the unfamiliar animal conditions made a count noun interpretation of the word modeled as a proper name due to the object kind bias (Markman & Hutchinson, 1984). It was for this reason that the children in the experiments were taught a count noun for the to-be-named toy in all the word learning conditions. Yet despite this, two-year-old children differed in their tendency to make a proper name interpretation of the word for one of the animal toys in the two Animal conditions of Experiment 1. This suggests that the difference Hall found between learning a name for a familiar or an unfamiliar animal is not only due to the object kind bias, but can be influenced by other factors such as highlighting the individuality of an animal by attributing mental states to it. Also, the children in Hall's (1991) experiment may have been influenced by the familiarity of the referent, not only because they knew a basic-level count noun for the toy, but also because they have more experience with naming of familiar animals than unfamiliar animals and thus may find it easier to construe familiar animals as namable individuals. The findings of Hall (1994) suggest another factor on children's ability to construe an animal as a namable individual. Hall (1994) found that children were more likely to make a proper name interpretation of a word for an atypical pet such as a bee if they heard the experimenter describe the bee as *my bee*. Children may well have known a basic level count noun for the bee, but they may still not have been sure of the bee's status as a namable individual until the experimenter high-lighted the bee's status as a pet.

Table 4. Number of Two-year-old Girls and Boys Making Interpretations of Each Type in the Four Word Learning Conditions of Experiment 1 of Chapter 4

Condition		PNn	CNn	PNsk	PNok	CNok	R
Non-Animal							
Mental							
Girls	(N = 7)	5	0	0	0	1	1
Boys	(N = 7)	1	2	0	0	1	3
Pragmatic							
Girls	(N = 7)	0	0	1	3	1	2
Boys	(N = 7)	5	1	0	0	1	0
<hr/>							
Total Non-Animal							
Mental	(N = 14)	6	2	0	0	2	4
Pragmatic	(N = 14)	5	1	1	3	2	2
<hr/>							
Animal							
Mental							
Girls	(N = 7)	5	1	0	0	0	1
Boys	(N = 7)	7	0	0	0	0	0
Pragmatic							
Girls	(N = 7)	3	3	0	0	0	1
Boys	(N = 7)	3	3	0	0	0	1
<hr/>							
Total Animal							
Mental	(N = 14)	12	1	0	0	0	1
Pragmatic	(N = 14)	6	6	0	0	0	2
<hr/>							
Overall Total							
Mental	(N = 28)	18	3	0	0	2	5
Pragmatic	(N = 28)	11	7	1	3	2	4

Note: PNn = Proper name for the named toy; CNn = Count noun for the named toy and the other toy of the same kind; PNsk = Proper name for the other toy of the same kind as the named toy; PNok = Proper name for one of the toys of the unnamed kind; CNok = Count noun for the toys of the unnamed kind; R = random response pattern

Table 5. Number of Three-year-old Girls and Boys Making Interpretations of Each Type in Experiment 2 of Chapter 4

Condition		PN _n	CN _n	PN _{sk}	PN _{ok}	CN _{ok}	R
Pragmatic							
Girls	(N = 7)	3	4	0	0	0	0
Boys	(N = 7)	6	1	0	0	0	0
Mental							
Girls	(N = 7)	4	0	0	2	1	0
Boys	(N = 7)	2	1	0	2	1	1

Note: PN_n = Proper Name for the Named Toy; CN_n = Count Noun for the Named Toy Kind; PN_{sk} = Proper Name for the Other Toy of the Same Kind; PN_{ok} = Proper Name for One of the Toys of the Unnamed Kind; CN_{ok} = Count Noun for the Toys of the Unnamed Kind; R = Random Response Pattern

Table 6. Number of Four-year-old Girls and Boys Making Interpretations of Each Type in Experiment 3 of Chapter 4

Condition		PNn	CNn	PNsk	PNok	CNok	R
Pragmatic							
Girls	(N = 7)	5	1	1	0	0	0
Boys	(N = 7)	5	0	2	0	0	0
Mental							
Girls	(N = 7)	5	1	0	0	1	0
Boys	(N = 7)	6	1	0	0	0	0

Note: PNn = Proper Name for the Named Toy; CNn = Count Noun for the Named Toy Kind; PNsk = Proper Name for the Other Toy of the Same Kind; PNok = Proper Name for One of the Toys of the Unnamed Kind; CNok = Count Noun for the Toys of the Unnamed Kind; R = Random Response Pattern

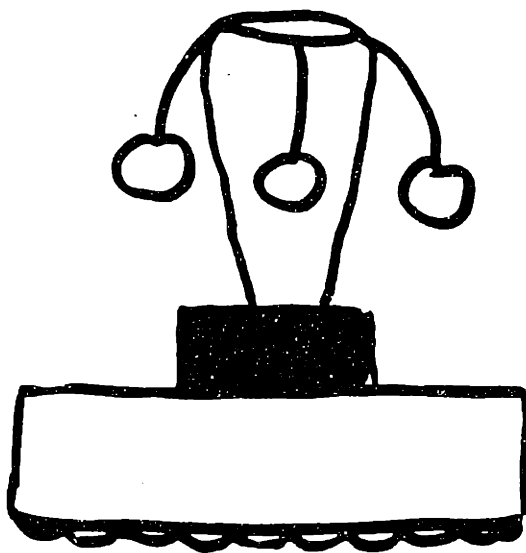


Figure 18. A depiction of the novel toys used in the experiments.

Figure 19. Percent Selection of Each Toy by Two-year-olds in the Baseline Condition of Experiment 1.

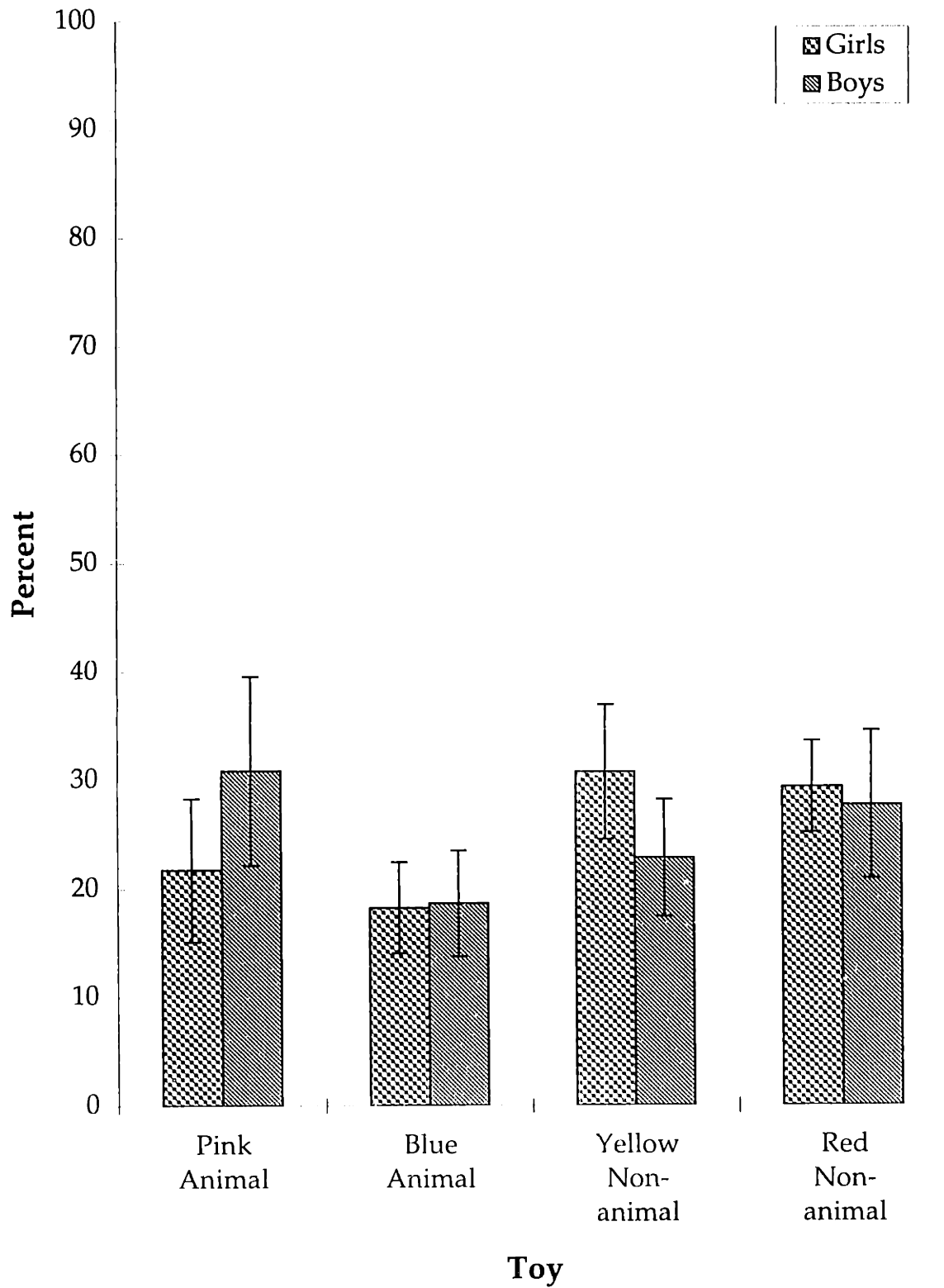


Figure 20. Percent Selection of Toys by Two-year-old Girls in the Non-animal Conditions of Experiment 1.

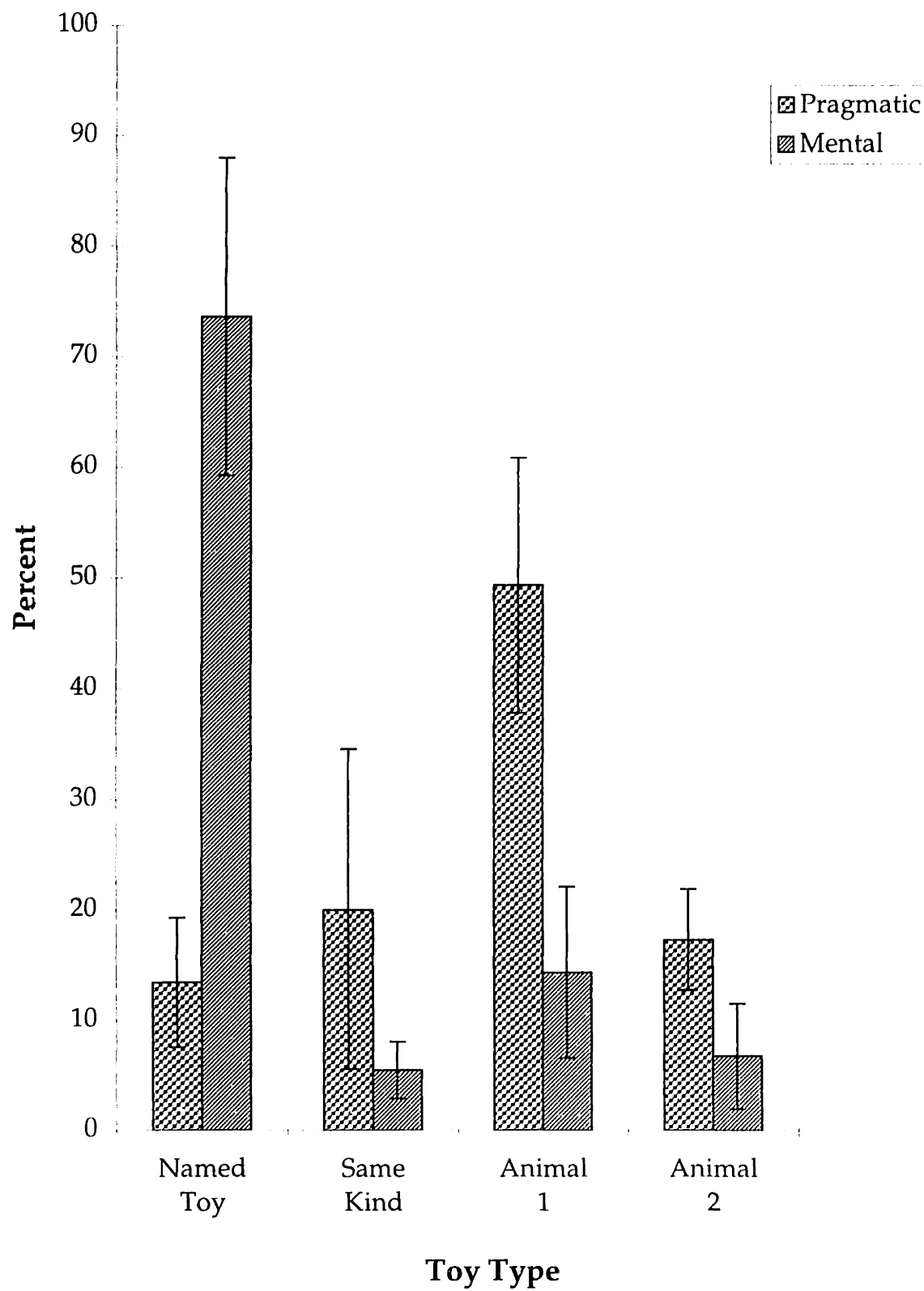


Figure 21. Percent Selection of Toys by Two-year-old Boys in the Non-animal Conditions of Experiment 1.

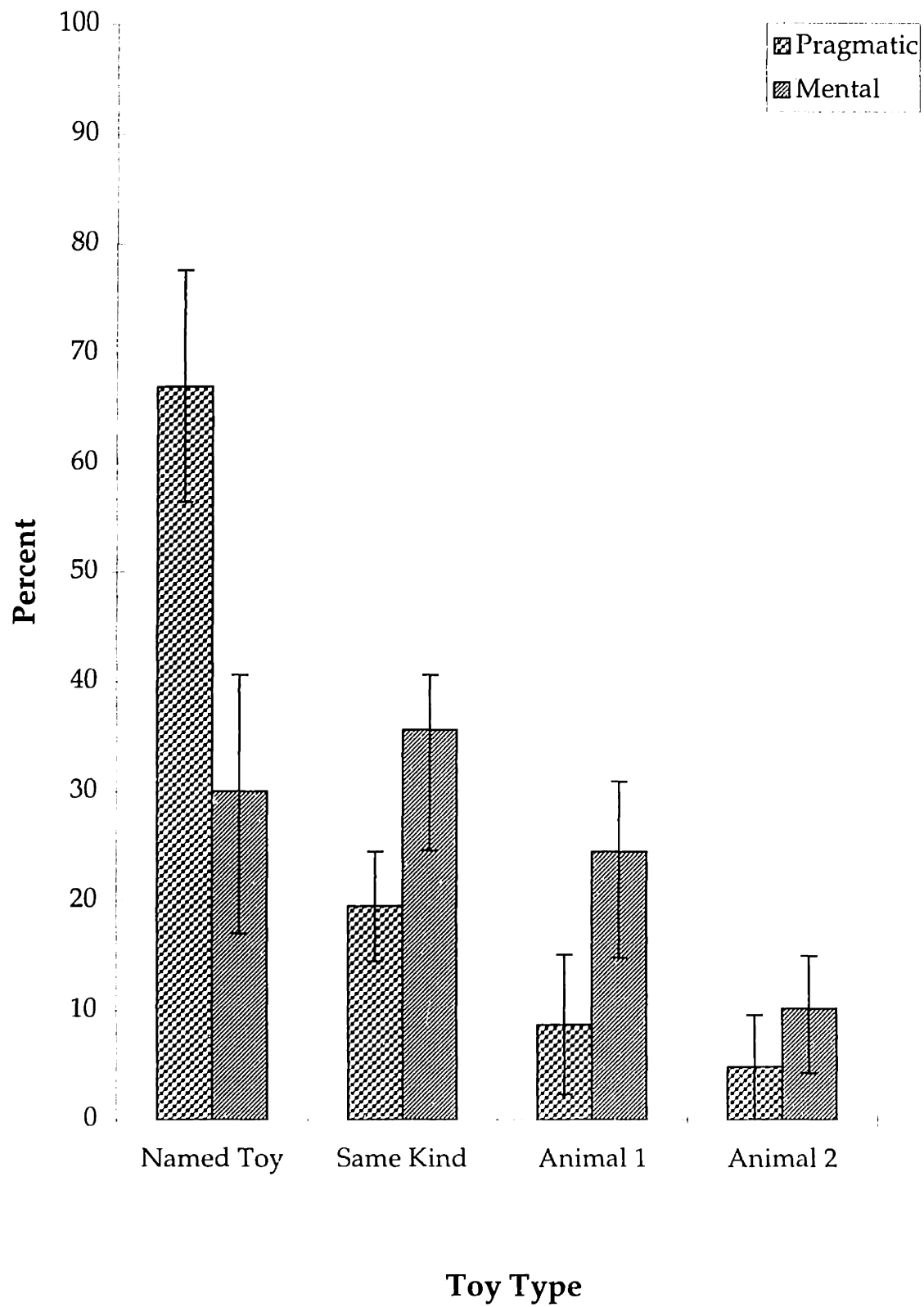


Figure 22. Percent Selection of Toys by Two-year-old Girls in the Animal Conditions of Experiment 1.

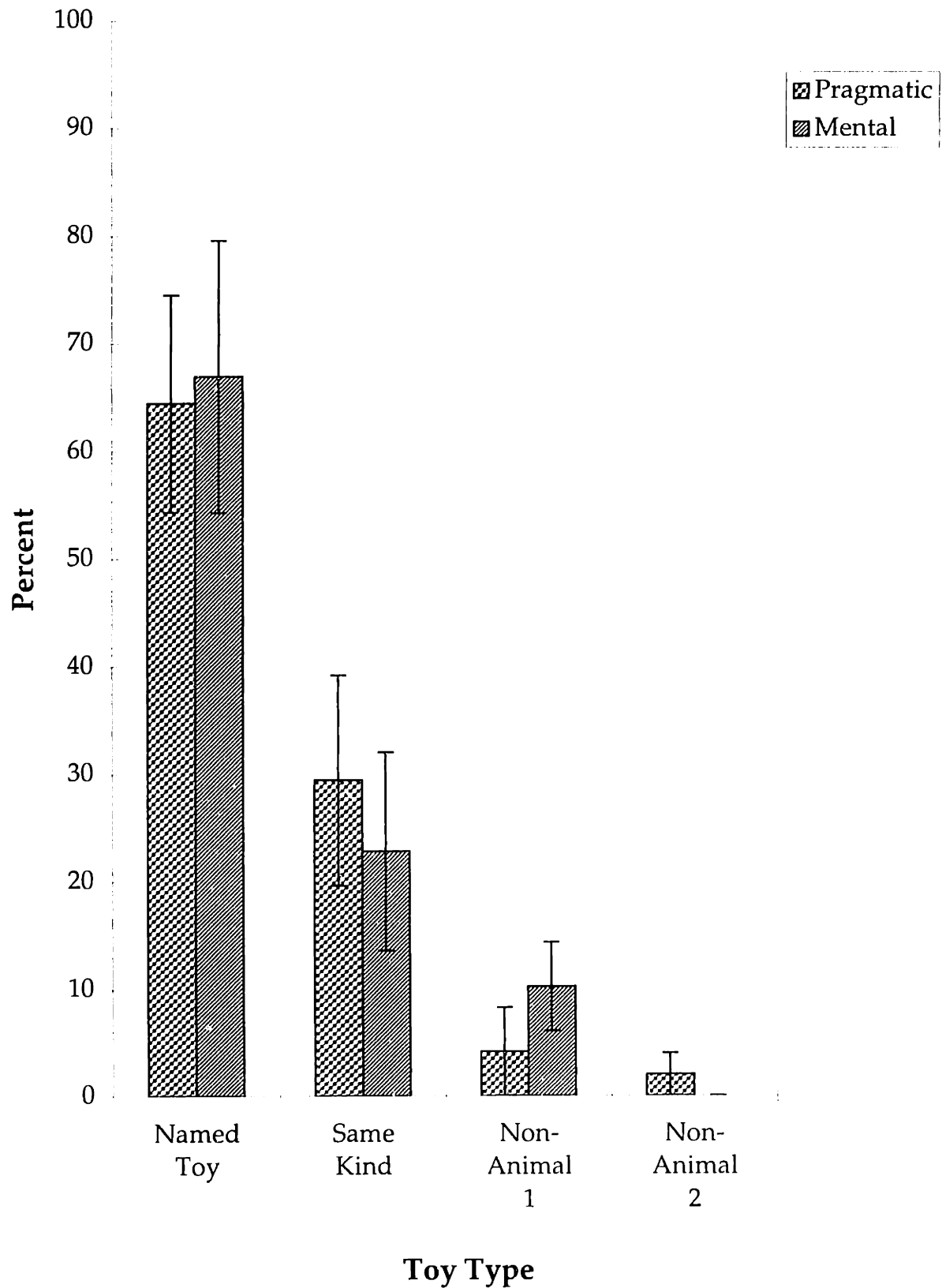


Figure 23. Percent Selection of Toys by Two-year-old Boys in the Animal Conditions of Experiment 1.

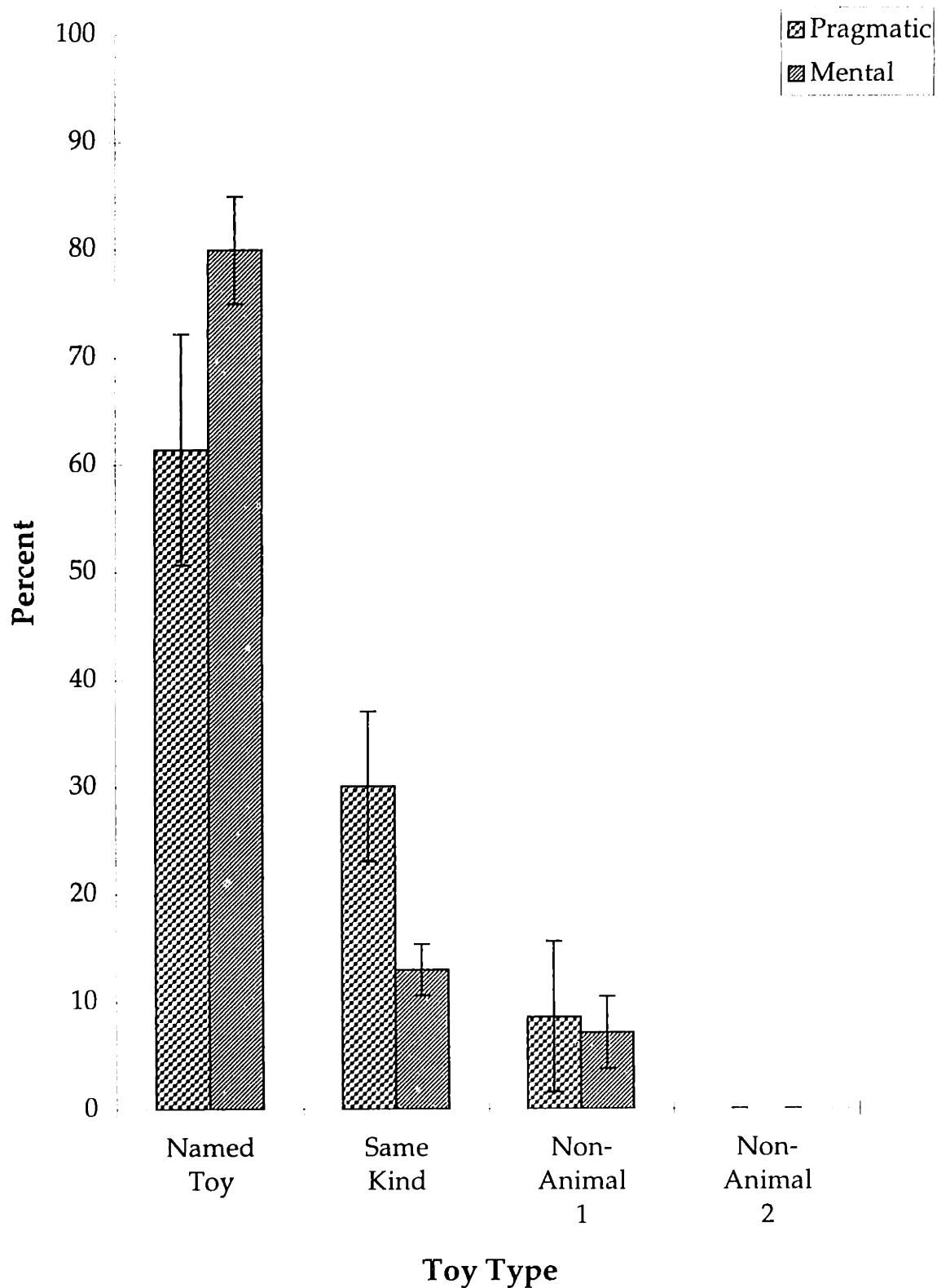


Figure 24. Percent Selection of Toys by Three-year-old Girls in the Pragmatic and Mental Conditions of Experiment 2.

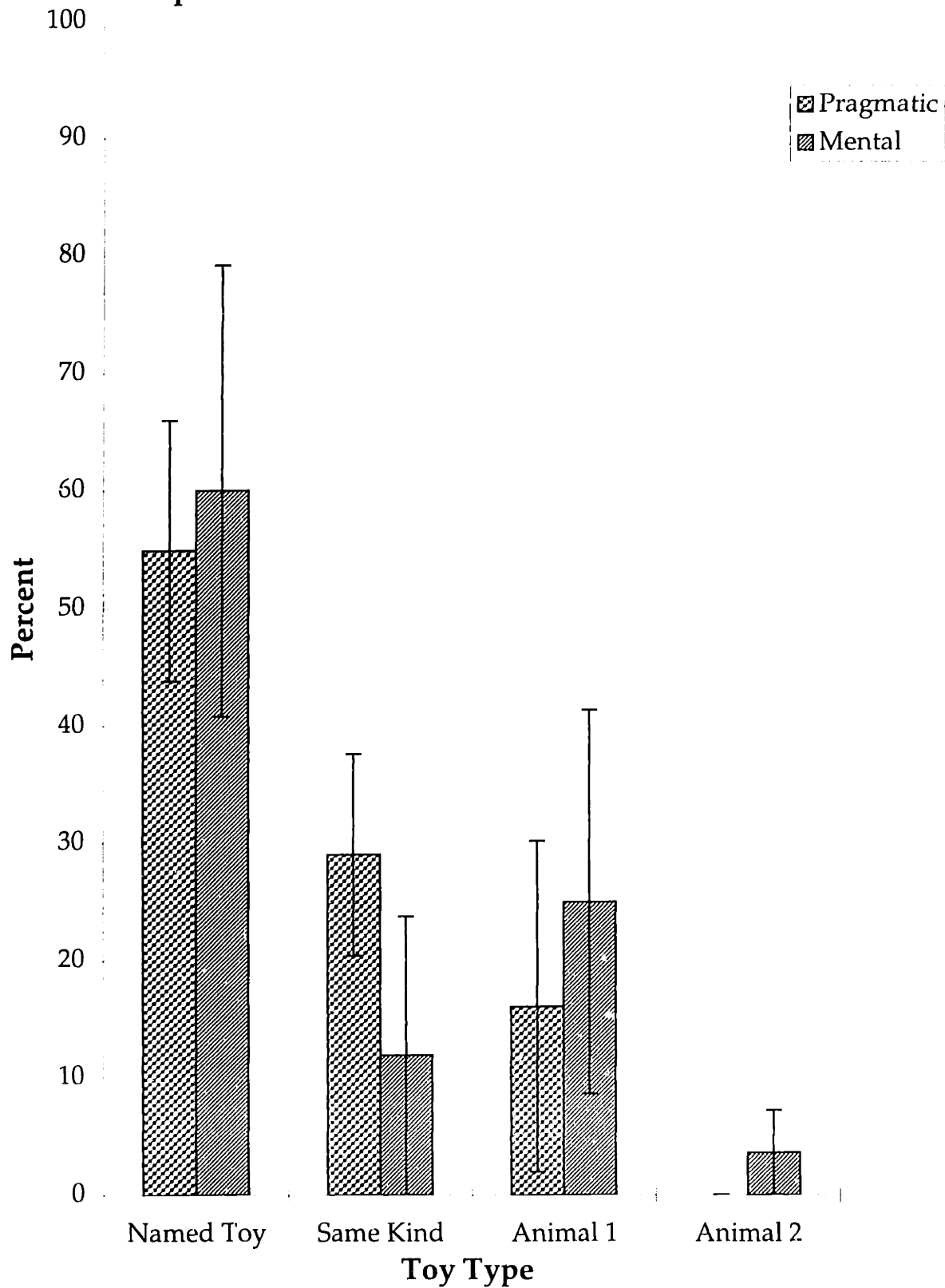


Figure 25. Percent Selection of Toys by Three-year-old Boys in the Pragmatic and Mental Conditions of Experiment 2.

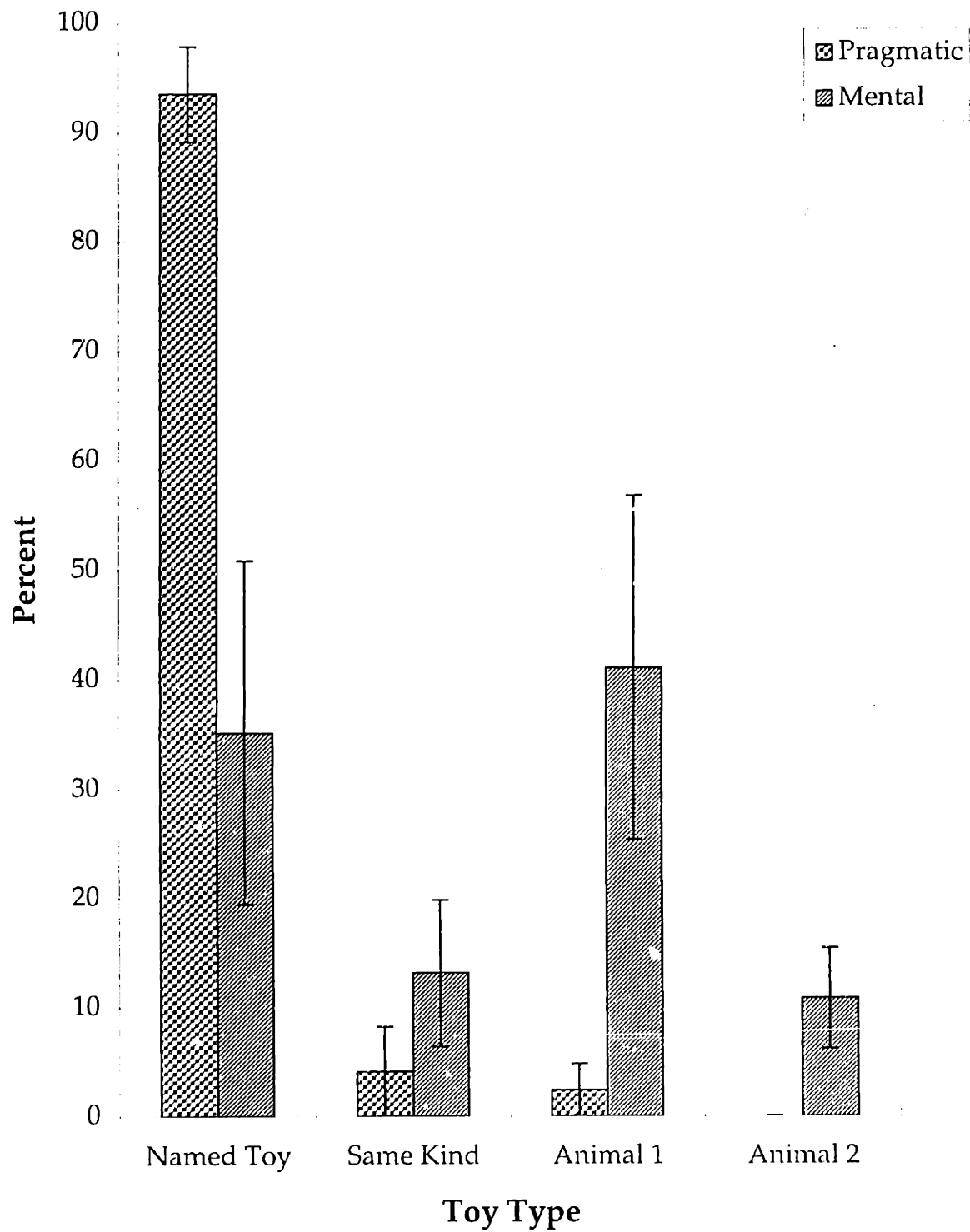


Figure 26. Percent Selection of Toys by Four-year-old Girls in the Pragmatic and Mental Conditions of Experiment 3.

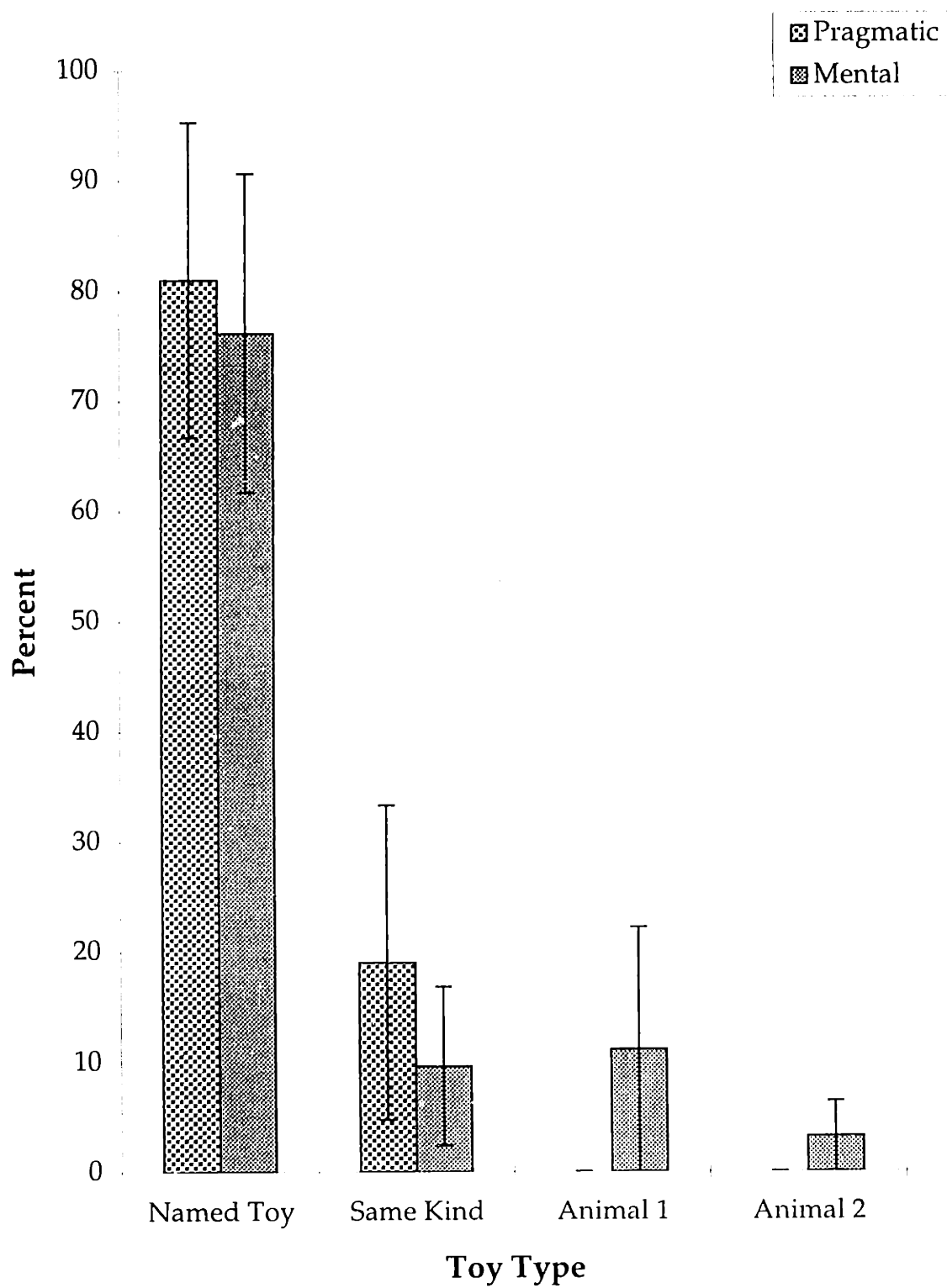
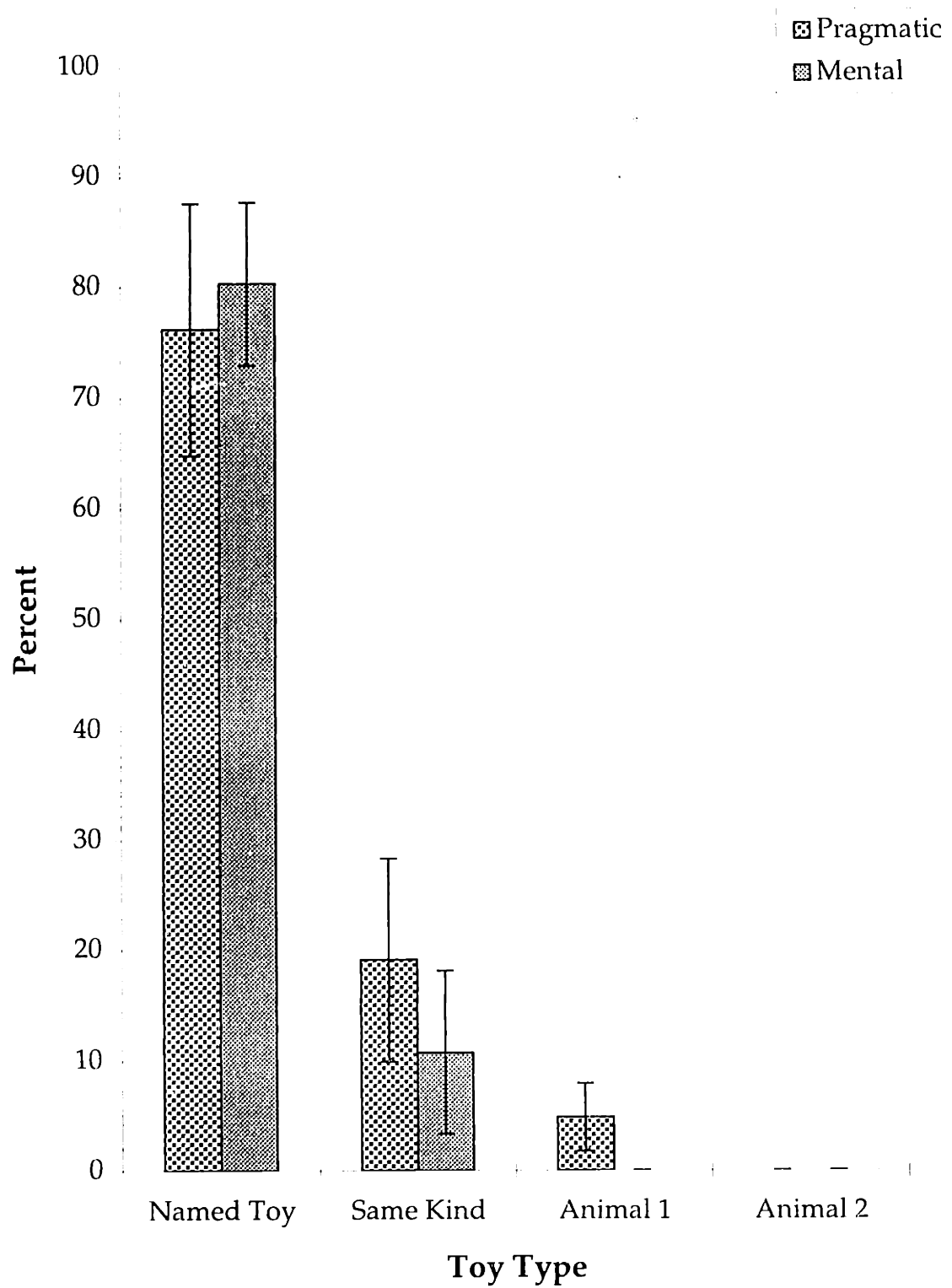


Figure 27. Percent Selection of Toys by Four-year-old Boys in the Pragmatic and Mental Conditions of Experiment 3.



CHAPTER 5

Conclusion

5.0 Summary

The work presented in this thesis contributes to the study of the human mind's ability to individuate entities, identify them over time and learn proper names for them. Adults readily individuate entities of many kinds—other people, everyday objects, places and abstract entities—and can trace their identities over time and learn proper names for them. As discussed in Chapter 1, this is because adults have sortal concepts which refer to kinds with individuated entities in their extensions. Sortals provide criteria of application, individuation and identity. Criteria of application are provided by all concepts, including predicates like *red*. They specify the conditions under which a concept applies. For example, the sortal dog applies to dogs but not to other entities. The criteria of individuation of a sortal specify where a member of the kind designated by the sortal begins and ends. These criteria support counting. The criteria of identity associated with a sortal specify the range of property changes a member of the kind designated by the sortal can undergo while still remaining a member of the kind. It is these latter criteria which support proper name reference because a proper name traces the identity of its bearer through the entire existence of the entity and also permits reference to the bearer in hypothetical situations.

During cognitive development, children must master adult distinctions. Chapter 1 introduced the Continuity and Discontinuity hypotheses of cognitive development which make claims about the relationship between the child's conceptual abilities and the adult's and about the manner in which cognitive development unfolds. On the Continuity hypothesis, children are argued to have the same fundamental cognitive capacities as adults and cognitive development is a matter of learning mappings between pre-existing concepts and language, and of the elaboration of knowledge (e.g. Macnamara, 1982; Pinker, 1984). On the Discontinuity hypothesis, young children are argued to differ radically from adults and cognitive development is a matter of constructing adult concepts via general purpose learning

mechanisms which associate experiences and help the child to learn language (e.g. Piaget, 1954; Quine, 1960, 1969).

Chapter 2 discussed infants' understanding of the concept person. The evidence presented therein suggests that prelinguistic infants represent people as intentional entities (e.g. Woodward, in press) and that they are able to individuate and identify inanimate objects under some conditions, such as when given spatiotemporal information that there are two objects in a display (e.g. Spelke *et al.*, 1995a). This provides compelling evidence of continuities in cognitive development and supports the claim that young infants have at least part of the elaborate conceptual structure needed to represent kinds of individuals and specific individuals. Nonetheless, there is evidence of development in infants' representation of people. For example, early in infancy, children do not seem to understand pointing. The development of abilities such as this may provide evidence of discontinuities in cognitive development, or they may simply reflect elaboration of infants' existing knowledge about people. There is some compelling evidence of discontinuity in cognitive development: young infants do not seem to be able to individuate inanimate objects on the basis of kind or property differences alone, suggesting that they do not have the sortals to support individuation and identity within inanimate object kinds (Xu & Carey, 1996; Xu, Carey, & Welch, under review). Research investigating infants' ability to individuate one person from another and a person and an inanimate object is motivated in part as an attempt to discover whether infants have a sortal more specific than physical object, namely person, prior to the acquisition of basic level inanimate sortals such as cup. However, the existing research is inconclusive and hence does not provide definitive evidence either for or against the Continuity or Discontinuity hypotheses. Work by Wu (1997) points to limits on infants' ability to use features in conjunction with positional information to individuate two people, and work by myself, Xu and Carey fails to provide clear evidence of 10-month-old infants' ability to individuate a person and an inanimate object. Work by Bonatti *et al.*, (1998) provides positive evidence that infants are able to individuate a doll's face and an inanimate object, but leaves open the question of whether infants construe the doll as a person. Several possible experiments discussed in the chapter and below promise to provide a clearer picture of the infant's understanding of person.

Chapters 3 and 4 turned to the study of children's representations of individuals and their proper names. The results of experiments presented in Chapter 3 showed that both children and adults interpret a word introduced with ambiguous syntax and used to refer to an animal toy as a proper name: they continue to judge that the toy is the referent of the word despite changes in the toy's appearance and location and despite the introduction of a toy identical to the named toy at the time the word was introduced. This means that by age three, children are able to represent unique individuals, and what is more, they interpret proper names as referring to them. This constitutes evidence of continuity in children's understanding of proper name reference. Both children and adults as a group do not make a proper name interpretation of the word if it is used to refer to a simple artifact such as a shoe or bottle, suggesting that such objects are not natural candidates for proper names, although neither children nor adults as a group make a clear interpretation of the word in this case. The findings presented in Chapter 3 militate against discontinuity proposals of proper name reference, such as the possibility that young children are similarity-bound in their interpretations of word meanings (e.g. Landau, Smith, & Jones, 1988) and interpret proper names as referring to animals highly similar to the named animal or to animals belonging to a restricted subkind.

The experiments presented in Chapter 4 investigate some conditions under which 2- to 4-year-old children are willing to make a proper name interpretation for an individual. Previous work on preschoolers' assumptions about namable individuals has suggested that they assume that the appropriate referents for proper names are people, animals and their surrogates, such as animal toys (Gelman & Taylor, 1984; Hall, 1994; Katz *et al.*, 1974). However, Chapter 4 presented evidence that even 2-year-olds will construe an individual which does not resemble an animal as namable if given information which suggests that the individual is important, such as the use of mental verbs to describe the individual or the use of a proper name in the subject position of a sentence to refer to the individual. This provides support for the Continuity hypothesis because it suggests that young children, like adults, are able to construe a range of individuals as namable. These findings also suggest that 3-year-olds' unwillingness to make a proper name interpretation of a word for a simple artifact introduced with ambiguous syntax is not driven by the fact that the object is not an animal toy. Rather, the

performance of children (and adults) in the experiments reported in Chapter 3 is likely due to their failing to construe the object as a namable individual. There is evidence of development in children's willingness to construe a non-animal object as a namable individual, insofar as 2-year-old boys and girls differ in the conditions under which they construe a non-animal object as namable but four-year-old boys and girls do not differ. Whether this is evidence of a genuine discontinuity in development or a case of knowledge elaboration is an open question.

5.1 Future Directions

There are many possible directions in which to pursue research on individuation, identity and proper names in cognitive development. Only a few are suggested here. The findings presented in Chapter 2 leave open a wide range of possibilities regarding infants' conceptual abilities. Further experiments are needed to determine whether young infants have sortals more specific than physical object, and in particular, whether they have the sortal person. For example, one possibility considered in Chapter 2 was that infants may have two sortals at the same level of specificity, physical object and animate entity. Experiments probing infants' ability to individuate a non-human animal and an inanimate object could bear on this question, as could experiments probing infants' ability to individuate a non-human animal and a person. A convergent means of investigating infant understanding of person would be to explore the relationship between the acquisition of the ability to trace the identity of people and the production of proper names. Methods such as the head-turn paradigm could be used to this end to probe infants' understanding of proper name reference and to assess their ability to trace person identity, for example by introducing the name in the presence of a particular individual and then using the name in the presence of that individual and another and measuring infant preference for the individuals.

Children's assumption that proper names refer to individuals discussed in Chapter 3 could be further studied. One possible approach might be to compare the pattern of inferences which are supported by kinds and the pattern of inferences which are supported by individuals. Both similarities or differences in patterns of inferences over kinds or individuals would be informative as these would help reveal how children (and adults) represent

kinds, individuals and their names. Also, the mechanisms for picking out individuals could be compared. For example, if the use of a demonstrative to refer to an individual supports the very same inferences as the use of a proper name, this would support the idea that the notion of an individual is very general and would suggest that proper names enjoy no special status as a means of designating an individual (c.f. Bloom, 1990a; 1996). A possibility related to this would involve further exploring the difference in picking out non-animal individuals found between 2-year-old boys and girls Experiment 1 of Chapter 4. The influence on boys and girls of using a means of referring to an individual other than the use of a proper name could be investigated in the light of the difference found between the sexes when a proper name is used.

The range of individuals which children are willing to name could be further investigated by probing children's assumptions about the namability of entities which adults commonly name, such as places and media products. Differences in acquisition of names for such individuals could point to underlying differences in children's, and possibly adults', representations of different individuals. This in turn could inform the question of whether proper name reference is uniform and proceeds by the same conceptual mechanisms regardless of the kind of individual named. Further, patterns of inferences over non-animal individuals could bear on the question of whether anthropomorphism precedes proper name attribution or follows it, as discussed in Chapter 1.

Many questions which arise in investigating individuation, identity and naming from a cognitive development perspective also arise when different cultures are compared. For example, the question of the range of individuals which people are willing to name, the uniformity of proper name reference, and anthropomorphism in naming arise with the same force when comparing one culture to another, as when comparing children and adults. Existing anthropological records could be examined to shed light on these aspects of proper name semantics. Also, language grammars mark proper names differently (e.g. English vs. Japanese), which raises the possibility that children acquiring different languages may learn proper names in a different manner, a possibility that could be directly studied. In addition, the study of adults who speak different languages could shed light on the relation between the syntax and semantics of proper names, and

uncover whether syntax influences proper name semantics or is independent of it.

A good deal of research in cognitive development has been devoted to children's understanding of kinds and categories and their names. It has been argued in this thesis that the representation of individuals is a closely related and fundamental part of the human conceptual system insofar as individuals belong to kinds and their individuation and identity is supported by sortal concepts referring to kinds. The avenues of research suggested throughout the thesis hold the promise of further illuminating people's representation of kinds as well as individuals, and the relationship of these representations to language.

References

- Alford, R. D. (1987). *Naming and identity*. New Haven, CT: HRAF Press.
- Baillargeon, R., Spelke, E. S., & Wasserman, S. (1985). Object permanence in 5-month-old infants. *Cognition*, 20, 191-208.
- Balaban, M. T., & Waxman, S. R. (1997). Do words facilitate object categorization in 9-month-old infants? *Journal of Experimental Child Psychology*, 64, 3-26.
- Baldwin, D. A. & Moses, L. J. (1994). Early understanding of referential intent and attentional focus: Evidence for language and emotion. In C. Lewis & P. Mitchell (Eds.) *Children's early understanding of mind*. Hove, England: Earlbaum.
- Bartsch, K. & Wellman, H. M. (1995). *Children talk about the mind*. New York, NY: Oxford University Press.
- Bloom, L., Tinker, E., & Margolis, C. (1993). The words children use: Evidence against a noun bias in early vocabularies. *Cognitive Development*, 8, 431-450.
- Bloom, P. (1990a). Semantic structure and language development. Unpublished doctoral dissertation, Massachusetts Institute of Technology.
- Bloom, P. (1990b). Syntactic distinctions in child language. *Journal of Child Language*, 17, 343-353.
- Bloom, P. (1996). Possible individuals in language and cognition. *Current Directions in Psychological Science*, 5, 3, 90-94.
- Bonatti, L., Frot, E., & Mehler, J. (1998). The subject-first hypothesis: An investigation into infants' metaphysics. Unpublished manuscript, Université de Paris 8.
- Bower, T. G. R. (1974). *Development in infancy*. San Francisco: W. H. Freedman & Co.
- Bower, T. G. R. (1982). *Development in infancy*. (2nd edition) San Francisco: W. H. Freedman Co.
- Brown, R. (1958). *Words and Things*. New York: Free Press, Macmillan.
- Bruner, J. S. (1975). From communication to language—a psychological perspective. *Cognition*, 3, 255-87.
- Burge, T. (1973). Reference and proper names. *The Journal of Philosophy*, 70, 425-439.
- Bushnell, I. W. R., Sai, F., & Mullin, J. T. (1989). Neonatal recognition of the mother's face. *British Journal of Developmental Psychology*, 7, 3-15.
- Butterworth, G. (1991). The ontogeny and phylogeny of joint visual attention. In A. Whiten (Ed.), *Natural theories of mind: Evolution, development, and simulation of everyday mindreading*. Oxford, England: Blackwell.
- Carey, S. (1985). *Conceptual change in childhood*. Cambridge, MA: MIT Press.
- Carey, S. (1992). Cognitive development. In D. N. Osherson & E. E. Smith (Eds.), *An invitation to cognitive science*, Vol. 3. Cambridge, MA: MIT Press.

- Carey, S. (1992). Does learning a language require the child to reconceptualize the world? *Lingua*, 92, 143-167.
- Carey, S. & Xu, F. (in press). Sortals and kinds: An appreciation of John Macnamara. In R. Jackendoff, P. Bloom, & K. Wynn (Eds.), *John Macnamara: On the border*. Cambridge, MA: MIT Press.
- Clark, E. (1987). The principle of contrast: A constraint on language acquisition. In B. MacWhinney (Ed.), *Mechanisms of language acquisition*. Hillsdale, NJ: Erlbaum.
- Csibra, G., & Gergely, G. (1996). Can one-year-olds infer the goal of an action without seeing it achieved? Poster presented at the 10th Biennial International Conference on Infant Studies, Providence, RI, April.
- Eibl-Eibesfeldt, I. (1989). *Human ethology*. New York, NY: Aldine de Gruyter.
- Fodor, J. A. (1983). *Modularity of Mind*. Cambridge, MA: MIT Press.
- Gelman, R., & Spelke, E. S. (1981). The development of thoughts about animate and inanimate objects: Implications for research on social cognition. In J. H. Flavell & L. Ross (Eds.), *The development of social cognition in children*. Cambridge, England: Cambridge University Press.
- Gelman, S. A., & Markman, E. (1986). Categories and induction in young children. *Cognition*, 23, 183-208.
- Gelman, S. A., & Taylor, M. (1984). How 2-year-old children interpret proper and common names for unfamiliar objects. *Child Development*, 55, 1535-1540.
- Gergely, G., Csibra, G., Bíró, S., & Koós, O. (1994, June). The comprehension of intentional action in infancy. Poster presented at the 9th Biennial International Conference on Infant Studies, Paris, France.
- Gergely, G., Nádasdy Z., Csibra, G., & Bíró, S. (1995). Taking the intentional stance at 12 months of age. *Cognition*, 56, 165-193.
- Gopnik, A. & Astington, J. W. (1988). Children's understanding of representational change and its relation to the understanding of false belief and the appearance-reality distinction. *Child Development*, 59, 26-37.
- Goren, C. C., Sarten, M., & Wu, P. Y. K. (1975). Visual following and pattern discrimination of face-like stimuli by newborn infants. *Pediatrics*, 56, 544-549.
- Gupta, A. K. (1980). *The logic of common nouns*. New Haven, CT: Yale University Press.
- Hall, D. G. (1991). Acquiring proper names for familiar and unfamiliar animate objects: Two-year-olds' word-learning biases. *Child Development*, 62, 1442-1454.
- Hall, D. G. (1994). Semantic constraints on word learning: Proper names and adjectives. *Child Development*, 65, 1299-1317.
- Hall, D. G. (1996). Preschoolers' default assumptions about word meaning: Proper names designate unique individuals. *Developmental Psychology*, 32, 1, 177-186.

- Hall, D. G. (in press a). Semantics and the acquisition of proper names. In R. Jackendoff, P. Bloom, & K. Wynn (Eds.), *John Macnamara: On the border*. Cambridge, MA: MIT Press.
- Hall, D. G. (in press b). Continuity and the persistence of objects: When the whole is greater than the sum of the parts. *Cognitive Psychology*.
- Hirsch, E. (1982). *The concept of identity*. New Haven, CT: Yale University Press.
- Jacobson, S. W. (1979). Matching behavior in the young infant. *Child Development*, 50, 425-430.
- Johnson, S. C., Booth, A., & O'Hearn, K. (1998, April). Inferring the unseen goals of a non-human agent. Poster presented at the 11th Biennial International Conference on Infant Studies, Atlanta, GA.
- Johnson, S. C., Slaughter, V., & Carey, S. (in press). Whose gaze will infants follow? The elicitation of gaze-following in 12-month-olds. *Developmental Science*.
- Johnson, M.H., Dziurawiec, S., & Morton, J. (1991). Newborn's preferential tracking of face-like stimuli and its subsequent decline. *Cognition*, 40, 1-19.
- Katz, N., Baker, E., & Macnamara, J. (1974). What's in a name? A study of how children learn common and proper names. *Child Development*, 45, 469-473.
- Kim, J. J., Marcus, G. F., Pinker, S., Hollander, M., & Coppola, M. (1994). Sensitivity of children's inflection to grammatical structure. *Journal of Child Language*, 21, 173-209.
- Kripke, S. (1972). Naming and necessity. In A. P. Martinich (Ed.), *The philosophy of language (2nd edition)*. Oxford: Oxford University Press.
- Kripke, S. (1980). *Naming and necessity*. Oxford, England: Basil Blackwell.
- Landau, B., Smith, L. B., and Jones, S. (1988). The importance of shape in early lexical learning. *Cognitive Development*, 5, 287-312.
- Legerstee, M. (1992). A review of the animate-inanimate distinction in infancy: Implications for models of social and cognitive knowing. *Early development and parenting*, 1, 59-67.
- Leslie, A. M. (1994). ToMM, ToBy, and agency: Core architecture and domain specificity in cognition and culture. In L. Hirschfeld & S. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture*. New York, NY: Cambridge University Press.
- Leslie, A. M., Hall, D. G., & Tremoulet, P. (1997). Object-based attention in infancy. *Technical Report No. 41*, Rutgers University Center for Cognitive Science.
- Leslie, A. M., Xu, F., Tremoulet, P., & Scholl, B.J. (1998). Indexing and the object concept: Developing 'what' and 'where' systems. *Trends in Cognitive Science*, 2, 1, 10-18
- Liittschwager, J. C., & Markman, E. M. (1993). Young children's understanding of proper nouns versus common nouns. Poster presented at the biennial meeting of the Society for Research in Child Development, New Orleans, LA, April.

- Liittschwager, J. C. (1994). Children's reasoning about identity across transformations. Unpublished doctoral dissertation, Stanford University.
- Maccoby, E. E. & Jacklin, C. N. (1974). *The psychology of sex differences*. Stanford, CA: Stanford University Press.
- Macnamara, J. (1982). *Names for things: A study of human learning*. Cambridge, MA: MIT Press.
- Macnamara, J. (1986). *A border dispute*. Cambridge, MA: MIT Press.
- Marcus, G. F., Brinkmann, U., Clahsen, H., Wiese, R., & Pinker, S. (1995). German inflection: The exception that proves the rule. *Cognitive Psychology*, 29, 189-256.
- Markman, E. M. (1989). *Categorization and naming in children: Problems of induction*. Cambridge, MA: MIT Press.
- Markman, E., & Hutchinson, J. (1984). Children's sensitivity to constraints on word meaning: Taxonomic vs. thematic relations. *Cognitive Psychology*, 16, 1-27.
- Markman, E., & Wachtel, G. (1988). Children's use of mutual exclusivity to constrain the meanings of words. *Cognitive Psychology*, 20, 121-157.
- Meltzoff, A. N. (1988). Infant imitation and memory: Nine-month-olds in immediate and deferred tests. *Child Development*, 59, 217-225.
- Meltzoff, A. N. (1995). Understanding the intentions of others: Re-enactment of intended acts by 18-month-old children. *Developmental Psychology*, 31, 838-850.
- Meltzoff, A. N., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science*, 198, 75-78.
- Meltzoff, A. N., & Moore, M. K. (1983). Newborn infants imitate adult facial gestures. *Child Development*, 54, 702-709.
- Meltzoff, A. N., & Moore, M. K. (1992). Early imitation within a functional framework: The importance of person, identity, movement and development. *Infant Behavior and Development*, 15, 479-505.
- Meltzoff, A. N., & Moore, M. K. (1994). Imitation, memory and the representation of persons. *Infant Behavior and Development*, 17, 83-99.
- Meltzoff, A. N., & Moore, M. K. (1995). Infants' understanding of people and things: From body imitation to folk psychology. In J. L. Bermudez, A. Marcel, & N. Eilan (Eds.), *The body and the self*. Cambridge, MA: MIT Press.
- Meltzoff, A. N., & Moore, M. K. (1998). Object representation, identity, and the paradox of early permanence: Steps toward a new framework. *Infant Behavior and Development*, 21, 201-235.
- Moses, L. J., & Flavell, J. H. (1990). Inferring false beliefs from actions and reactions. *Child Development*, 61, 929-945.
- Murphy, C. M., & Messer, D. J. (1977). Mothers, infants and pointing: a study of a gesture. In H.R. Schaffer (Ed.), *Studies in mother-infant interaction*. London: Academic Press.
- Nelson, K., Hampson, J., & Shaw, L. K. (1993). Nouns in early lexicons: Evidences, explanations and extensions. *Journal of Child Language*, 20, 61-84.

- Perner, J., Leekam, S.R., & Wimmer, H. (1987). Three-year-olds' difficulty with false belief. *British Journal of Developmental Psychology*, 5, 125-137.
- Piaget, J. (1954). *The construction of reality in the child*. New York: Basic Books.
- Pinker, S. (1984). *Language learnability and language development*. Cambridge, MA: Harvard University Press.
- Prasada, S. (1995). Young children's use of structural cues in learning the meanings of novel adjectives. Unpublished manuscript, Dartmouth College.
- Putnam, H. (1975). The meaning of "meaning". In K. Gunderson (Ed.), *Language mind and knowledge*. Minnesota Studies in the Philosophy of Science. Minneapolis: University of Minnesota Press.
- Quine, W. V. O. (1960). *Word and object*. Cambridge, MA: MIT Press.
- Quine, W. V. O. (1969). *Ontological relativity and other essays*. New York: Columbia University Press.
- Rips, L. J. (1975). Inductive judgments about natural categories. *Journal of Learning and Verbal Behavior*, 14, 665-680.
- Rosch, E., & Mervis, C. B. (1975). Family resemblances: Studies in the internal structure of categories. *Cognitive Psychology*, 7, 573-605.
- Rosch, E., Mervis, C. B., Gray, W. D., Johnson, D. M., & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology*, 8, 382-439.
- Rovee-Collier, C. K., & Fagen, J. W. (1981). The retrieval of memory in early infancy. In L. P.P. Lipsitt (Ed.), *Advances in Infancy Research*, Vol. 1. Norwood, NJ: Ablex.
- Russell, B. (1905). On denoting. In R. C. Marsh (Ed.), *Logic and Knowledge*. London, England: Allen and Unwin.
- Sabbagh, M. A., & Baldwin, D. A. (1997). Infants' ability to distinguish objects on the basis of feature information and form-function type correspondences. Poster presented at the biennial meeting of the Society for Research in Child Development, Washington, D. C., April.
- Scaife, J. F. & Bruner, J. S. (1975). The capacity for joint visual attention in the infant. *Nature*, 253, 265-266.
- Schwartz, S. P. (1979). Natural kind terms. *Cognition*, 7, 301-315.
- Searle, J. R. (1958). Proper names. *Mind*, 67, 166-173.
- Sorrentino, C. M. (1995). Who's who from an infant's eye view? A proposal for investigating infant understanding of person individuation and numerical identity. Unpublished manuscript, Massachusetts Institute of Technology.
- Sorrentino, C. M., Xu, F., & Carey, S. (1996, April). Do 10-month-old infants individuate objects on the basis of the person/inanimate distinction? Poster presented at the 10th International Conference on Infant Studies, Providence, RI.
- Spelke, E. S. (1988). Where perceiving ends and thinking begins: The apprehension of objects in infancy. In A. Yonas (Ed.) *Perceptual*

- development in infancy. Minnesota Symposium on Child Psychology* (Vol. 20). Hillsdale, NJ: Lawrence Erlbaum, Associates
- Spelke, E. S. (1990). Principles of object perception. *Cognitive Science*, 14, 29-56.
- Spelke, E. S., Breinlinger, K., Macomber, J., & Jacobsen, K. (1992). Origins of knowledge. *Psychological Review*, 99(4), 605-632.
- Spelke, E. S., & Kestenbaum, R. (1986). Les origines du concept d'objet. *Psychologie Française*, 31, 67-72.
- Spelke, E. S., Kestenbaum, R., Simons, D.J., & Wein, D. (1995a). Spatiotemporal continuity, smoothness of motion and object identity in infancy. *British Journal of Developmental Psychology*, 13, 113-142.
- Spelke, E. S., Phillips, A. T., & Woodward, A. L. (1995b). Infants' knowledge of object motion and human action. In A. J. Premack, D. Premack, & D. Sperber (Eds.), *Causal cognition: A multidisciplinary debate*. Oxford, England: Clarendon Press.
- Taylor, M., & Gelman, S. (1988). Adjectives and nouns: Children's strategies for learning new words. *Child Development*, 59, 411-419.
- Trevarthan, C. (1979). Communication and cooperation in early infancy: A description of primary intersubjectivity. In M. Bullowa (Ed.), *Before speech: The beginning of interpersonal communication*. Cambridge, England: Cambridge University Press.
- Turkel, W. J. (1996). The anthropomorphic bias and the proper name. Unpublished manuscript, University of British Columbia.
- Uller, C., Carey, S., Huntley-Fenner, G., & Klatt, L. (in press). What representations might underlie infant numerical knowledge, *Cognitive Development*.
- Valentine, T., Brennan, T., & Brédart, S. (1996). *The cognitive psychology of proper names*. New York, NY: Routledge.
- Walton, G. E., Bower, N. J. A., & Bower, T. G. R. (1993). Recognition of familiar faces by newborns. *Infant Behavior and Development*, 15, 265-269.
- Watson, J. S. (1972). Smiling cooing, and "the game". *Merrill-Palmer Quarterly*, 18, 323-340.
- Wiggins, D. (1980). *Sameness and substance*. Cambridge, MA: Harvard University Press.
- Wiggins, D. (1967). *Identity and spatio-temporal continuity*. Oxford, England: Basil Blackwell.
- Wilcox, T., & Baillargeon, R. (in press). Object individuation in infancy: The use of featural information in reasoning about occlusion events. *Developmental Science*.
- Wimmer, H. & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, 13, 103-128.
- Woodward, A. (in press). Infants selectively encode the goal object of an actor's reach. *Cognition*.

- Woodward, A. (under review). Selectivity and discrimination in infants' encoding of human behavior.
- Woodward, A., Phillips, A., & Spelke, E. S. (1993). *Infants' expectations about the motion of animate and inanimate objects*. Paper presented at the 15th Annual meeting of the Cognitive Science Society, Boulder, CO.
- Wu, X. (1997, April). Developmental changes in infants' individuation of people. Poster presented at the biennial meeting of the Society for Research in Child Development, Washington, D. C.
- Wynn, K. (1992). Addition and subtraction by human infants. *Nature*, 358, 749-750.
- Xu, F. (1998, August). Weakly Whorfian? The role of language in acquiring kind concepts in infancy. Poster presented at the 20th Annual meeting of the Cognitive Science Society, Madison, WI.
- Xu, F. (1997). From Lot's wife to a pillar of salt: Evidence that physical object is a sortal concept. *Mind and Language*, 12, 365-392.
- Xu, F., & Carey, S. (1996). Infants' metaphysics: The case of numerical identity. *Cognitive Psychology*, 30, 111-153.
- Xu, F., Carey, S., & Quint, N. (1997, April). Object individuation at 12 months: Shape and other properties. Poster presented at the biennial meeting of the Society for Research in Child Development, Washington, D. C.
- Xu, F., Carey, S., & Welch, J. (under review). Infants' ability to use object kind information for object individuation.

Appendix

Examples of Proper Name, Unambiguously Not Proper Name and Ambiguous Responses for the Three Question Types in the Animal and Artifact Conditions of Experiment 1, Chapter 3

Condition	Direct Question	Category	Response
Animal	Means	Proper Name	Trial 1: "Name of that particular bear" Trial 2: "That particular doll"
		Not Proper Name	Trial 1: "Bear" Trial 2: "Baby"
		Ambiguous	Trial 1: "It's a name" Trial 2: "Brown"
	Sentence	Proper Name	Trial 1: "Zavy the bear is brown" Trial 2: "Feppy is my favorite doll"
		Not Proper Name	(No responses of this type were given.)
		Ambiguous	Trial 1: (The participant declined to respond.) Trial 2: (The participant declined to respond).
	Synonym	Proper Name	Trial 1: "Ann" Trial 2: "Bruno"

		Not Proper Name	Trial 1: "Stuffed animal" Trial 2: "Girl"
		Ambiguous	Trial 1: "When I go to bed at night I like to hug my feppy" Trial 2: "Piffy is sitting in her chair"
Artifact	Means	Proper Name	Trial 1: "A name" Trial 2: "Identity of that bottle"
		Not Proper Name	Trial 1: "Covered" Trial 2: "Decorated"
		Ambiguous	Trial 1: "Name of the bottle" Trial 2: "It's a shoe"
	Sentence	Proper Name	Trial 1: "Feppy is sitting right there" Trial 2: "Zavy is a shoe"
		Not Proper Name	Trial 1: "Why are you making that bottle zavy?" Trial 2: "That shoe is quite piffy"
		Ambiguous	Trial 1: "Daxy is blue" Trial 2: "I drank water out of zavy"
	Synonym	Proper Name	Trial 1: "Russell" Trial 2: "Russell"
		Not Proper Name	Trial 1: "Water bottle" Trial 2: "Shoe"

Ambiguous

Trial 1: "Bottle"

Trial 2: "Joe"

Note: Means = "What does x mean?"; Sentence = "Can you use x in a sentence?"; Synonym = "Can you think of a synonym for x or a word like it?"