NAIVE PSYCHOLOGY: PRESCHOOLERS' UNDERSTANDING OF INTENTION AND FALSE BELIEF AND ITS RELATIONSHIP TO MENTAL WORD

by

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Jianhua Jian

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DEDICATION

To my dear husband, who encourages me to be the one I want to be,
instead of the one I should be,

To my two dear daughters, who lead me into the amazing world of little children,

To my dear parents, who always give and never ask for return,

To my parents-in-law, who love me as their daughter,

To my dear sister, who shares the happiness and the sadness of my journey,

To my Heavenly Father, who makes the impossible possible.

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ABSTRACT

In the current study, children's understanding of false belief, intention, and their ability to distinguish the appearance of a character from its reality was investigated. Seventy-two three to five years olds were recruited from several preschools in the Silicon Valley in California. During the experiment, children were shown an animated movie in a computer and asked the false belief, intention, and appearance-reality distinction questions. Following the animated movie, children were also asked if they understand 10 mental words that depicted the human mind, such as *think, want, believe*, etc. The relationship between the children's knowledge of the human mind and the mental words they understood was explored.

Results of the current study revealed that children who were four and half to five performed better than children three and half to four on false belief tasks. Children's performance on intention and appearance-reality distinction questions did not differ significantly across age. However, girls' performance was superior to boys' performance on intention questions. Similarly, girls' knowledge of overall naïve psychology was also superior to that of boys Moreover, the order of the naïve psychology concepts that children passed in current study was from intention to appearance-reality distinction and then false belief. Finally, the regression analysis of the data revealed that the mental word vocabulary children processed was closely related to naïve psychology development. More specifically, the number of total mental words that were reported by children or assessed by contextual questions was a significant predictor of naïve psychology knowledge.

CHAPTER 1

INTRODUCTION

The world is a huge puzzle for young children when they begin to decode its meanings. How can they understand what happens, or what others are thinking? Yet they can tell amazing stories about what happens around them. One day, I stopped at a traffic light, as did several other cars. My daughter, who had just turned three, asked "Why all those cars come here?" I responded, "What do you think?" "Are they all here for a party?" she asked. I laughed and explained why all the cars stopped at the same spot. Children's understanding of mind has drawn a great deal attention from developmental psychologists since the early 1980s. This domain of discipline has been referred to as the theory of mind, naïve psychology, and more broadly, folk psychology, depending on the interpretation of the specific content of the knowledge.

Studies of this phenomenon try to answer questions such as "How do children distinguish the physical world and mental phenomena?" "How do children understand others' thinking?" "What mechanism underlies this understanding?" and "What is the relationship between an understanding of mind and social behavior?" According to Wellman (1990), an understanding of mind is part of both children's and adults' ontological knowledge, their understanding of what sorts of things there are in the world. In addition, an understanding of the mind is also fundamental to an understanding of the social world. In everyday life, we form ideas about other people and about social

situations. We interpret other peoples' actions, and we predict what they will do under certain circumstances.

Several theories have been developed during the past few decades to explain children's understanding of the mental world. The most popular theoretical perspectives are early competence (modularity) and conceptual change (theory theory) accounts. The former suggests that children's theory of the mental world has a specific, innate basis. First, the essential character of a theory of the mental world is determined by specialized mechanisms deploying specialized representations, which do not apply to other cognitive domains, and which can be selectively impaired. The origin of this theory may be a cognitive module (Scholl & Leslie, 1999, 2001) that is part of the genetic endowment. Second, this innate module can be triggered by appropriate environmental factors, for example, puberty. This view is a type of early competence theory. However, this view stresses that the modularity does not mean the entire theory of the mental world is modular, but rather that it has a specific innate basis. This theory is intended primarily to capture the origin of theory of mind abilities and not the full range of mature activities that may employ them. In contrast, the theory theory (Gopnik & Meltzoff, 1997; Gopnik & Wellman, 1994; Wellman, Cross, & Watson, 2001) indicates that the progress underlying mental world understanding are simply general processes of theory or knowledge formation and are presumed to be the same as those employed in scientific reasoning. An interrelated body of knowledge is based on core mental-state constructs such as *beliefs* and *desires*.

Although most researchers agree that children's understandings of the mental world encompasses such concepts such as desires, beliefs, intentions, and other inner experiences (Wellman, 1990; Wellman & Watson, 2001; Wellman & Woolley, 1990), a large volume of research is dedicated to children's understanding of belief, especially false belief (Leslie & Polizzi, 1998; Perner, 1996; Scholl & Leslie, 2001). Some researchers have raised the concern that the studies on children's mental knowledge are too narrowly restricted to the topic of false belief. Other aspects of this knowledge, such as desire, intention, motivation, and the corresponding emotion, deserve more attention (Astington,1998; Bloom & German, 2000, Roth & Leslie, 1998; Wellman, Cross, & Watson, 2001). False-belief tasks measure only one narrow aspect of social cognition development. Standard tasks to assess understanding of the mental states of desire and also intention are not well developed, and available data are insufficient to determine whether an understanding of these states is developed in as regular a manner as that of beliefs. Therefore, a battery of social cognition tasks would be highly desirable for researchers interested in young children's understanding of the mental world. Moreover, children's performance on tasks designed to tap some mental concepts, such as ontological knowledge, intention, and belief, is seldom compared. Very few studies have investigated children's understandings of these concepts simultaneously. Performance across these concepts as well as an integrated picture of children's understanding of the mental world is unclear. Thus, the attention of the field has started switching from false-belief studies, to the relationship among the network of the related mental concepts.

Finally, the role of language in children's understanding of the mental world is controversial (Astington, 2001; Astington & Jenkins, 1999). The nature of the interaction between language and mental knowledge as well as the direction of the impact of language remain unclear. Researchers interested in this relationship have argued that language is crucial in two different ways. First, it provides a means for representing mental concepts in contradistinction to the evidence given in reality. Second, because some mental concepts, such as belief, desire, and intention, depend on children's internal resources as well as on social support, language is also the means by which children become aware of mental concepts, in both content and attitude. It is not known whether children's understanding of intention is as closely related to language ability as their understanding of belief. Thus, studies that explore the relationship between language ability and children's understanding on mental world would be helpful to answer the question.

Based on these concerns about the existing literatures during in the past few decades, the current study has three goals: (1) to investigate preschool children's understanding of intention and to determine whether a developmental trend can be identified; (2) to compare children's performance across standard false belief task, the current task assessing an understanding of intention, and their ability on the appearance-reality distinction; and (3) to examine the relationship between children's knowledge of the mental world and the availability of their mental words.

To accomplish these goals, an animated movie was designed to test children's understanding of intention, ontological knowledge, and false belief. For the test of

intention, the children were also provided an opportunity to answer the question with a non-verbal response, that is, to press a space bar to show their understanding of the protagonist's intention of the exhibited behavior. This non-verbal response removed the language barrier from the child's expression channel and at the same time was used as an indicator that the child had internalized the protagonist's intention and expressed it in an action.

In the remainder of this paper, some main theories in the field of naive psychology as well as topics that have great interest to researchers will be introduced. Then, the critical issues in the field are discussed and the results of the current study are presented.

CHAPTER 2

FOLK PSYCHOLOGY / NAÏVE PSYCHOLOGY

General Introduction

Although the term *folk psychology* and *naïve psychology* are used by researchers in this field interchangeably, the meaning of these two terms is slightly different. Folk psychology refers to people's understandings of mental states based on their daily experiences or common sense psychology. This type of understanding is in contrast to the in-depth and scientific understanding of mentalism. On the other hand, naïve psychology is more focused on the developmental side of the knowledge and the characteristics displayed during the formation of the understanding. Actually naïve psychology is only one aspect of children's naïve theory. Others aspects include naïve physics, naïve biology, and naïve chemistry. Naïve theories are less complete than adults' common sense theories and at the same time, less logical as compared to "scientific" knowledge.

The term *theory of mind* is also used to describe the phenomenon. Sometimes this term is used broadly to refer to children's social cognition, but implying that children's social understanding is based on their understanding of other's minds. However, the term may also be used to designate the field of study or a specific task used in studies of this type, such as false belief. Some researchers, like Moore and Frye (1991) and Astington (1998), have opposed the use of this term non-differentially and argue that "the term 'the theory of mind' belongs to those who believe that the theory of mind is a theory, and is a theory that the child possesses" (Astington, 1998, p.33). They prefer to use the term *folk*

psychology or *commonsense psychology* which indicates that "the child is not really developing a theory in anything like its scientific sense but rather a way of thinking and talking about self and other that involves mental states" (Moore & Frye, 1991, p.1). In this paper, I will use both *naïve psychology* and *theory of mind* to describe the phenomenon.

The research topics of this field include deceptions, pretending, intention, desire, and beliefs. Other more broad topics include illusions, interpretations, impressions, guesses, hopes, and wishes. In essence, it is about children's understanding of mental states. Wellman (1990) indicated some general principles about an understanding of mind:

1. Thoughts are different from things. Thoughts are mental and immaterial; things are physical and concrete.
2. Beliefs are different from actuality. Thus, beliefs can be false.
3. Desires are different from outcomes; plans are different from acts.
4. Fantasy is unconstrained by factuality. One can imagine impossible, unreal objects.
5. Mind is private and mind is individual. Thoughts, desires, and consciousness are not public.
6. Mind is not body. Body can be confined; however, the mind is free. (Wellman, 1990, pp.3-4)

These clarifications suggest that for most adults there is a mental world of thought, beliefs, desires, fantasies, mental entities, and private selves, a world that we know and understand but one quite different from the physical, public, factual, material world. For a child developmentalist, the interest lies in questions such as "Is an understanding of mind inborn?" "Is the knowledge of mind developed through daily observations?" "If it is obtained from the everyday experience, when and how are such notions acquired?"

A classic hypothesis is that children initially do not share adult notions of mind. Instead they have a non-mental perspective on events. Piaget (1929) called this phenomenon "childhood realism."

> Let us imagine a being, knowing nothing of the distinction between mind and body…His notions of self would undoubtedly be much less clear than ours. Compared with us he would experience much less the sensation of the thinking self within him, the feeling of a being independent of the external world… The psychological perceptions of such a being would be entirely different from our own. Dreams, for example, would appear to him a disturbance breaking in…We shall try to prove that such is the case with the child. The child knows nothing of the nature of thought, even at the stage when he is being influenced by adult talk concerning "mind," "brain," "intelligence." (Piaget, 1929, p. 37)

Another perspective (Foder, 1987) suggested that an understanding of mind is innately given. According to this perspective, the mechanism underlying the understanding of mind is prewired and is available at birth; it emerges through maturation. Yet a third position (Wellman 1990) provided an alternative explanation of how to understand the developmental process. Those holding this view argued that an understanding of mind could not be innately given, because infants do not have a theory of mind. Yet preschool children construct an understanding of mind in the course of their development. This third perspective is more closely related to Piaget's theory (1929), except that it acknowledged that children had some kind of understanding of mind at an earlier stage than Piaget proposed.

Dominant Theories in the Field

Corresponding to the three perspectives mentioned above, there are three standard theories in the field of naïve psychology: simulation (Bruner, 1990; Nelson, 1986),

modularity (or early competence) (German & Leslie, 2000, 2001; Leslie, 1987, 1994, 2000a, 2000b; Leslie & Polizzi, 1998; Leslie & Roth, 1993; Roth & Leslie, 1998; Scholl & Leslie, 1999), and theory theory (or conceptual change) (Astington, 1998; Gopnik & Meltzoff, 1997; Gopnik & Wellman, 1994). All of these theories assume that children have concepts of mental states such as desire, intention, belief, and underlying causal connections between desire, intention, and action. They agree that the development of these concepts is universal, seemingly effortless, and largely dissociable from more general intellectual development. However, they differ significantly on how these concepts are obtained by young children.

In the philosophical literature, a distinction is drawn between postulational and taxonomic theories (Samet, 1993). The concepts in a *postulational theory* are abstract and unobservable entities that are assumed to exist in order to explain and predict observable phenomena. In this view, mental state concepts are theoretical entities that children postulate in order to explain and predict people's interactions. In a *taxonomic theory,* the concepts are not of unobservables that we assume to exist in order to provide explanations, but, rather, we have some direct experience of them and from this experience organize a conceptual structure.

Simulation theorists' theory of mind is a taxonomic one. They assume that even though children explain and predict human action on the basis of concepts of belief and desire, these concepts are derived from children's own experience of such states. The other two theories are more consistent with postulational theory. For *theory-theorists,* mental state concepts are abstract and unobservable theoretical entities that children

postulate in order to explain and predict observable human behavior. This view does not deny that children experience these states in themselves, but such experience is indirect and informed by the theory they currently hold (Gopnik & Wellman, 1992; Gopnik, 1993). *Modularity theorists* also regard children's concepts of mental states as abstract theoretical postulated entities, organized into causal laws that can be used to interpret a wide range of evidence. However, they are innate, not constructed (Fodor, 1992; Leslie, 1994). In the following section, theory theorywill be introduced first, followed by the modularity and the simulation theory.

Theory Theory

The central idea in this theory is the contention that the processes of cognitive development in children are similar to, indeed perhaps even identical with, the processes of cognitive development in scientists. Children's learning experience is similar to theory change in science, or paradigm shifts. The focuses of this theoretical position include children's categorizations, their naïve understanding of biology and physics, and their understanding of the mind. Many researchers have adopted this philosophical stand including Wellman's (1990) and Gopnik and Meltzoff's (1997) positions here.

Wellman (1990) noted three features of a theory.

> First, knowledge is coherent; the concepts and terms of interest become embedded in one another, each providing necessary support for the rest. In the extreme, concepts within a theory or theoretical terms get their meaning through their interconnections with other terms in the theory, by virtue of their place in a context of cohesive propositions. Second, theories rest upon specific ontological distinctions or commitments. Theories carve phenomena into different kinds of entities and processes; they specify, directly or indirectly, the kinds of things that are in the relevant domain. Third, a theory provides a causal-explanatory

> framework to account for or to predict the outcome of an action or situation. (Wellman, 1990, pp. 6-7)

The next question, given the definition of theory, is whether the everyday understanding of mind constitutes a theory. Wellman (1990) argued that the adults' knowledge of the mental world, the realm of beliefs, desires, intentions, thoughts, and so forth, is a theory.

> It is a naïve theory, not a developed or disciplined scientific one, but a theory nonetheless. Moreover, intuitively adults' knowledge of the mind can be characterized by the three theory-relevant features mentioned above. For the criteria of coherence, adults' understanding of mental terms is a mutually defining body of knowledge. The explanation of one term depends on the aid of other related terms. For example, if I try to define thoughts, I will mention ideas, memories, imagination, beliefs, fantasies, and the like. With respect to ontology, adults' knowledge of the mind is based on a basic and relevant ontological distinction: that between internal mental entities and processes on the one hand and physical objects and events on the other. The presence of this ontological distinction is evident in many natural languages, for example, idea vs. thing, psychological versus physical, fantasy versus reality, mind versus body, mental versus real. With respect to causal-explanatory criteria, adults explain their own and others' actions in terms of the wishes, hopes, beliefs, plans, and intentions of the actor. (Wellman, 1990, pp. 7-8)

If adults' understanding of mind is coherent, ontological, and causal-explanatory, what would children's understanding of mind be like? Most researchers agree that children have a theory of human mind; however, they disagree about when and how the understandings are acquired.

First is the question of "when" Wellman (1990) has provided data to indicate that three-year olds appreciate the necessary ontological distinction between mental and physical entities. He and his collaborators have investigated (1990), for example, children's understanding of the distinction between a thought about a chair versus a chair.

As for the "how" question, they also conducted studies of children's causal-reasoning about actions. They concluded that for two-year olds' naïve psychology is based on an understanding of simple desires; it includes no understanding of belief, that is, no understanding that persons possess internal mental representations as to how the world is. It is not until three years old that children can reason based on their understanding of beliefs. Three-year olds' causal reasoning differs from that of older children's in two respects.

> First, although 3-year-olds are committed to the folk psychological theory of mind, they are only novice theorists, mastering the theory's central tenets and grasping its most implications but not fluent yet in the theory's workings, applications, and nuances. Second, it is important to consider the notion of mind that characterizes the young child's theorizing. In this regard, I claim that children's theory of mind changes in an important and qualitative way during the preschool years because their notion of mind itself changes. It seems to me that the young child could explain and predict much about human action by treating the mind itself as something like a simple container. (Wellman, 1990, pp. 9-11)

Gopnik and Meltzoff (1997) also paid attention to the distinctions between scientific reasoning and folk psychology reasoning. They identified several aspects in which scientists were different from children.

First is the phenomenological difference. Scientists appear to be more consciously reflective about their theorizing than children. Scientists articulate their beliefs about the world or about their fields of scientific endeavor, and so do children. However, children do not typically articulate the processes that generate those beliefs or that lead them to accept them, nor are they very reliable when they do. On the other hand, all children develop theories. Conceptual change in children takes place within a single individual and takes place relatively quickly. Gopnik and Meltzopp (1997) also noticed that

children's theories were not radically different from those of adult scientists. Children's theories and theory construction might be implicit rather than explicit. The reason that we think their theories are primitive may be due to their limited ability to report their understanding.

Second is the sociology. The striking sociological difference between children and scientists has more to do with the kinds of problems children and scientist approach than with the processes they use to solve them. Scientists typically approach the problems where evidence is quite limited. The paucity of evidence leads to the division of labor and to many of the technological and sociological institutions characteristic of science. The division of labor is one consequence of the different problems children and scientists tackle, and it may give scientists an advantage in solving those particular problems. However, this does not imply that the cognitive resources they use to tackle those problems are different (Gopnik & Meltzoff, 1997). Moreover, children's sociological organization may be superior to the scientist's for cognitive purposes. Infants and children have infinite leisure. There are no other demands on their time and energy and they are free to explore the cognitive problems relevant to them almost all the time. They also have a community of adults who, in one way or another, act in ways that further the children's cognitive progress. This community already holds many of the tenets of the theory that the child will converge on and has an interest in passing on information relevant to the theory to the child (Gopnik & Meltzoff, 1997).

Third is the timing and convergence. Children converge on roughly similar theories at roughly similar times. On the contrary, scientists do not always show this sort

of uniform development. The theory theory proposes that if cognitive agents begin with the same initial theory, try to solve the same problems, and are presented with similar patterns of evidence over the same period of time, they should converge on the same theories at about the same time. Moreover, children all over the world may develop similar representation at similar times because the representations are innate, and they mature at the same rate, or the crucial evidence is universally the same, and so are children's theorizing capacities. For scientists, however, the assumption of common initial theories and common patterns of evidence does not usually hold. Moreover, different scientists also often begin with different theories and quite typically approach different problems (Gopnik & Meltzoff, 1997).

In general, Gopnik and Meltzoff (1997) contend that theory change is a model of cognitive development. Our everyday understanding of the mind should be thought of as analogous to a scientific theory. Particularly, children's early understanding of the mind can be usefully construed as a theory, and change in this understanding can be thought of as theory change. In the course of developing an account of the mind, children postulate such mental entities as perceptions, beliefs, and desires as a way of explaining ordinary human behavior. Furthermore, there are significant conceptual changes in the child's understanding of the mind. A shift from a nonrepresentational to a representational view of the mind takes place between the age of three to five.

Like Wellman (1990), Gopnik and Metlzoff summarized some features of theories as well. Structural features of theories are described below.

First is abstractness. Theories include entities and laws that are postulated or recruited from elsewhere to explain evidence. Second is coherence: Theoretical constructs work together in systems with a particular structure. The entities postulated by a theory are closely interrelated with one another. Third is causality. Theories should be able to provide some underlying causal explanation to the superficial regularities in the data. The theoretical entities are seen to be causally responsible for the evidence. Fourth is the ontological commitment. Theories make ontological commitments and support counterfactuals. The theoretical entities and laws are supposed to tell you what there is and what it must do.

Functional features of theories include the following. First is prediction. A theory should be able to predict a wide variety of evidence, including evidence that plays no role in the theory's initial construction. However, the predictions based on a theory can be either correct or incorrect because theory goes beyond the evidence and is never completely right. Second is the interpretation. Theories produce interpretations of evidence, not only simple descriptions. Theories strongly influence which pieces of evidence we consider salient or important. Theories provide a way of deciding which evidence is relevant to a particular problem. Third is explanation. The coherence and abstractness of theories and their causal attributions and ontological commitments give them an explanatory force. Explaining something means that we can give an abstract, coherent, causal account of the phenomenon.

Dynamic features of theories are the defeasibility characteristics of theories. Theories may turn out to be inconsistent with the evidence, and because of this theories

change. Theories change is a result of a number of different epistemological processes. One particularly critical factor is the accumulation of counterevidence to the theory, and this is the defining feature of theory change.

Gopnik (Gopnik & Meltzoff, 1997) described several steps for theory change.

The first step is the conflict between theory and the counterevidence. When the old theory gets messy, the need for the coherence of the theory will work out and play a major role in the theory change.

A next step requires an alternative model to the original theory. Often the original idea for the new theory is an extension or application of an idea already implicit in some peripheral part of the earlier theory. The earlier idea is itself modified to fit its role in the new theory.

The final step for theory formation is a period of intense experimentation and observation. Experimentation allows scientists to test the predictions of the theory. But it is worth pointing out that even in science, much experimentation is much less focused.

Gopnik and Meltzoff (1997) argued that children have cognitive structures like those of scientists. Children's theories also appeal to be abstract theoretical entities, with coherent causal relations among them.

One of the basic questions to ask is "what is the input to the theory systems." One possibility is that other representational systems translate sensory information into some higher level of ordinary, primary knowledge. Not all representations are assigned by theories. Rather, an earlier level of processing provides the evidential input to the theory formation. Fodor (1983) referred to these systems as *modules*. An alternative explanation

is *theory-ladenness*, in which the system might simply assign theoretical representations to sensory input without a separate level of evidential representation. In this view, there is no "ordinary knowledge" level of representation; at least not once we get pasta very low level of perceptual processing. All representation will be the result of the application of everyday theories.

In both views, the theoretical representation assigned to a particular input would then interact in particular rule-governed ways with the other representations of the theory. Certain representations will match the predictions of the theory. Some suggest causal links between theoretical representations. It is the mismatch and the causal explanation that lead to the changes within the theory. There are two types of theories. One is the representation system that can be altered by the patterns of representation. Second is that the rules structuring the relations between inputs and representations can be changed as more inputs are available (Fodor 1983; Gopnik & Meltzoff, 1997).

Modularity Theory

An alternative to theory theory is modularity theory. According to this theory, cognitive structures are the consequence of innate modules. Representations of the world are not constructed from evidence in the course of development. Instead, representations are produced by innate structures, modules, or constraints that have been constructed in the course of evolution. These structures may need to be triggered, but once they are triggered, they create mandatory representations of input (Fodor, 1983).

Gopnik and Meltzoff (1997) argued that although modules are innate, not all innate structures are modular. They distinguished two types of nativism: modularity nativism and starting-state nativism.

For starting-state nativism, the child is innately endowed with a particular set of representations of input and rules operating on those representations. These initial structures, although innate, would be defeasible. Any part of them could be altered by new evidence. In other words, the innate theories have considerable effect on the end product of what children will perceive of the world. However, these theories can be later modified and revised (Gopnik & Meltzoff, 1997).

Modularity nativism, on the other hand, implies a much stronger set of claims. In Fodor's (1983) theory, modules are not only innate, they are also relatively stable. The representations that are the outcome of modules cannot be overturned by new patterns of evidence. The classic examples of modules are the specialized representations and rules of the visual and syntactic systems. Such modules are supposed to automatically map given perceptual inputs onto a more abstract set of representations. Outputs from the system may be taken up by other, more central systems, but the relation is asymmetrical. Information from higher systems cannot reshape the representational structure of the module. Once the module has matured, certain representations of the input will result. Other representations simply cannot be formulated, no matter how much evidence supports them.

Difference between Theory Theory and Modularity in Relation to Development

Gopnik and Meltzoff (1997) summarized several aspects that differentiate theory theory from modularity in children's developmental course of mental knowledge. First are inputs. For theory theory, input is evidence. It radically alters the nature of theoretical concepts. The theory theory proposes that there is something about the world that causes the mind to change, and this fact ultimately gives the truth of theories. A theorizing mechanism is a representational system that reorganizes itself in response to input. It is an inherently developmental system.

In modules, the relation between input and representation is different: experience is simply represented as the module says it should be represented. Relevant experience can trigger the use of a privileged representations system, but the experience does not reshape or reconstruct the privileged representations themselves, nor does it alter future relations between inputs and representation.

Second are predictions. The theory theory predicts a succession of different theories, each replacing the earlier theory. Furthermore, it predicts that there will be typical intermediate stages in the development of theories that reflect the dynamic features of theory change. In other words, theory theory predicts that there will be incorrect predictions, and these predictions will lead to representational change. Finally, it predicts that input from the environment will be a crucially important causal factor in determining the character and sequence of successive theories.

Modular representations do not lead to predictions through some set of inductive or deductive generalizations or through a process of theory testing. They lead to

predictions because they are specifically designed by evolution to do so. Thus, in this view, development may be the result of the maturation of another innate structure; a later module coming on line; or the result of external, non conceptual changes in information processing. It is really the assumption that performance, rather than competence, is what develops. Unlike the theory theory, which predicts that there will be incorrect predictions and that these predictions will lead to representational change, modularity theories can only account for incorrect predictions by some process external to the module. So modularity theorists tend to interpret incorrect predictions as performance errors.

Third are parameters. Parameters are described as alternative branching routes that determine the eventual form the module may take. Parameters allow for a somewhat richer developmental story than one in which a module is simply turned on or off. The relation between the input and the setting of the parameter is still a relation of triggering. In contrast, in a theory theory, by analogy with scientific theories, there should an indefinite scope for genuinely novel theories, not simply a choice of several options.

Difference in Relation to Other Systems

The examples of modularity are relatively peripheral systems, such as low-level visual and auditory perception and syntax. These systems may be considered as indefeasible. This is particularly true for syntax, where modularity arguments have been made most strongly. Although some theorists tried to apply modularity to semantics and higher-level cognition, it has considerably less support than modularity accounts of low-level abilities. The representations of syntax, perception are at the end of the line in term

of their cognitive function. In the case of concepts, beliefs, and words, however, such structures can not be the end of the line. Our concepts and beliefs and the meanings of our words can and do change all the time. The modularity account gives a poor explanation in the formation of these higher level cognitions (Gopnik & Meltzoff, 1997, Gopnik & Wellman, 1994).

In general, the differences between the modularity theory and the theory theory concern the relation between experience and conceptual structure, between inputs and representations. The crucial evidence differentiating the two views lies in the dynamic properties of modules and theories, in how they develop. However, not all of the dynamic features of modules and theories will be different. Some knowledge at birth or in very early infancy is compatible with either an innate initial theory or an innate module. The theory theory proposes that there are mechanisms that, given evidence, alter representations in particular ways. If two children start out with the same theory and are given the same pattern of evidence, they will converge on the same theory at roughly the same time (Gopnik & Meltzoff, 1997; Gopnik & Wellman, 1994).

Simulation Theory (Empirical Generalizations)

Although nativist's accounts of cognition have been more prevalent than empiricist ones, there are also accounts in cognitive science and in cognitive development that are much more in the empiricist tradition. These accounts explain cognition in terms of the accumulation of particular pieces of information about the world, i.e., the experience of an individual. Examples of empirical generalization are scripts and

narratives. Scripts are cognitive structures that are supposed to have some predictive or generalizing force, but they are very different from theories. Nelson (1986) has argued that much of the child's early knowledge is organized into "event structures" much like scripts. Bruner (1990, 1995) suggested that much of our ordinary knowledge is organized in terms of narratives, a kind of empirical generalization. The main features of narratives are time and place. They consist of a set of fairly narrow generalization which events typically follow.

In the area of development, the empirical generalization approach proposes that children combine primitive representations of events into more complicated, ordered structures. This process of combination is often quite context-specific, and factors like familiarity and repetition play an important role (Bruner, 1995).

Compared to Theory and Module Approach

Gopnik and Meltzoff (1997) compared the simulation theory to theory and module approach as follows. First, like theories, but unlike modules, empirical generalizations, e.g., scripts, narratives, and nets are defeasible. Second, empirical generalizations contrast with theories on the structural and functional dimensions.

Causal claims. In empirical generalizations, the vocabulary of claims is just the same as evidential vocabulary. Separate abstract entities and laws are not generated. By themselves, empirical generalizations make few, if any causal claims. At the most, they

invoke a very general notion that there is some causal link between the antecedent and consequent.

Ontological commitments. Empirical generalizations do not make ontological commitments or support counterfactuals.

Prediction and explanations. As a result, the predictions they can generate are quite limited, basically in the form that what happened before will do so again. They lead only to very limited constraints on the interpretation of new data. Ultimately, they generate, at best, rather limited and shallow explanations. For example, consider the "restaurant script." Knowing what happens in a restaurant is entirely a matter of fairly arbitrary generalizations about particular events, such as ordering, receiving the food, paying, etc. The parts of the script are described in exactly the same terms one would describe the events themselves, not in terms of some underlying abstract entities. Moreover, the connections between the parts are not law-like or even causal at all. There are no causal links between the parts of the event. However, for theory, some abstract structures are usually constructed based on the event. Restaurant script tells us what the restaurants we encounter are typically alike. Restaurant theory provides us with deeper and more abstract predictions, explanations, and interpretations of restaurants. When we want deeper explanatory adequacy or wider predictive power, we turn from scripts to theories.

Patterns of developmental change. In the case of a theory, we will typically see a pattern in which the child holds to a particular set of predictions and interpretations for some time; the child has a particular theory. Then we may expect a period of disorganization, in which the theory is in crisis. And finally, we should see a new, equally coherent and stable theory emerge. In contrast, in the case of an empirical generalization, the child manifests a more contextually specific pattern of development. Very familiar and frequent pieces of information are learned first, and other pieces of information are gradually added to this story.

Summary of the Three Positions on Naïve Psychology

Evidence can be provided for the accountability of the three positions in terms of how they explain the formation of the mental understanding. Modules must help to provide the input for theorizing processes. There must be some innate mechanisms that will help us to transfer the stimulation of the environment into the inner or the higher level of the mental structures. The question is how to identify the border between modules and theories. One way might be by distinguishing modular perceptual processes and central cognitive ones. We might make a principled distinction between perception and cognition by saying that perceptual processes are those that lead to unrevisable representations. These representations are the input to theories.

Although modular systems can provide input for theorizing systems, in some respects the two types of structures simply coexist and develop in parallel and independently. Modules provide input to theories, but they are not replaced by theories.

Modules' representations may contradict theoretical representations and yet coexist with them. When modular and theoretical representations coexist, the theories underwrite a different and much wider range of other mental phenomena than modules.

Like modules, empirical generalizations could be an important source of input to theorizing mechanisms. A sufficiently rich set of observations and generalizations could provide a child with an important initial knowledge from which new theories could later be constructed. The generalizations also play a crucial rule in theory change. This type of knowledge provides us with counterevidence to the predictions of the theory. The theory itself can't directly generate the counterevidence, though theory-internal considerations of simplicity of coherence may also play a role in theory change. On the other hand, empirical generalizations are deeply influenced by theories. Earlier empirical generalizations usually are phrased in the vocabulary of an existing theory. Once we get past the modular level, we may always represent the world in terms of the representational vocabulary of our theories.

Some theorists have suggested that modules, empirical generalizations, and theories are ordered: that modules lead to empirical generalizations, which lead to theories. Others (e.g., Gopnik & Meltzoff, 1997) think this is not the correct picture. They postulated that modules, theories, and empirical generalizations are all in play literally from birth. Innate theories assign powerful, abstract, and predictive representations to the outputs of modules. New information coming into the cognitive system is represented in terms of these theories. The empirical experience helps children constitute the sequence or the prototype of certain events. These empirical generalizations foster the development

of theory. More importantly, some of these kinds of inputs lead to revision of the theory, and the modular outputs are assigned new representations by the new theory and so on. Thus, it is important to keep in mind that although each position has its own strength in explaining children's understanding of psychological phenomena, there are areas that one position cannot possibly cover thoroughly.

Empirical Research and Theoretical Models on Naive Psychology

Ontological Knowledge

Ontological knowledge deals with our basic conceptions of what sorts of "things" there are in the world. For naïve psychology, our everyday mentalism divides the world into two ontologically different categories: mind versus matter. A starting point to understand children's development of theory of mind, then, is whether and when they appreciate this ontological distinction.

Childhood Realism

Piaget (1962) used the phrase "childhood realism" to describe young children's inability to distinguish mental from real, physical phenomena. Young children tend to "substantiate" psychological phenomena so that thought can be passed to others, and dreams can be visible to others. In philosophical discourse, one sense of realism refers to the view that the everyday objects of our perception exist independently of our thinking of them, occupying portions of an external space. Realism in this sense can be contrasted with idealism, which encompasses a variety of views holding that we do not have true

knowledge of the existence of such a real world. Physical objects are material, external, public, and objective, whereas ideas are mental, internal, private, and subjective. Thus, realism and idealism appear to be the fundamental ontological distinction between ideas and independently existing physical objects.

Wellman (1990) distinguished two types of childhood realism. One is ontological realism which refers to a belief that mental phenomena are real physical phenomena. As Keil (1979) indicated, young children "apparently think that all things are types of physical objects" (p. 128). For example, a child might not be able to distinguish a real house from the concept or mental image of a house. Epistemological realism is more concerned with the acquisition of knowledge or how ideas and objects are related. For example, if ideas are physical things, they can be collected from the outside world and transferred through some physical device. Ontological realism refers to the existential status of ideas, and epistemological realism refers to the origins and nature of ideas. The difference between these two sorts of realism can be illustrated by a person who is an ontological dualist, that is, who conceives of ideas and physical things as fundamentally different, but who at the same time might firmly believe that ideas are directly, physically caused by objects and correspond exactly to objective situations. Wellman indicated that Piaget did not distinguish between the ontological and epistemological aspects of childhood realism and thus did not consider the possibility that children might be susceptible with one form of realism but not the other. He claimedhat young children might not be ontological realists, but they may still be epistemological realists. Thus, an

important question to ask is whether children can make a distinction between mental representations and physical objects.

Children's Ontological Knowledge on Mental Entities

According to Wellman (1990), mental activities include verbs such as remember, guess, believe, think, know, dream, etc. Mental entities refer to the mental contents or products of such everyday mental activities and statements. Wellman identified several aspects to distinguish mental entities, such as a thought about a chair, from everyday physical objects, a chair. First, physical objects, as opposed to their mental counterparts, provide behavioral-sensory evidence. In other words, physical objects can be touched, sat on, or broken up. Second, physical things have a public existence. Other people can sit, move, or rock in a chair. In contrast, a dream of a chair can only be touched, sat or moved by a person who dreams about it; no one else can experience these things. Third, a physical object has a consistent existence. A physical object is there regardless of whether you are thinking about it. However, a mental entity can come and go simply by willing.

To answer the question of whether young children are realists, Wellman and his colleagues completed a series of studies based on the features of mental entities. In one study (Wellman & Estes, 1986), they asked three, four, and five year olds if the cookie or the thought-cookie (other mental states are dream, remember, and pretend) could be seen, touched, and manipulated, which could be seen by someone else, and which could be manipulated in the future. They found that even three-year-olds were correct in ascribing

behavioral-sensory, public, and consistent status to physical objects but not mental entities 75% of the time. In another study, they told a story depicting different types of objects, real objects, mental entities, and real but absent or non-possessed objects, and asked behavioral-sensory, publicness, and consistency questions about each character's experience presented in the story. The result of the study showed thatthe children made appropriate distinctions between physical and mental entities in their judgments and in their extended explanations. Three-year-olds were nearly as clear about this fundamental distinction as four and five year olds.

To make their claim more assured, Wellman and his colleagues (Estes, Wellman, & Woolley, 1989) studied on children's understanding of less substantial physical entities, which they called "impostors." They told 59 three to five-year-old children a simple story on mental entities, solid physical objects, and close imposter entities. The examples they used for imposters in their study were shadow of a tree, used-up toothpaste, a photograph of a lion, burned-up leaves, smoke, pain (tummy-ache) and sound (beep). Following each story, the children were asked to judge if they could see, touch, and hide the entity. After the judgment questions, the children were also asked why the entity could be seen, touched, or hidden, or vice versa.

When children were asked if someone could see or touch prototypic physical objects, 90% of their responses were "yes," as was appropriate. When asked if mental entities could be seen or touch, 75% of the responses were "no." For responses to the explanation question, children tended to give physical or moral reasons for solid physical items that not be seen, touched, and hidden. In contrast to the physical-moral

explanations given for solid physical items, mental items elicited predominantly mental explanations. For close impostor items, children gave mainly location-possession explanations. They said that the item in question was unavailable or gone. Or they gave some physical ability explanations; they said that the actor could not accomplish the specified act. Even three-year-olds never gave mental explanations to close impostor items.

Thus, Wellman and his colleagues (Estes et al., 1989) concluded that young children were not realists in the sense of equating mental entities with the physical objects. More importantly, they were not realists in the more subtle sense of confusing mental entities with physical but intangible entities such as smoke, shadows, or sounds, nor did they seem to confuse metal entities with physical representational entities such as photographs. However, the data also showed that three-year-olds, while significantly distinguishing mental entities from physical ones, did not do so as consistently as four or five year olds. In particular, three-year-olds often used physical-moral explanations to explain their judgments of mental entities ("You can't touch it because you'll get too dirty.")

Along the line of the above study, Wellman and his colleagues (Estes et al., 1989) studied three to five year-olds' understanding of mental images. Three contrasting entities: real objects, real hidden objects (such as a deflated balloon hidden in a box), and mental images of real objects (such as a mental image of a deflated balloon) were used. For mental image questions, they first showed the children the balloon, and then asked them to close their eyes and make a "picture of it in your head." After the presentation of the

objects and the imagination of the mental image, children were asked if they could be seen, touched, or seen by others besides the child.

The other study (Estes et al., 1989) contrasted a mental image and a photograph in a closed container. Besides the questions mentioned for the above study, the children were asked one more question regarding the possibility of using the entity for some function for which the actual object could be used. Mental images and inaccessible photographs are alike in the sense that neither can be used in the same way as the objects they represent, and neither can be seen, touched, or seen by someone else. They differ in that mental images can be mentally transformed but inaccessible photographs cannot. Results of these two studies showed that preschoolers distinguished between mental images and inaccessible physical representations in their judgments as well as in their explanations. The children showed a solid understanding of the distinction between mental and physical representations. Children in these studies consistently judged that mental images could not be seen, touched, seen by someone else, or used in the way a real object could be used, but they could be mentally transformed.

In general, Wellman and his colleagues have indicated the features of children's ontological understanding of mental phenomena: First, children appeal to the commonsense criteria of behavioral sensory evidence (visibility, tangibility) to distinguish mental entities from prototypic physical objects. However, children do not mistake such characteristics to be essential. They are able to distinguish mental entities from physical entities that are intangible or invisible (like smoke, sounds). Second, they contend that mental entities can be transformed just by mental effort, which is insufficient

to transform parallel physical entities. Third, young children might have some understandings that mental entities are private. However, this understanding might only be applied in their own experience. When children were asked if a second person could see a first person's mental entity, they uniformly said "no." They also said "no" when they were asked if the first person could see his or her own mental entities. But when children were asked if they could see their own image, they say "yes," and they denied such visual experience of their image to someone else.

A pioneer researcher who has done extensive studies on children's ontological knowledge is Frank Keil. One of his studies (Keil, 1979) revealed children's understandings on mental entities by requiring children to judge certain sentences as anomalous. Keil indicated that in our daily language, there are rules of specifying certain predicates to be combined with certain terms logically. When this constraint is violated, the sentence doesn't make sense. For example, "the ruler is long" sounds logical, but "the idea is long" sound silly. By listing sentences with different combinations of predicates and terms, Keil asked children to judge the "silliness" of the sentences. He found that preschoolers and kindergartners sometimes applied physical predicates, such as "is heavy," "is red," and "is tall" to dreams and ideas, as well as for trees and dogs.

The results of Wellman's studies (Wellman, 1990) seem contradicting with Keil's (1979) findings. Wellman argued that the difference hinged on the questions that children were asked. Keil questioned them about ideas and thoughts in themselves; however, children may have judged the logic of the sentences based on a specific content of a mental state (such as a dream about a giant) instead of on the mental entity (such as a

dream) per se. However, at the same time, Wellman (1990) denies that three-year-olds had acquired an adult knowledge about the mentality or reality of all entities. In fact, much acquisition of this specific knowledge is acquired in later childhood. The bottom line to Wellman (1990) was that they understand the essential distinctions.

Another type of research has focused on children's ability to distinguish the appearance-reality entities (Keil, 1989; Peskin, 1996; Peskin & Olson, 2001). In a study by Peskin (1996), three and five-year-olds were presented a story about a mean goblin dressed up as a nice boy so his intended victim would agree to play with him. Children were asked if the disguised character would later carry out the intended misdeed. Most three-year-olds asserted that the goblin would continue to act benignly, in congruence with his dress appearance, but five-year-olds correctly predicted that the disguised character would later carry out the intended misdeed. It seemed that three-year-olds had difficulty in interpret the underlying thinking of the goblin because of his appearance.

In another study, Peskin and Olson (2001) examined if children predicted behavior based on appearance rather than the underlying disposition. They explored this possibility by telling children a story on a character that undergone costume change but no deception (a cat wearing a sheep costume, a pig wearing a rabbit costume, and a dog wearing a lion costume. And children were asked what the sound of the character while it was disguised as another type of animal. The result showed that in determining a character's behavior in a narrative, five-year-olds, but not three-year-olds predicted that the character's biological essences or predispositions prevailed across unintentional changes in appearance. It appeared difficult for the younger children to override the

appearance of the character that they even ignored a biological reality with which they were familiar with.

False Belief and Belief-Desire Reasoning

The ontological understanding of mental entities helps children solve the problem of what they are, while the understandings on desires and beliefs enable children to attribute particular attitudes to the mental entities. In essence, beliefs are mental attitudes about the world. They describe both a mental state and the world states. Beliefs also help to trace the mental causes for actual behaviors (Gopnik & Meltzoff, 1997).

An important feature of beliefs is that beliefs do not necessarily correspond to actual states of affairs; representations do not faithfully capture reality. In this sense, like other mental entities, beliefs are independent from the physical worlds. Moreover, they are subjective thoughts of the human mind. The obvious evidence of children's understanding of beliefs is from the fact that they can reason the causes of human actions. The focus of the studies along this line is thus whether children can predict human behavior based on the actor's belief, and like adults, can construe human actions as resulting from internal states of belief.

False Belief

Children's understanding of belief has been studied through story comprehension, moral judgment, person perception and metacognition. One research paradigm that has

been attractive to many researchers since the 1980s is the false belief task, beginning with Wimmer and Perner (1983).

In a standard false belief task (Baron-Cohen et al., 1985; Wimmer & Perner, 1983), a character watches an object to be hidden in a location (Location A). While the character is away, unknown to him, the object is moved from the original location to a new location (Location B). Now the character returns and looks for the object he just put away before he left. Children were asked where the character would look for the object. The appropriate prediction of the character's action from information about the character's false belief suggests an impressive understanding of mind. Most of the children younger than four failed the false belief tasks. They consistently predict that the character would search where the object really was rather than where he should believe it to be. Namely, younger children had difficulty in suppressing their own observation of the reality and inferring the action from other person's false belief.

This standard false belief is usually referred to as an "unexpected location task." Following this logic, other research paradigms have been invented to study false beliefs. One is the "unexpected contents" (Hogrefe, Wimmer, & Perner, 1986; Perner et al., 1987). In this paradigm, children were shown a container that ordinarily held one set of thing (e.g., candies), but which turned out to hold something quite different (e.g., pencils). Or the deceptive object was a sponge that looked like a rock (Flavell, 1986a, 1986b, 1988, 1993, 2000; Sapp, Lee, & Muir, 2000). Children were allowed to look into the container and know what was actually inside. Children were then asked what other people would think was inside the container without looking inside. The other paradigm was the

"unexpected picture" (Gopnik & Astington, 1988; Jenkins & Astington, 1996). The task design was a picture book in which a partial view of what appeared to be cat's ears were actually the petals of a flower. The children were asked what another child, who saw only the partial view, would think it was before seeing the whole picture. A majority of the false belief studies reported that children with understanding of other people's beliefs were at about four years of age, but not much younger.

Recently, some researchers have used children's literature as an instrument to test children's understanding of false belief (Clancy et al., 1998; Szarkwoicz, 2000). In Szarkwoicz's study, "Harry the Dirty Dog" was chosen as the narrative for the false belief task. In the narrative, a spotty dog got very dirty and looked like a black dog. His families did not recognize him until he jumped into the bath to wash off the dirt. Children aged three to five were asked who the families thought he was. They found that the proportion of children who passed the narrative task was higher than that of children who passed the standard false belief task. Although the difference was not statistically significant, Szarkwoicz attributed this higher passing rate on the narrative task to children's sense of belonging and participation in a familiar and interactive setting. In addition, narrative linked events of a false belief task into a coherent episode. The narrative task was composed of a series of events which linked to form a cohesive storyline. These events were expressed in terms of the mentality of the characters and the physical setting. Hence, the narrative task facilitated children's recall of salient information.

Belief-Desire Reasoning

Some researchers have criticized false belief tasks as a particularly difficult form of reasoning about beliefs and argued that young children might be capable of engaging in belief-desire reasoning but still not be able to succeed in the false belief tasks. Wellman and Bartsch (1988) did some experiments to investigate the belief-desire reasoning through story telling. In one experiment, children aged from three to four years old were told stories depicting a character's desire and belief and then were asked to predict the action of the character. An example is "Sam wants to find his puppy. His puppy might be hiding in the garage or under the porch. But Sam thinks his puppy is under the porch. Where will Sam look for his puppy: in the garage or under the porch?" Wellman and Bartsch found that children's performance on this type of task was at high level. Even three-year-olds had little difficulty in predicting a character's action in accordance with the character's beliefs.

Wellman's Model for Children's Belief-Desire Psychology

According to Wellman (1990), in order to be a successful belief-desire reasoner, children must (1) be able to predict actions given relevant information, such as an actor's beliefs and desires; (2) be able to make backward inferences and explaining actors' observed actions by appeal to their beliefs and desire; (3)be able to infer characters' emotional reactions to the outcomes of their actions; and (4) be able to infer a character's beliefs from information as to that character's perception and infer desires from information as to physiological states.

To exam these hypotheses, Wellman and Bartsch (1988) did several experiments on backward belief-desire reasoning. In one of their studies, a specific action of a character was described to children from three to four years old, as well as to adults. And the children and adults were asked to explain the character's action. There were three types of action description. The first type was neutral descriptions: "Jane is looking for her kitten under the piano. Why do you think Jane is doing that?" The second type was anomalous belief descriptions: "Jane is looking for her kitten. The kitten is hiding under a chair, but Jane is looking for her kitten under the piano. Why do you think Jane is doing that?" The third type was the anomalous desire descriptions: "Jane hates frogs, but Jane is looking for a frog under the piano. Why do you think Jane is doing that?"

The responses of the children and adults were categorized into three types of explanation. The first type was the psychological cause, including desires, beliefs, perceptions, physiological states, and preferences. Second was the non-psychological cause, like external states of affairs or physical causes. Third was a failure to generate an explanation at all. The psychological causes were further categorized into belief-desire and other constructs, including physiological states, perceptions, emotions, mind changing, pretense, preferences, and traits. Furthermore, the explicit and implicit explanations were distinguished within the category of belief/desire explanations. Explicit desire explanations included relevant desire verbs such as *want, desire*, and *hope*. Explicit belief explanations included belief verb such as *think, know*, and *guess*.

The results of this study indicated that children's responses had a very similar level and patterns of explanations as adults'. The three-year-olds did not differ from

adults in terms of their use of a psychological belief-desire framework. The proportion belief, desire, preference, or perception explanations of these young children were very close to the adult's version. Wellman and Bartsch (1988) claimed that quite young children share with adults at least the rudiments of a common belief-desire psychology. In addition, belief-desire explanations were by far the most frequently used explanation for actions across all age groups. And they distinguished desire from beliefs. More than half of the three-year olds spontaneously mentioned belief terms in their unprompted responses. Wellman and Bartsch argued that children could not possibly achieve this without genuine understandings of beliefs when straightforward desire terms were available. However, they found some differences between young children and adults. First, children attempted fewer explanations before any prompt was given. Second, age differences were found on the belief explanation. On anomalous belief items, for those action descriptions most designed to provoke belief explanations, 53% of three-year-olds' explanations referred to belief, whereas the comparable figure for adults was 86%.

Wellman and Bartsch (1988) indicated two features of three-year-olds' belief conception: (1) Children understand that belief is a mental state that is "about" an external state of affairs and (2) beliefs are different from desires. To have a desire is to have a positive disposition toward an object. To have a belief, however, is to have a conviction about a state of affairs. Wellman and Bartsch believed that three-year-olds could make the distinction between these two concepts. They predicted that a character with a single desire would engage in different acts depending on his or her beliefs.

Wellman (1990) also tried to distinguished beliefs and desires in such a way that one was cognitive and representational (belief) and the other was not (desire). In adult psychology, both desires and belief can be propositional attitudes, and they can be both representational as well. However, for very young children, it is possible that desires are not representational. In this simple concept, desires are not attitudes about a proposition but attitudes about an actual object or state of affairs. Wellman termed this type of understanding "simple desire". In the case of simple desires, the conceiver can simply think of the target person as having an internal longing for an external object. In the case of belief, it seems the conceiver must think of the target person as representing the object somehow. Wellman also distinguished simple desires from drives in such a way that

> Drives describe the organism's internal physiological state, while simple desires describe a specific object that is sought…For example, being hungry can be satisfied by an apple, and orange, or a sandwich. The object is not specified by stating the drive. But 'wanting an apple' is not satisfied by a sandwich; the object is essential. (Wellman, 1990, p.212)

Wellman and Woolley (1990) conducted a series of studies on two-year-olds to test the hypothesis of "simple desire." In one study, children were introduced to four types of desire/belief tasks. In *not-own desire tasks*, children were told about a character with two options (swimming in the pool or playing with the dog by the doghouse). Then children were asked their own preference. After citing their own desire, they were told the character had the opposite desire and asked to predict the character's action. *Not own belief task* was constructed comparable to not-own desire task. In a *no-preference desire task*, children saw that target objects were really in both locations (markers are in the desk and in the toy box). Then they were told a character's desire (to find markers) and

asked to predict where the character would look to get the markers. In a *discrepant belief task*, children were told that an object was in both locations, but the character only believed that the object was in one location and his desire for the object was explicitly told. Then children were asked where the character would look for the object. In *non-preference desire tasks*, children saw that target objects were really in both locations (for example, markers are in desk and in the toy box). And they were told the desire of the character (to find markers).

The result of this study (Wellman & Woolley, 1990) revealed that young children were largely correct on tasks requiring reasoning about human action on the basis of actors' simple desires. At the same time, they performed significantly more poorly on tasks requiring understanding of actors' beliefs. Wellman and Woolley concluded that young children understood simple desire reasoning preceding belief-desire reasoning. Although children around two years olds used mental words such as *think, know*, and *forget*, they didn't understand a construct of belief. However, two year-olds had a better performance on desire tasks. They could correctly predicted characters' actions given information as to the characters' desires. Wellman and Woolley suggested that understanding of belief-desire psychological causation, in contrast to simple desire causation, was beyond the grasp of children until about their third birthday.

Pretend Play

Pretend play is another aspect that researchers have tried to investigate children's understanding of mind. Much of the literature on pretense has been guided by the work of

Alan Leslie. Leslie (1987) first observed his own children using a banana as if it were a telephone. A child might pick up a banana; hold it up to his ear and mouth and say, “Hi. How are you? I’m fine. OK. Bye.” Later Leslie (1994) investigated the pretense behavior through a series of experiments. In his tea party experiment, children were encouraged to “fill” two toy cups with “juice,” “tea,” or whatever they designated the pretend contents of the bottle to be. Then the experimenter asked children to watch him picking up a cup, turning it upside down, shaking it for a second, and replacing it alongside the other cup. Children were then asked to point out the “full cup” and the “empty cup.” When asked to point at the “empty cup,” two-year-olds pointed to the cup that had been turned upside down.

Researchers interested in this topic have identified some defining features of pretense: an animate pretender, a reality, a mental representation, the intentional projection of that mental representation onto the reality, and the pretender’s awareness (Lillard, 2001a, 2001b; Nichols & Stich, 2000). However, controversy remains with regard to the presence of the action of the pretend. Nichols and Stich (2000) suggested that pretenders will actually do things to produce the appropriate pretended behavior. However, Lillard argued that although pretending almost requires action, one need not act continuously or even necessarily at all. The action is an optional feature of pretend.

Influential theories on pretense include Leslie’ (1994) metarepresentation model, Nichols and Stich’s (2000) Possible World Box (cognitive architecture) model and Lillard’s (2001c) Twin Earth (social cognitive) model. Although most of the pretense theorists agree that the representation underlying the pretense scenario is quarantined

from the common representations of the mental world that depicts the realty, how this representation functions to enable children to distinguish the realty from the pretense remains controversial.

Leslie (1987, 1994) proposed the metarepresentational modelto explain children's pretense behavior. According to Leslie (1994), representations that serve pretense are marked in a special way to indicate that their functional role is different from the functional role of unmarked (or the "primary") representations. These marked representations are "decoupled" copies of the primary representations which do not have the normal input-output relations that unmarked primary representations have. Leslie called these marked representations "metarepresentations" (later he changed this term into *M-representation*). On the other hand, Leslie noticed that young children were explicitly aware of the fact that pretending involved thoughts that diverged from reality. Children who were pretending must self-consciously realize that the pretend situation was represented. Thus, Leslie claimed that all pretense-representations included the "pretense" concept; pretense-subserving mental representations always included both a specification of an "agent" and a representation of the "agent-informational relation-expression," the concept of pretense. According to this point of view, pretense is considered the same as other mental concepts such as belief and desire. If children engaged in pretense play, they were capable of achieving a theory of mind.

Although Leslie's (1994) assumption of the "marked representations" has been acknowledged by many theorists in the field, his inclusion of the understanding of "pretense" in his model raised concerns. Other theorists have argued that

> . . . The pretense could proceed without the subject having any beliefs with contents like "I am pretending that this (empty) cup contains tea"… the pretense could proceed perfectly well even if the subject did not have the concept of pretense and thus could have no beliefs at all with contents of the form "I am pretending that P." (Nichols & Stich, 2000, pp.137-138)

To provide an alternative account for pretense, Nichols and Stich concur that some piece of cognitive architecture must be devoted to keeping the real and the fictional separate. They proposed a Possible World Box (PWB) model.

The PWB (Nichols & Stich, 2000) is a representation system into which real representations can be dropped and which allows both pretense and hypothetical reasoning under the facilitation of other specified unites. Its job is

> . . . not to represent the world as it is or as we'd like it to be, but rather to represent what the world would be like given some set of assumptions that we may neither believe to be true nor want to be true. The PWB is a "work space" in which our cognitive system builds a temporarily stored representations of one or another possible world. (Nichols & Stich, 2000, p.122)

In the example of the tea party, the episode began when a representation with the content "we are going to have a tea party" was placed in the PWB. What happened next was that the cognitive system started to fill the PWB with an increasingly detailed description of what the world would be like if the initiating representation were true. The crucial mechanism making these happen is the inference mechanism, which is the same as the one used in the formation of real beliefs. However, in the case of pretense, new representations are added to the PWB by inferring them from representations that are already there. PWB is the pretense-initiating representation. In order to fill out a rich and useful description of what the world would be like for the pretense scenario, the system

will require lots of additional information, which comes from the pretender‘s belief system.

However, one important issue thatneed ed to be addressed was how pretenders generated the correct representation of the pretense scenario when the representations in the PWB were incompatible with something in the belief system. Our cognitive system must distinguish those beliefs that need to be modified in light of a newly acquired belief from those that do not. Nichols and Stich (2000) suggested an “Updater” mechanism to account for this differentiating ability. They believed that the updater was responsible for the updating process of the belief system, and it was a sub-system in the inference mechanism. The basic idea is that when the pretense is initiated, the updater is called into service. It treats the contents of the belief system when a new belief is added, though in the PWB, it is the pretense premise that plays the role of the new belief. The updater goes through the representations in the PWB, eliminating or changing those that are incompatible with the pretense premises. Thus, these representations are unavailable as premises when the inference mechanism engages in inferential elaboration on the pretense premises. Or in an alternative way, the updater serves as a filter on what is allowed into the PWB.

PWB is similar to Leslie’s (1994) metarepresentation (MR) device in several respects. First, both the MR and PWB refer to a class of representations that is specially marked and different from the unmarked representations functionally. Second, both suggestions agree that the representations in either MR or PWB are the tokens of the same types as the representations in the belief system. However, Leslie did not address

the problem of the contradictions between general knowledge and pretense assumptions. Another difference between Nichols-Stich's and Leslie's account for pretense behavior is the issue of children's understanding of "pretense" itself. According to Leslie, all pretense-representations include the "pretend" concept. On the contrary, Nichols and Stich considered this unnecessary and unwarranted. They argued that if engaging in pretense and understanding pretense in others both depended on representations that included the pretend concept, then neither would be possible until that concept became available.

Another leading theorist, Angeline Lillard (2001c) proposed a "Twin Earth" model to explain the phenomenon. "Twin Earth" is a term borrowed from philosophers, which was originally used to

> . . . argue for semantic externalism, the view that meanings are not just private mental properties. Twin-Earth was proposed as a planet where there is a substance that looks, behaves, and for all intents and purpose is exactly like water and is even called "water," but whose chemical composition is not H2O, but some different and complex formula, abbreviated as XYZ. Because in an ordinary person's head Twin Earth "water" had the same meaning as Earth "water," this thought experiment convinced many the meanings are not just "in the head" and must partly reside in the entities which they are about. (Lillard, 2001c, p. 516)

Lillard (2001c) argued that pretend play for children was similar to Twin Earth for philosophers. When children pretend, they create an imaginary world that is in many ways just like the real world. Identities, concepts, and relationships are essentially the same. But a few identities or parameters are changed in the pretense setting: a banana becomes a phone, a stick becomes a horse. As part of the play, the child reasons about relationships in this new world. A banana becomes a phone, but phones are the same, so how a phone can be used is the same. Lillard suggested that both pretend play and Twin

Earth are quarantined worlds, decoupled from the real world. Furthermore, just as the Twin Earth scenario has allowed philosophers to make important headway to solve their problems, pretend play contexts appear to support superior levels of reasoning in children. Finally, philosophers must signal to each other that they are discussing Twin Earth rather than real earth. In essence, the important similarities between these two phenomena are that both are decoupled from reality yet maintain the critical relations of the reality and that both enhance reasoning under some circumstances.

The Twin Earth model emphasizes the role of social context, i.e., the interaction between children and their parents, siblings, and care givers and the mental skills such as reading intention, engaging in joint attention and social referencing (the ability that children understand adults' attitude). Children's pretense play evolved from early pretense with parents or siblings, to symbolic function, to the decoupled world of pretend (Twin Earth), and finally to the pretend role play. The center of the model is the decoupled pretend world. In this quarantined world, an object or person can be something or someone else and will partake in the scripts and schemas associated with that new identity. But the change is not a permanent one. At the end of the pretense, everything reverts to its real status. Although Lillard (2001c) agreed that the entry into this decoupled world appeared to stem from more biological than social forces, the social environment could encourage its earlier appearance.

Similar to Leslie (1994), Lillard (2001c) suggested that pretending involves projecting a mental representation onto a reality: "If one is not aware of the distinction

between the represented [pretense] and the real, then one is not pretending" (Lillard, 2001c, p. 498).

The "decoupled pretend world" is also similar to Leslie's MR device and Nichols and Stich's (2000) Possible World Box, in which a separate set of representations about reality is quarantined and triggered in a pretense setting. However, Lillard's approach emphasized more on the input of environment and the social interaction available to children.

Several research paradigms have been designed to investigate the pretense phenomenon. In one of his early researches, Leslie (1994) introduced two- and three-year old children to a pretending birthday party with toy animals and toy cups, plates, etc. The cups and plates were then pretended to be filled with juice and water, and children were asked to tell what was in the cups. In other setting, some pretending actions of the animals (such as the lamb rolling in the muddy puddle) were shown to children and later children were asked "What has happened to Larry (the name of the toy lamb)?" Nine of 10 participating children passed the test, indicating that two-year-olds could infer correctly what the experimenter was pretending. Children were able to calculate the essential elements in the pretend setting and relate the agent to the imaginary situation. More specifically, children were able to calculate, in terms of language, the speaker's meaning and the linguistic meaning in terms of action, the agent's pretend goal and pretend assumptions. Children were also capable of communicating their pretend ideas back to the participating agents intentionally. Thus, Leslie suggested that correct

responses in the pretense questions imply children had and understanding of representations at an early age.

Lillard and her colleagues (Aronson & Golomb, 1999; Lillard, 1993, 1994, 1996, 1998, 2001a, 2001b; Sobel & Lillard, 2001a, 2001b) presented children with character who could not mentally represent something but who was behaving as that something typically behaved. For example, a doll called Moe, was described as a visitor from a land of the trolls who had never seen a kangaroo and did not know that kangaroos hopped, but it yet hopped like a kangaroo. Then children were asked if the troll was pretending to be a kangaroo. The study result indicated that less than one third of the four -year-olds and half of the five-year-olds passed the test. In contrary to Leslie's (1994) conclusion, Lillard indicated that children did not have a representational concept of pretense until the sixth or eighth year. However, Lillard's procedure (Sobel & Lillard, 2001a) was criticized that there was no logical alternative explanation that the troll's behavior was more salient than his mental state and that the troll's action contradicted his mental state.

In another study, Perner, Baker and Hutton (1994) showed children that a character put a carrot into an empty cage under two conditions. In one case, the character had seen a rabbit inside, and in the other she knew there was not a rabbit inside. The test question concerned whether the character really thought there was a rabbit inside or was just pretending. Three-year-olds claimed that the character was just pretending in both cases, whereas four-year-olds correctly discriminated pretense and false belief. Custer (1996) tried to remove the contradictory action component to examine children's understanding of pretense representations. She showed children drawings of people

engaged in action. For example, in one scenario, a child sat on the bank like he was fishing, but actually a boot was being caught. In the pretense condition, the child in the picture was described as pretending (to fish). Three- and four- year olds were then shown two additional pictures and asked to choose which "thought picture" showed what the person had in his mind: one showing him catching a fish or one depicting the real situation. Even three-year-olds usually chose the fish picture for pretense.

Intention

Intention is central to an expanded everyday understanding of action. As it is easily mixed with the concept of desire, Wellman (1990) tried to explain the difference between these two concepts. According to Wellman, both terms shared the nature meaning of *want*. *Want* is used ambiguously to denote desires (Bill wants candy), and closely related intents (Bill wants to go to the candy store). In spite of this close relationship between desire and intention, intentions are separable from desires. Desire is more apt to *wish, hope*, and *fancy*, and intention is closer to *plan, aim*, and *decide*. Intentions are not a sort of desires; instead, they function to actualize desires. Desires fuel intentions and intentions actualize desires. Intention is the junction where belief and desire meet. An intended plan of action is designed to achieve certain desires on the basis of certain beliefs. According to Wellman (1990), "In naïve psychology, intentions are the proximal cause of actions. Hence, in commonsense psychology actions are essentially intentional; they are to be explained in terms of the actor's intentions" (p. 110).

Numerous studies have reported thatthe average age for children t o understand intention is from three to five years old (Astington & Gopnik, 1991; Gopnik, 1993; Gopnik & Wellman, 1991). However, some researchers have studied children who were younger than three years old (Gergely et al., 1995; Legerstee, Barna, & DiAdamo, 2000; Leslie & Keeble, 1987).

Some theorists considered the naïve theory of physics as the origin of the understandingof intention (Leslie, 1994, Leslie & Keeble, 1987, Spelke, 1990; Spelke, Breinlinger, Macomber, & Jacobson, 1992). During the first year of life, infants have already the capacity to represent and reason about animate and inanimate physical objects. Some researchers have claimed that infants inferred intentions in the behavior of people but not in the movements of inanimate objects. Woodward (1998) conducted a habituation study on five- to nine-month-old infants. In Woodward's study, infants were habituated to an arm and a hand that reached and grasped one of two toys. In the test events, either the location of the two toys or the path of movement was switched. In the new object-old path event, the arm reached for the old location, and the hand grasped a new object. In the old object-new path event, the hand grasped the same object as in habituation but followed a different path. This sequence was repeated in an experiment in which the arm and hand were replaced by a stick and a mechanical claw. In the animate condition, infants dishabituated when the hand reached for a different object, but in the inanimate condition, the infants dishabituated when the claw followed a different path. The author concluded that the five- and nine-month-old infants considered the movements of people and objects differently, even when the trajectories on which the

animate and inanimate objects moved were identical. When observing the actions of social objects (hands), infants focused on what these actions were directed at, but when observing movements of inanimate objects, infants focused on the movements only.

In another study, Legerstee et al. (2000) studied infants' reactions toward the interaction between humans and objects to identify the precursor to the development of intention of infants. In this study, they habituated six-month old infants to an actor who was either swiping at or talking to something hidden behind an occluder. After habituation, infants were shown two contrasting test events in which the infants saw either a person or an inanimate object while the actor was obscured. The results of the study revealed that when six-month-olds saw people talking, they expected these actions to be directed at persons and not at inanimate objects. Infants who were familiarized with the profile of an actor who appeared to talk to something hidden behind an occluder looked longer when the recipient of the actions was revealed to be an inanimate object rather than a person. In contrast, infants who had been habituated to an actor who swiped at something hidden behind an occluder looked longer when the hidden object turned out to be animate. They further indicated that these distinct response patterns could not have been the result of the visual difference between the two stimuli because the infants did not show such differential looking during the control condition, in which the infants were not habituated to any action of the actor. Instead, the infants' differential looking pattern varied as a result of the different types of actions to which they had been habituated.

Although Legerstee et al. (2000) agreed that the infants' differential responsiveness to people and objects during the test events may not indicate that six-

month-old infants understood human actions as the result of the person's thoughts or beliefs, they suggested that infants did construe intentional actions such as talking and reaching in terms of desires or actions directed toward objects instead of simply as movements.

However, Gergely (2001) criticized the results of Legerstee et al.'s (2000) study, indicating they demonstrated only a simple associative learning. Therefore caution should be exercised in interpreting evidence for early differential responsiveness to humans versus inanimate objects during the first six to eight months of life as involving understanding intentionality or mental states in others.

Gergely, Nadasdy, Cscibra and Biro (1995) performed a habituation study on 12-month-old infants. They argued that the crucial evidence for young children's understanding of intention was that they would generate expectations about the particular actions the agent was likely to perform in a new situation to achieve his goal. In their habituation study, they demonstrated that infants could infer on the basis of their naïve theory of mind the likely future actions of an agent as a function of the intention attributed to him. In order to fulfill the intentional causal analysis, young infants must able to perceive three things. First is the self-initiated movement which indicates the agency. Second is the "equifinal structure of an action." "The goal of an agent can be discerned from observing that under varying environmental conditions his different actions result in one and the same consequence" (Gergely et al., 1995, p.171). Third is the rationality of the action: The behavior of the agency must be interpreted as a coherent and rational approach to the goal.

In Gergely et al.'s (1995) experiment, in the habituation phase, there were two conditions: the rational and non-rational approach. In the rational approach, infants observed the behavior of two circles (one big and one small) positioned at a distance from each other with a rectangular obstacle placed in between them. First, the large circle expanded then it contracted, regaining its original size. This was immediately followed by a similar expansion-contraction sequence performed by the small circle. This sequence of events was then repeated again, providing a contingent turn-taking structure for the stimulus event. After this "exchange," the small circle began to move toward the large circle. The event continued by the small circle starting to approach the large circle, following the shortest pathway that could connect them. However, it stopped in front of the rectangular obstacle, which blocked its path to the large circle. The small circle then retreated to its original position and started out again toward the large circle. However, this time, it jumped over the obstacle and landed in front of the large circle. The small circle continued to approach the large circle until they made contact. When they touched each other, the large circle exhibited again the contraction-expansion routine, which was immediately reciprocated by an identical response preformed by the small circle, and this interchange was repeated a second time. For the non-rational approach, the actions of the two circles were identical to those in the rational approach. However, the rectangular obstacle was placed behind the small circle rather than between the two circles.

Thus, in the rational approach, the event satisfied both of the conditions of equifinality (the equifinal outcome-same consequence of the small circle's action: the spatial location next to the large circle) and rationality (jumping to avoid obstacle) of

action. The infants observing this display took the intentional stance and attributed the equifinal outcome of the agent's actions as the goal of the agent. For the non-rational approach, it was difficult to coherently interpret the agent's behavior as a goal-directed action, because there was a more rational mean action available (i.e., approaching the goal through the shortest straight pathway leading to it) than the rather more complex and apparently unmotivated action (approach, retreat, and jump) that was actually performed by the agent. Therefore, it was more likely that the infants would abandon their interpretation of the small circle's behavior as that of a rational agent (Gergely et al., 1995).

In the test phase, infants in both conditions observed new action and old action events. In the new action event, the small circle approached the large one through the shortest straight pathway with no obstacle in between, and in old action event, the small circle exhibited the same behavior as the jumping action in the non-rational approach condition with the absence of the rectangular obstacle (Gergely et al., 1995)

The reasoning behind Gergely et al.'s (1995) experiment was that for infants who had habituated with the rational condition, they should be able to predict that the small circle would approach its goal in the most rational manner now available, that is, the small circle should go through the shortest straight pathway leading to it, which also required the least effort. In contrast, the old action should be unexpected for the infants, even though the pathway of approach was identical to that observed during the habituation phase. Thus, it was predicted that infants who were habituated to the rational

approach condition would dishabituate significantly more to the non-rational jumping action than to the rational straight-line approach.

On the other hand, infants who were habituated to the non-rational approach condition would abandon the intentional stance and would not consider the small circle to be a rational agent. Therefore, when infants under this condition observed the new situation, they developed no specific expectations as to the most likely approach route that the small circle would follow. Here, the straight -line approach of the new action would not result in less dishabituation than the jumping approach of the old action (Gergely et al., 1995).

The result of this study indicated that during the test phase, the old action display resulted in significantly more dishabituation than did the new action display. The subjects of the rational approach group looked significantly longer at the habituation events than did the subjects in the non-rational approach group. In spite of the fact that the new action was more novel to the infants, they showed less surprise when seeing the new action display, indicating that from the intentional stance they could predict the new action of the agent as the most rational means. Gergely at al. (1995) concluded that as young as 12 month old, infants were able to differentiate the intentional actions.

There is fewer intention studies focused on older children. In one study conducted by Astington and Lee (1991), children were presented pairs of picture stories having the same outcome, but only one of which was intended. For example, one pair was composed of a brief story about a girl who threw some crumbs on the ground, followed by another story about a girl who dropped some crumbs on the ground. After the stories, the children

were asked: “Which girl meant the birds to eat the crumbs?” They found that successful performance on their tasks was only at chance level for three-year-olds but rose substantially above chance between the ages of four and five years. They concluded that it was not until later in the preschool years that children had a concept of intention as an internal, mental state that caused people’s actions.

In another study conducted by Joseph (1998), three- and four- year-olds’ understanding of intention was examined in the context of pretend. Two dolls were introduced to the children, and they were also told that one doll was pretending sneeze, and the other one had a cold and was really sneezing. Two to four similar stories were presented to the children. After the presentation, the children were asked “Who is trying to sneeze?” and “How can you tell that the boy (girl) is trying to sneeze?” In the 3-yesr-old group, four of 13 children who were able to provide appropriate intention attributions; while in the four-year-old group, 11 of 17 children were successful. Joseph concluded that when given a contrast between an involuntary behavior and the same behavior performed deliberately through an act of pretend, four-year-olds were able to discriminate the intentionality of the pretend behavior, and three-year-olds had an emerging understanding of the intention concept.

More recently, Hulme et al. (2003) conducted a study on six- to nine-year-old children’s understanding of intentional context. In this study, Hulme et al. composed six intentionality stories. For example, in one of the stories, a new student (Rosie) was told to fetch a whistle from a teacher who she had never met before. The information on the teacher available to the new student was manipulated by providing three conditions: (1)

neither the participants nor Rosie knew what the teacher looked like, (2) the teacher's picture was shown only to the participants, and (3) the teacher's picture was shown to both Rosis and the participants. Then the children were asked "Does Rosie know what the person who has the whistle looks like?" and "Choose the picture that best fits what Rosie is thinking." (the intentionality question) The results of the study showed that many six-year-olds chose the actual character as a thought content for the story's protagonist in the "participant only" condition. In the "neither" condition, where children shared the ignorant state of the protagonist, they preferred a prototypical symbol. In general, children about age nine years succeeded in predicting the thinking stage of the protagonist, while those around six years failed to inhibit their own knowledge of the true state. They also indicated that children's performance on the intentional context tasks was in sharp contrast to their performance on the false belief task, in which most of the six-year-olds passed.

In sum, despite some researchers' efforts trying to identify children's ability to understand intention in infancy, in the early 12 to 18 months of age, children's understanding of intention is closely related to action, which might not be as "mentalistic" as adults' version of desires or intentions. Young children still treat intentions as states linked to some action of another. Based on this primitive understanding of intention, some behaviors may be intentional even if they do not involve articulated prior mental states. At the same time, infants do not simply identify actions with particular bodily movements. Rather, infants seem to understand something about the goal-directed character of actions. Instead of distinguishing between mental states and

physical ones, infants seem to first distinguish between persons and objects, and they seem to treat ideas like success and failure as simple relational notions that connect the actions of a person and events in the world.

In terms of when children obtain genuine understanding of intention, there is no consensus among researchers. Some studies suggest that by the age of two to three, young children have elaborated the initial theory of intentional action into a true mentalistic account of desire. Around two and one-half, they show some signs of conceiving intention prior to and independent from actions (Bartsch & Wellman, 1995; Wellman, 1990; Wellman & Woolley, 1990). By around three to four, children can appreciate other aspects of intention, e.g., intentions mediate between desires and actions. Although there is no direct cognitive evidence for intermediate conceptions that link the understanding of goal-directed action at 18 months and the more elaborated understanding of desires as mental states at two and one half, it seems plausible that continuing processes of theory formation and change bridge these two developmental periods.

Other research (Hulme et al., 2003) has demonstrated that children's ability to comprehend intention is not mature until age six or beyond. It is especially difficult for children to inhibit their own knowledge of the contextual information and infer a protagonist's attribution. Moreover, the developmental order of intention and false belief understanding has been controversial. Some (Wellman, 1990; Wellman & Woolley, 1990) have suggested that understanding of intention proceeds false belief comprehension. On

the other hand, whether children's true ability to appreciate intention isbeyond th e grasp of belief understanding remains unclear.

Theory of Mind and Language

The most studied relationship is the connection between false belief and language. It is noteworthy that from age three to five, the period during which children's theory of mind develops, is also the major period of language acquisition. Jenkins and Astington (1996, 1999) found high correlations between three- to five-year-olds' scores on standard false-belief tests and various standard measures of general language ability, such as the Vocabulary and Sentence Memory subtests of the Stanford Binet Intelligence Scale and the Test of Early Language Development (Hresko, Reid, & Hammill, 1981).

The most debatable issue in this relationship is which one depends on which one. Some researchers (Call & Tomasello, 1999; Freeman, Lewis, & Doherty, 1991; Plaut & Karmiloff-Smith, 1993) have suggested that theory of mind depends on language. It is argued that linguistic ability is required for successful performance on theory of mind tasks. Children are told a story, and they have to comprehend this input, process the experimenter's questions, and make responses. However, this argument does not speak to the question of whether theory of mind development depends on language, just to the limitations of the research methods. If the task demands less linguistic ability, younger children will perform correctly. A stronger view on this stand states that linguistic development intrinsically supports theory of mind development. Language development provides children with resources, such as syntactic ability or semantic understandings that

promote or allow mental understandings. The most sited evidence of this claim is from studies of deaf children whose language development is delayed although their nonverbal intelligence and social adjustment are within normal levels (de Villiers & de Villiers, 2000; Peterson & Siegal, 1995).

The second hypothesis proposes that the direction of the influence among these two areas is from theory of mind to language. For example, the classical Piagetian view is that conceptual development precedes semantic development. Children must first develop concepts and only then can develop linguistic forms that encode or elaborate them (Piaget, 1962). Such an argument is consistent with the proposal that false-belief understanding is dependent on innate modular systems (Leslie & Roth, 1993). It is also consistent with Perner's (1991) proposal that children use mental models to represent false beliefs.

The third position suggests that language and theory of mind are both dependent on other factors that bring about development in these two areas. According to some views, these other factors are internal, such as development in working memory or executive function, which allow children to reason using more complex embedded rules that are then exploited in both theory of mind and language tasks (Zelazo & Jacques, 1996). According to other views, these factors are external and involve the child's increasingly sophisticated participation in social and cultural activities (Nelson, 1996).

Recently, an interaction position, which was based on the theory theory point of view, has argued that theory of mind and language are intertwined, each promoting development of the other through a bootstrapping mechanism (Gopnik & Meltzoff, 1998). According to this position, semantic and cognitive developments emerge simultaneously;

neither type of development appears to precede the other. This suggests that a bidirectional interaction between conceptual and semantic development. Earlier cognitive developments may not only serve as a prerequisite for semantic developments, as the classic Piagetian model suggests, but actually motivate semantic developments. Children are actively engaged in solving particular conceptual problems at particular times, and the child's attention is drawn to words relevant to those problems.

Based on this argument, neither conceptual development precedes semantic development nor vice versa. It is not simply that children have an innate repertoire of concepts and are merely waiting to map the correct term onto that concept. But it is also not the case that children are simply mindlessly matching our linguistic behavior to that of our teacher and that our cognition is shaped accordingly. Rather, the two types of developments, learning the work and learning the related concept, appear to go hand in hand, with each type facilitating the other. For example, when young children encounter new words, like apple, cup, horse, or umbrella, from a pictures book, first of all, they will infer that all objects have a name to be discovered. Secondly, they will also infer that all objects belong in some category or other, i.e., that objects in general are divided up into kinds. When children deal with sorting problems, they will apply these discoveries and exhaustively place all objects in a mixed array of different locations. Their nonlinguistic behavior would parallel how they linguistically placed all the different objects into different categories. Moreover, many words will be linked to one another in a coherent, theoretical way, and appreciating these links is part of understanding the theory (Gopnik & Meltzoff, 1998).

From the theory theory perspective, children can take advantage of the linguistic signals only if they see them as relevant to the specific problems they are trying to solve. Moreover, children do not simply match the meanings of the words they hear in the adult language. Rather, they use these words to encode the conceptual structures they are themselves developing at the moment, the structures that are central to their theories. In this view, linguistic knowledge might interact with cognitive development; however, the nature of the interaction would itself depend on the child's previous cognitive achievements and present cognitive problems. Semantic and conceptual developments facilitate each other and they are closely intertwined from the very beginnings of language (Gopnik & Meltzoff, 1998).

The next question is what aspects of language are related to theory of mind development? Pragmatic, semantic and syntactic aspects are important elements in language. It is likely that all three are related to the theory of mind. However, it is also likely that each plays a different role. Pragmatic features underlie the ability to use and interpret language appropriately in social situation, which depends on keeping track of listeners' and speakers' beliefs and intentions Thus, pragmatics and theory of mind are related by definition. Scores on a test of pragmatic ability were found to be related to false-belief task performance in a sample of autistic children (Eisenmajer & Prior, 1991).

Semantics is concerned with word meaning. Semantic ability facilitates children's participation in verbal social interaction, which is considered to be important to theory of mind development. Olson (1988) argued that theory of mind depends on the acquisition of particular terms, such as *think, know*, and *remember*, that are used to refer to mental

states. Such states are unobservable, although their effects can be felt in the self and observed in others. These unobservable phenomena are brought to the child's attention when they are referred to with linguistic terms. The same linguistic terms are applied to the child's own states and to those of other people, which allows children to map their subjective feelings onto other people's experiences and develop an understanding of these states. Moore, Pure, and Furrow (1990) showed that there is a relation between children's comprehension of words such as *think* and *know* and their performance on tests of false-belief understanding.

Syntax refers to the structural features of the language. It is argued that syntactic ability will help children distinguish the reality from the representational states. For example, "John thinks the chocolate is in the cupboard." The embedded sentence, "The chocolate is in the cupboard," forms a subordinate clause that acts as the grammatical object of the verb *think* in the main sentence. The "object complements" like this allow the report of false beliefs: the whole construction may be true even though the embedded sentence is false. One can truthfully say, "John thinks the chocolate is in the cupboard," even if it is actually in the drawer. During the preschool years, children achieve mastery of the basic syntactic forms of their language. Relations do exist between theory of mind tasks and syntactic tasks that use complement-taking verbs, but from the available data, one cannot determine the direction of the relation (Tager-Flusberg, 1997).

Critics of Theory of Mind Tasks

False Belief Task

Among the tasks designed for theory of mind, perhaps the most controversial one is the false belief task. Many researchers have used the false belief task to investigate children's self-knowledge and knowledge others. Gopnik (1993) claimed that "at about age four, there is an important developmental shift to a representational model of the mind" (p. 1), and Wimmer and Weichbold (1994) stated that "not until the age of about 4 years do children become able to attribute belief states to themselves and other people" (p. 45). Under this view, failure at false belief task reflects some serious deficit in children's understanding of the mental lives of themselves and others. However, some researchers (Bloom & German, 2000; Wellman. 1990) have maintained that even though children understand that beliefs can be false, this is still a difficult task. To solve the problem, the child has to follow the actions of two characters in a narrative, has to remember both where the object used to be and where it is at the time of the test, and has to appreciate the precise meaning of the question (that it means where will Sally look, not where she should look).

The task is too hard for one- and two-year –olds, because the child must simultaneously consider two different beliefs or representations of one target (i.e., the child's own belief and the actor's belief), and they lack sufficient attentional and linguistic resources to cope. When the task is modified by making the question simpler, more specific, or making the change of location less salient, giving the children a memory aid for false belief content, children of three-year-old can usually accomplish the

task. This finding is used to support the argument that younger children have sophisticated conceptual competence when it comes to understanding that beliefs can be false, but this competence is filtered through inefficient processing capacities (German & Leslie, 2000).

The more serious problem is that false belief tasks are inherently difficult. They require children to reason about a belief that is false. Beliefs are supposed to be true. Even for a child who clearly understands that beliefs can be false, getting the right answer places non-trivial processing demands. To succeed at the false belief task, children must override useful and simple common theory.

In addition, some researchers (Wellman, 1990) have pointed out that children have the tendency to directly copy a belief. For example, when asked about the content of their friend's belief, a child knows that belief is a reality-oriented representation and hence a direct copy of reality. Therefore, the child is more likely to report what exists in the reality instead of what's in another person's mind.

Thus, some researchers have suggested other means to detect whether children can reason about mental states. For instance, in a study by O'Neill (1996), two-year-olds observed as an attractive toy was put on a high shelf. As this happened, the child's parent was either present or absent. When later asking for help in retrieving the toy, the children were more likely to name the toy and gesture to the location when their parent had not been present to witness the placement of the toy than if their parent had been present. This implies that children modify their behavior according to the knowledge states of other people. Moreover, researchers have shown that children have mental

representations through pretend play (Leslie, 1994), can attribute goals to other agents (Csibra, Gergely, Biro, Koors & Brockbank, 1999; Gergely et al., 1995), can imitate the intended and the completed-actions of other agents (Carpenter, Akhtar & Tomasello, 1998; Meltzoff, 1995), and can follow the gaze of an inanimate object if it displays evidence of being an intentional agent (Johnson, Slaughter, & Carey, 1998). The emergence of alternative tasks suggests an urgent need to design appropriate tasks to tackle children's understanding of mind. The old method does not meet the demand of a richer understanding of young children' knowledge of mental world.

The Interview Technique

False belief tasks are usually conducted in a well structured manner. For other studies, researchers have adopted the interview as their main method of investigation (Wellman 1990). However, the nature of this type of study has two drawbacks. One is that the specific items of sentences of the interview will limit the ability of the task to detect children's understanding of the mental states. For instance, in Wellman's (1989) study with "close impostors," smoke was used as an example for impostor and compared with solid physical objects and mental entities. For children who have little experience of smoke, they might not be able to judge the questions of whether smoke can be seen, touched, or hidden. Secondly, the understanding of a told story and the questions requires a certain level of linguistic proficiency. The language requirement lays another burden on children's information processing capacity while trying to decipher both the meaning of the situations and the questions. Depending merely on the interview technique has posed

some limitations on obtaining more information of what is actually understood by children.

Genius Understanding of Mind

When do children acquire a genius understanding of mind? This question has many different answers depending on how define mental state is defined. Wellman (1990) mentioned two levels of mental understanding. One is called the "hypothetical or imaginary aspect of mind," which refers to the free manipulation of mental images and the thought of decidedly not real things and events. At this level, the mental images are mainly imaginary, counter-factual, fantastical entities. The second level of the mental state concerns the correspondence of mind, the reality, involving the notions such as true beliefs or knowledge and in the notion of mental causation of manifest behaviors. This is called the "causal aspect of mind." Wellman argued that children aged two and one half to three years understand the hypothetical nature of mind but fail to understand the causal nature of mind. And this is one of the reasons that children at this age fail to understand false beliefs.

Yet another issue related to the timing of genius understanding of mind concerns the distinction between perceptual versus conceptual knowledge. The main question is whether children's responses to the experimental conditions or the questions are perceptually driven or conceptually driven. Some researchers have implied thatchildren have an understanding of mental states as young as six to eight months by demonstrating that infants can distinguish animate and inanimate objects (Legerstee et al., 2000). It has

been argued that this might be the simple associative learning that infants are able to form during their first few months of life through their experience with different stimulus. For example, human actions such as talking and physical manipulation are some salient features of the interaction between infants and their care givers. Thus, infants at this stage tend to demonstrate the expectation that talking is likely to take place in the presence of a person rather than with an inanimate object and that manipulating is more likely to involve inanimate objects than a human. Thus, whether differential responsiveness to human agent can be interpreted as infants' underlying conceptual understanding of mind remains an unanswered question.

The Main Goal of the Current Study

In the previous sections, the theories, the main research domains of naïve psychology, as well as some critics of both theoretical and methodological issues of the studies related to the this topic have been discussed. It seems that the biggest concern in the field is not how to position the interests in certain theory system; rather, it is the method through which the interests are studied. Because the interests under the title "naïve psychology" are so broad, it is reasonable to have different theories to fit different topics and different task design to investigate the phenomenon. However, questions remain. How do we picture naïve psychology in a more comprehensive way? What would be the appropriate tasks to investigate different domains? Is there a developmental trend among the research domains, which might go from categorical understanding to the

understanding of desire, the understanding of intention, and then finally the understanding of false belief?

To address the above questions, the current study is designed to use a computer aid animated movie to investigate related domains concerning naïve psychology, i.e., categorical knowledge, intentional reasoning, and the false belief understanding. In the study, three to five year old children will watch an animated movie that is generated on a computer, and they will then be asked to demonstrate their understanding of the intention of the character in the movie by doing a similar action that is shown by the character. Questions about their categorical knowledge, distinguishing the pretended object and the real object, as well as their reasoning on false belief, will be also asked after the movie is seen. In addition, information on how many mental words that children understand will be collected from parents, from children's self-report, and from contextual questions.

The main goal of the current study is to use an animated movie to (1) investigate children's knowledge of theory of mind (or naïve psychology), which in the current study includes children's ability to distinguish the appearance versus the reality of an entity and their understanding of intention and false belief; (2) investigate whether there is a developmental trend for these three domains of naïve psychology; (3) explore the relationship between naïve psychology and children's language proficiency on some mental words. In addition, because an animated movie is first used to examine the children's false beliefs and intentions, the age-appropriateness of the task and the questions will also be studied.

CHAPTER 3

METHODOLOGY

Subjects

The participants in the current study were 72 three and a half to five and a half year old children from four preschools in the metropolitan area of Silicon Valley, California. Most of the children were from middle-class families. A consent form was given to the parents. Only those Children whose parents signed the consent form were included in the study. The age and gender of the participants are shown in Table 3.1.

Table 3.1

Age and Gender Information of the Participants

3 ½ - 4		Beyond 4 – 4 ½		Beyond 4 ½ - 5		Beyond 5 – 5 ½	
Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
4	10	10	7	14	14	6	7

Out of a total of 72 children, there were 37 whose first language was English, 26 whose first language was Chinese, and nine who spoke other languages at home, such as Spanish, Arabic, and Indian. In addition, among these 72 children, twelve of them had experience playing with computers and the rest had none or very little.

Instrument

Screening Questionnaire

Before participating in the experiment, the children's parents were asked to fill out a screening questionnaire (see Appendix A) to determine (1) the extent thatthese children were familiar with computer usage, and (2) which first-language mental words their children were able to use. A list of ten mental words was given to parents. The ten mental words included *real, pretend, imagine, dream, try, decide, want, believe, think* and *know*. Parents were instructed to check all the mental words that their children could use in their first language. In addition, parents were also asked to provide information about their children's birth date, gender and the primary language they used at home.

Computer

A computer with keyboard was used to show the animated movies in the study.

Animated Movies

The main characters of the animated movies were a baby bear and a mommy bear. The movie itself was non-verbal, but the experimenter explained the story while the movie played. The order of the scenes and the description of the story are presented as follows:

Scene One (false belief session - FBS): A baby bear and his mother are having a picnic in a forest. Mommy Bear feels thirsty, and she decides to get some water. She puts

an apple in a basket and leaves the picnic scene. While Mommy Bear is away, Baby Bear hides the apple under a bucket. Mommy bear returns and looks for her apple.

Scene Two (intention training session - ITS): On the screen, there is only Baby Bear and some tree leaves. As soon as the child presses the space bar, Baby Bear puts the leaves on and make himself into a "tree."

Scene Three: (intention familiarity session – IFS): Similar to the first scene, the bears are having a picnic. One of Baby Bear's friends invites him to play ball. But since he has not finished his meal yet, Mommy Bear does not allow him to go. He tries to sneak out of his mother's sight but she catches and brings him back. Baby Bear thinks hard (a mental action indicated by a question mark blinking above his head). While Baby Bear thinks, his motherfalls asleep. While she sleeps, Baby Bear gets an idea concerning how to go and play with his friend. He picks up some tree branches from the ground, covers himself with the branches, and turns himself into a "tree." After he walks a few steps toward his friend, his mother wakes up and looks for her son. Baby Bear freezes for a while, and then he walks toward his friend again when his mother has left the scene to look for him, finally he joins his friend to play ball.

Scene Four (intention experiment session - IES): This is the experimented session. The story is the same as that in Scene Three, except the movie pauses when Baby Bear thinks hard. The question mark above Baby Bear's head blinks. As soon as the child presses the space bar on the key board, BabyBear puts on the leaves, turns himself into a "tree," and runs away with his friend to play.

Mental Word Assessment

Interview questions were created to assess whether the children understood words related to abstract mental states. The 10 target mental words were the same as those in the parental screening questionnaire. Two types of questions were asked for each mental word. The first type consisted of direct question, such as "Do you know the word *dream*?" "What does *dream* mean?" The second type consisted of contextual question, in which the children were asked if they understood the mental state after they were presented with a setting (see Appendix B).

Procedure

The experiment was conducted on the children individually. Children whose native language is not Chinese were all tested in English. Eight children whose native language is Chinese were tested in Chinese because of their difficulty understanding the English questions. Among these eight children, four were from three and a half to four; one was from four to four and a half; two were from four and a half to five and one was older than five. Before the study began, the children were told that they were going to view four animated movies and then be asked some questions. The child was first brought into the administration office of his or her preschool or to a table in a corner of his or her classroom. During the first part of the experiment, the animated movies were shown to the children and they were asked to answer questions following each. In the second part of the experiment, the children were tested to determine whether they understood the ten mental words (see Appendix B).

Twelve out of 72 children's parents observed the experiment. The parents were told that they could only observe the experiment and should not provide any hint to the answers; however, they were allowed to provide clarification for their children's answers if their pronunciation of certain words were not clear.

The False Belief and Intention Understanding

The movie, which was designed for examining the false belief and intention, was shown in order during scene one through four. The experimental procedures are presented in Table 3.2.

Mental Word Assessment

The second part of the experiment was composed of the mental word assessment. Children were tested to determine whether they understood ten mental words: *real, pretend, imagine, dream, try, decide, want, believe, think and know* (see Appendix B). The child was first asked directly if he or she knew the word. For example, for the word *real*, he or she was asked "Do you know the word *real*?" "What does *real* mean?" Besides the direct questions, the child was also tested to determine whether he or she understood the word in a context. For example, for the word *real*, the child would be shown an apple eraser and asked if it was a real apple. Most of the direct questions were asked before the context questions and only two (for the word *try* and *want*) were asked after. The reason that some direct questions were asked after the context questions was to avoid providing any hints for the context questions.

Table 3.2

Experimental Procedures for Animated Movie

Scene	Verbal Explanations
1. False belief session	While the movie was shown, the experimenter explained, "One day, Baby Bear is having a picnic with his mom in the forest. After they eat for a while, Mommy Bear feels thirsty. She needs to get some water. This is what she does before she leaves. And this is what happens after she leaves." Then the child was shown the rest of Scene One. After viewing the movie, the child was asked the following questions: 1. Where did Mommy Bear put the apple before she left to get the water? 2. Where is the apple now? 3. Where will Mommy Bear first look for the apple when she returns? Why? Question One through Three are false belief questions.
2. Intention training session	The child was told: "In this second movie, I am going to show you a little trick that Baby Bear can play. Do you see this long black bar on the key board? This is a space bar. Look what happens as soon as I press the space bar." The experimenter then demonstrated how to press the space bar and pointed at the screen in order to draw the child's attention to what happened Baby Bear. Then, the experimenter asked the child to try it by her- or himself. The child was asked to press the space bar twice so that they would be familiar with how to press the space bar. After successfully pressing the space bar, the child was also told, "See, this is how you can help Baby Bear hide."
3. Familiarity intention session	While the movie was being shown, the experimenter said, "Let's watch another story. This is Baby Bear having a picnic with his mother again. While they are having their meal, the Baby Bear's friend comes and invites Baby Bear to play with him. But Mommy Bear says, 'No, no. You have to finish your meal first.' Baby Bear is thinking very hard (as indicated by a blinking question mark above baby bear's head). 'Hmmm, What can I do?' While he is thinking, his mother falls asleep. And this is what Baby Bear did: He hides behind the tree branches and walks a few steps toward his friend. After a while, Mommy Bear wakes up. Baby Bear freezes when his mom wakes up. She can't find her son and says, 'Where is Baby Bear? Where is Baby Bear?' And she goes to look for him. This is what happens later (after Mommy Bear walks out of the scene, Baby Bear runs toward his friend). After viewing the story, the child was asked: "Do you understand the story?"

Scene	Verbal Explanations
4. Intention experiment session	Before the movie was shown, the child was told, "I am going to show you the same story again. But this time, while the movie is shown, I am going to ask you some questions." When the question mark blinked repeatedly above Baby Bear's head, the movie paused and the child was asked: 4. What is Baby Bear thinking now? 5. What can Baby Bear do now? Can you help? The child was given one minute to respond to Question five. If the child pressed the space bar, Baby Bear turned himself into a "tree" and escaped to play with his friend. If the child failed to press the space bar within one minute, the experimenter would press the space bar and show how Baby Bear could turn himself into a "tree." The experimenter recorded how many seconds it took for each child to respond. If the child puzzled when the question mark blinked, the experimenter would prompt, "Do you remember the trick that Baby Bear can do? Can you do anything to help him?" After Baby Bear changed himself into a "tree" and took a few steps toward his friend, the experimenter clicked the pause button so that the screen would be frozen. The experimenter then pointed at the "tree" and asked, 6. Why does Baby Bear do this? 7. Where is Baby Bear now? 8. What do you think this is? Is this a tree or a bear? Did Baby Bear become a tree? For Question eight if the child answered that the Baby Bear did become a tree, the experimenter would then ask, "Why can the tree walk?" Question Four through Six were intention questions. Question Seven through Eight were appearance-reality distinction questions. After the child answered the above questions, at the scene that Mommy Bear woke up and began to look for Baby Bear, the experimenter clicked the pause button, and the scene would again freeze. Then the experimenter pointed at the "tree" and asked the following questions: 9. What does Mommy Bear think this is? Why? 10. Does Mommy Bear know where Baby Bear is now? Why? Questions nine through ten were the new false belief questions generated from the current story. After each of these questions was asked, the experimenter continued the movie, and the little bear ran toward his friend to join him to play ball. At this point, the first part of the experiment ended.

After the child answered all of the questions, he or she was rewarded with a gift, such as an eraser pencil or a small toy.

Scoring

Mental words reported by parents were added up to obtain the total mental words reported by parents. This measure is referred to as total word by parent (WORD-PARENT).

For the questions that were asked followed each session of the animated movie, the first two questions served as the control questions for the traditional false belief task.

1. Where did Mommy Bear put the apple before she went to get the water?

2. Where is the apple now?

If children failed to answer these two questions correctly, they were scored 0 in the traditional false belief task.

The third question was the traditional false belief question (referred to as FALSE BELIEF-TRADITION).

3. Where will Mommy Bear first look for the apple when she returns? Why?

Children who responded with proper explanation that Mommy Bear would look in the basket, where she had left the apple before she left the scene were scored one point for this question. All others were scored a zero.

For the first intention question,

4. What is Baby Bear thinking now? (INTENTION-THINK)

If the child's answer was close to "He is thinking about how to play with his friend," "He is thinking how to hide," or "He doesn't want to eat his meal," he or she was scored one point. Children who provided unrelated answers, such as "He likes trees," or "I don't know," were scored a zero.

For the second intention question,

5. What can Baby Bear do now? Can you help (INTENTION-ACTION)?

If children pressed the space bar within one minute, theyscored one point. In addition, the experimenter recorded the number of seconds that passed before the child pressed the space bar, which is referred to as INTENTION-SECOND.

For the third intention question,

6. Why does Baby Bear do this? (INTENTION-WHY)

A child was given a score of one point for an answer that was close to "He wants to play ball with his friend," "He wants to hide from his mom," or "He doesn't want to finish his meal." If the child provided an unrelated answer, or answered "I don't know," he or she was scored a zero.

For the control question of the current false belief task,

7. Where is Baby Bear now?

Children who answered that Baby Bear was behind the tree or that he was hiding behind the tree were scored one point; otherwise they were given a zero.

For the appearance-reality distinction question,

8. What do you think this is? Is this a tree or a bear? Did Baby Bear become a tree? (APPEARANCE-REALITY)

Children who recognized that it was just Baby Bear disguised as a tree received one point. Otherwise, they were scored a zero.

For the first question of the current false belief task,

9. What does Mommy Bear think this is? Why? (FALSEBELIEF-CURRENT1)

If the child answered that Mommy Bear thought this was a tree, because she did not know Baby Bear was hiding inside, or if the child answered that Mommy Bear thought this was a tree, because it was green or it looked like a tree, they were scored one point. If they answered that Mommy Bear thought it was a tree because Baby Bear was hiding in itor "I don't know ," or other unrelated responses, they were scored a zero.

For the second question of the current false belief task

10. Does Mommy Bear know where Baby Bear is now? Why? (FALSEBELIEF-CURRENT2)

Children whose answer was similar to, "No, because she was sleeping," or "No, she didn't see baby bear was hiding behind the tree," were scored one point. If they answered, "Yes, baby bear is hiding inside the tree." or "I don't know," they were scored a zero.

To obtain a sub-total score for false-belief tasks, a child's scores on Question three, nine and ten were added up. This score is referred to as the "FALSEBELIEF-TOTAL." To obtain a sub-total score for the intention task, children's scores on Question four and six were added up. This score is referred to as the "INTENTION-TOTAL." The total score of naïve psychology is obtained by adding up the "FALSEBELIEF-TOTAL," "INTENTION-TOTAL" and "APPEARANCE-REALITY" and it is referred to as the "NPSYCHOLOGY-TOTAL."

For the mental word assessment, the children's self-report (direct assessment) and answers on the contextual questions were scored separately.

If a child could provide a meaningful explanation, such as a phrase or a sentence with the target word, they were scored one point for the target word. For example, when asked to define "what does dream mean?" if the child answered, "You will dream when you sleep," or "I dream my daddy play with me," they were scored one point. In addition, if children had already used the words *want*, *think, know, try* etc, when they answered the questions for either the false belief, the intention tasks, or the contextual questions for the mental words, they were also given one point on each of these words. If they provided unrelated answers or said that they did not know, they received a zero. The sum of the total words for which the children could provide an appropriate explanation, or use to make a phrase, or utter when answering the test questions would be the total mental words from self-report. This measure is referred to as "WORD-DIRECT."

The scoring of the contextual questions for mental word is listed in T able 3.3. Each child's total points were accumulated to determine his or her measure of "WORD-CONTEXT."

Besides the self-report (direct assessment) and the context score, four combined scores were derived from each mental word. The four types of combined scores are generated as follows: 1. DIRECT1-CONTEXT1: if the child scored one on both self-report and context question. 2. DIRECT1-CONTEXT0: if the child scored one on self-report but zero on the context question. 3. DIRECT0-CONTEXT1: if the child scored zero on the self-report but one on the context question. 4. DIRECT0-CONTEXT0: if the child scored both a zero on the self-report and the context question. The generation of

Table 3.3

Scoring of the Contextual Questions

Word	Question	Answer and Score
1. real	(An apple eraser was presented) What's this? Is this real? Why?	If the child answered that it was an apple, but not real, or that it was an eraser, but it was not a real apple. In addition, they provided a reason such as it was an eraser, or it could not be eaten or it was too small, he or she was scored one point. If the child answered it was real or "I don't know," he or she was scored a zero.
2.pretend	(A real apple was presented) What's this? Is this a pretend apple? Why?	If the child answered, "No, it is real," or "It is not pretend," and provided a reason such as "It was big," " You could eat it," or "It had stem," etc, he or she was scored one point. If the child answer ed "Yes, it is a pretend one," or "I don't know," he or she was scored a zero.
3. imagine	(An apple with stickers on top was presented) Can you see the stickers on top of the apple? Imagine you are an ant, standing at the bottom of the apple, can you still see the stickers on top of the apple? Why?	If the child answered "no" and provided a reason such as "Because you are too little," or "The apple is too big," he or she was scored one point. If the child answered "yes" and provided a reason such as "Because I can see it," "Because they are there," or "I don't know," he or she was scored a zero.
4. dream	(Two cartoon pictures were presented: one depicted a sleeping child who was dreaming of a monster; the other depicted a child who was sitting at a table and thinking of a cake.) Could you tell me which	If the child pointed at the picture depicting a child thinking about a cake for the first question, and answered, "Because he wants a cake," or "Because he likes a cake" and pointed at the child dreaming about a monster for the third question, and answered, "Because he is sleeping," or "This is a monster," he or she was scored one

Word	Question	Answer and Score
	child is thinking something real? Why? Which child is dreaming? Why?	point. If he or she pointed at the wrong picture or said, "I don't know," he or she was scored a zero.
5. try	(A doll who was trying to jump over a bar three times was presented) This is Kathy. Watch what she does. Can you tell me what she is doing?	If the child answered, "She is trying to jump over this," or "She is jumping," he or she was scored one point. Children who provided unrelated answers, such as "She likes to run," or "I don't know," were scored a zero.
6. decide	(Kathy the doll was presented a second time) Kathy needs to change her dress. And Kathy decides that she will wear the same color as her sister today. If her sister wears yellow, what color will Kathy wear? Why?	If the child answered "yellow" and provided reasons such as "Because her sister wears yellow," "She wants to be the same as her sister," or "She wants to copy her sister," he or she was scored one point. Those who answered other colors and provided incorrect reasons, such as, "Because she likes to wear (the wrong color)," were scored a zero.
7. want	(A coloring picture and crayons were presented) Kathy is in the classroom now and these are the things thatshe picked for free play. Could you tell me why she picked these things?	A child who answered, "To color," "Because she wants to color," or "She wants to draw," was scored one point. Those who answered, "Because she likes these," or "I don't know," were scored a zero.
8. believe	(The Kathy doll and a stuffed dogwere presented) The child was shown the dog and asked, "What's this? Kathy said this is a duckling. Do you believe in her? Why?"	A child who provided reasonable explanations of why he or she believed Kathy's claim, such as "Yes, because I like Kathy," or "No, because it is not a ducking. It is a dog," was given one point. Children who provided conflict answer, such as, "Yes, because it is a dog, not a duckling," or "I don't know," were scored a zero.

Word	Question	Answer and Score
9. think	(The numbers one through five were presented, and children were asked to read them aloud. Then only number three was presented) Kathy said this is the number one, do you think she is right? Why?	Children who answered, "No, because it is number three," were scored one point. A child who answered, "Yes," or "I don't know," was scored a zero.
10. know	(Two groups of strawberries were presented. In one group, there were two strawberries, while in another group, there are three strawberries) Please help Kathy pick the group that has more strawberries. How do you know you are right?	Children whose selected the group with three strawberries, and explained that they had done so because it had three whereas the other only had two, were scored one point. If the child failed to adequately explain why he or she had selected the group with three or selected the group with two strawberries, he or she was given a zero.

these four types of combined scores was for the purpose of detecting the extent to which each child's answers on self-report was consistent with his or her answer to the context questions. All four combined scores were computed for each child across ten mental words.

CHAPTER 4

DATA ANALYSIS AND RESULTS

Descriptive Analysis

Children's performance on the false belief, intention and appearance-reality questions is summarized in the following frequency and percentage tables. In Table 4.1, the percentage of children who obtained the scores is based on the total number of subjects included in the study. In Table 4.2, the percentage of children who answered the questions correctly is calculated against the number of children in each age group.

Table 4.1

The Frequency and the Percentage of Children Who Provided Correct Answers on the False Belief, Intention, and Appearance-Reality Questions

Question	Score 0		Score 1	
	Freq.(*1)	Pct.(*2)	Freq.	Pct.
False Belief –Tradition	45	62.5%	27	37.5%
False Belief – Current 1	44	61.1%	28	38.9%
False Belief – Current 2	13	18.1%	59	81.9%
Intention-Think	10	13.9%	62	86.1%
Intention- Why	13	18.1%	59	81.9%
Appearance-Reality	32	44.4%	40	55.6%

*1: Freq.: The frequency of children who made the corresponding responses.
*2: Pct.: The percentage of children who obtained the corresponding score based on the total number of subjects included in the analysis.

From these data, it seems that children had a higher chance of passing the intention questions than both the false belief and the appearance-reality questions. Moreover, the traditional false belief and the first false belief question in the current study seem to have been the most difficult tasks for the children.

Table 4.2

The Frequency and the Percentage of Children Who Provided Correct Answers on the False Belief, Intention, and Appearance-Reality Questions across Age Group

Questions	Age 1 N=14	Age 2 N=17	Age 3 N=28	Age 4 N=13
False Belief –Tradition	2 (*1) 14.3% (*2)	5 29.4%	15 53.6%	5 38.5%
False belief-Current 1	4 28.5%	7 41.2%	10 35.7%	7 53.9%
False Belief –Current 2	7 50%	14 82.4%	27 96.4%	11 84.6%
Intention-Think	12 85.7%	13 76.5%	26 92.8%	11 84.6%
Intention-Why	10 71.4%	13 76.5%	24 85.7%	12 92.3%
Appearance –Reality	7 50%	8 47.1%	17 60.7%	8 61.5%

*1: The frequency of children who obtained the correct score.
*2: The percentage of children who obtained the correct score based on the number of children in the age group.

First, looking solely at the first three age groups, the percentage of children who passed the traditional false belief question (FALSEBELIEF-TRADITION), the second

false belief question in the current study (FALSEBELIEF-CURRENT2), and the second intention question (INTENTION-WHY)increased as the age of children gets older. This development trend was not obvious for the rest of the questions, However, an interesting fact was that the five-year-olds' passing rates on the traditional false belief question (FALSEBELIEF-TRADITION), the second false belief question in the current study (FALSEBELIEF-CURRENT2), and the first intention question (INTENTION-THINK) were lower than that of the four and half-year-olds. The passing rate was close across four age groups on the appearance-reality distinction question.

Samples of children's responses on the false belief, intention and appearance-reality questions are given in Table 4.3.

The frequency and the percentage of the mental words that children can understand assessed by the three different methods are presented in Table 4.4.

From this table, it seems that *imagine, decide* and *believe* are relatively difficult words to understand for children at the preschool age. In addition, the words *real, dream, want, think* and *know* were more consistently understood across the three assessment methods than were the words *pretend, imagine, try, decide* and *believe*.

The frequency of mental words that children understand across gender (boy vs. girl) is presented in Table 4.5.

Table 4.3

Sample Responses for False Belief, Intention, and Appearance-Reality Questions

Questions	Score 0	Score 1
Where will Mommy bear look for the apple when she returns? Why?	-I don't know -In the Bucket. Because the baby put the apple here. -In the bucket. The baby bear took it. -In the bucket. Because she is hungry. Because she likes apple. -In the bucket. Because she wants to eat the apple. -In the bucket. Because the apples are there. -In the bushes. -In the forest.	-In the basket. -Because Mommy bear put the apple here. - Because she wants to go and get it in her basket. -She doesn't know the apples are here (in the bucket). -Because she thought it was there. -Because she wants to find her apple.
What is Baby bear thinking ?	-I don't know. -Apple. A ball. The apples. Tree.	-When his mother is sleeping, he is going to get the tree and then he is going to tiptoeing and then his mom is going to look for him. -To put his mama to sleep and then he hide behind the tree. -He is thinking his friend. -He is going to hide. His mother is going to look for him and he is gonna go to other bear and play. -Put the tree and play with his friend. -He wants to play -To hide. He wants to play ball with him.
Why does Baby bear do this?	-I don't know -Because he wants to eat the apple. -Because he wants to. His mom is sleeping.	-Because he wanted to hide. Mama bear is sleeping. -Because he likes to hide in the tree. But his mom doesn't' want. -Because he doesn't want his mom to

Questions	Score 0	Score 1
	He wants to go out to that forest. -He doesn't want his mom play it. -Because he likes hide and seek.	see him. -Because he want to hide from his mommy. His mommy can't find him and he can go. -Mama bear try to find him. -Because he wants to play with his friend. -Because he likes to play ball.
What do you think this is? Is this a tree or a bear? Did the bear become a tree?	-I don't know. -A tree. A tree. The baby bear is a tree. -A tree. A tree. He became a tree. -A tree. Because mama bear is looking for him. -The leaves of a tree. It is a tree. Yeah, baby bear is hiding inside. -A tree. A tree. Yes, because he disappear and then he is coming out. -A Christmas tree. A tree. Yeah. He doesn't want his mommy to find him.	-A tree. No. Because he hides inside the tree. -A tree. No. Because he wants to hide from his mom. -A tree. A bear in a tree. No (the bear did not become a tree). -A tree. Baby bear wants to hide behind it. It is a bear. No (the bear did not become a tree). -A tree. No. Because he is hiding from mama bear. -Leaves. A bear. No. He is just inside it. -A tree. A tree. No. Because he is going to come out.
What does Mommy bear think this is? Why?	-I don't know -A tree. Because he is hiding. -A tree. Because she thinks baby bear is up in the sun. -A tree. Because she thinks her baby is hiding in there. -A bear. I think the bear is hiding in the tree. -A tree or bush. She thinks he is in there.	-A tree. Because it is not moving. -A tree. Because she sees it like a tree. -A tree. Because it is green. -A tree. Because it has leaves and trunks. -Tree. Because baby bear has magic. -Tree. Because it is. -A tree. Because it is standing up like this. -A tree. Because she didn't know baby bear is hiding under it. -A tree. She doesn't know anything. She doesn't know this is her son.

Questions	Score 0	Score 1
	-Baby bear. Because he is hiding.	-A tree. Because she looks for baby bear. -A tree. Because she wants to find the baby bear. -A tree. Because she didn't see the baby bear hiding there. -A tree. Because she just sleep. She didn't see. -A tree. Because she didn't know this was the baby. -A tree. 'Cause she didn't look there. She looked everywhere.
Does she know where Baby bear is now? Why?	-Yes, he is hiding in the tree. -She knows the baby bear is here, inside the tree.	-No, she thinks he is in the forest. -Inside the tree. Because she doesn't know. Because he is hiding. -No. She didn't know he made the tree. She looked for everywhere. -No. Because he is hiding behind there (the tree). -No. Because she don't know where he is. -No. Because he is gone. -No. Because she cannot find baby bear. - No. Mama bear is sleepShe don't know he get up and she don't know how to find the baby bear. -No. Because she fell into sleep. -No. I believe she don't know that. -No. Because she is not looking inside there.

Table 4.4

The Frequency and the Percentage of the Mental Words Assessed by the Three Methods

Word	Parent report		Self-report		Context	
	Freq.*	Percent %	Freq.	Percent %	Freq.	Percent %
Real	52	72.2	53	73.6	64	88.9
Pretend	46	63.9	44	61.1	60	83.3
Imagine	16	22.2	16	22.2	45	62.5
Dream	52	72.2	49	68.1	62	86.1
Try	55	76.4	53	73.6	67	93.1
Decide	23	31.9	26	36.1	50	69.4
Want	71	98.6	69	95.8	57	79.2
Believe	19	26.4	20	27.8	58	80.6
Think	64	88.9	57	79.2	68	94.4
Know	65	90.3	72	100	69	95.8

* Freq.: Frequency across the 72 subjects.

Table 4.5

The Frequency of Mental Word Understanding across the Three Methods and Gender

Word	Parent report		Self-report		Context	
	Boy	Girl	Boy	Girl	Boy	Girl
Real	25	27	23	30	30	34
Pretend	17	29	20	24	26	34
Imagine	6	10	8	8	23	22
Dream	21	31	21	28	29	33
Try	24	31	24	29	32	35
Decide	10	13	13	13	26	24
Want	34	37	33	36	24	33
Believe	7	12	9	11	28	30
Think	30	34	26	31	33	35
Know	31	34	34	38	32	37

The difference between genders in the mental word understanding is obvious only in the parent report, especially for the words *pretend, dream* and *try*. However, in the self-report and the context assessment, the frequency of the mental words that the children understand is almost the same among both boys and girls.

The frequency of the mental words that children understood across languages (English vs. non-English as the primary language) is presented in Table 4.6.

Table 4.6

The Frequency of Mental Word Understanding across the Primary Language

Word	Parent report		Self-report		Context	
	English	Non-English	English	Non-English	English	Non-English
Real	29	23	31	22	33	31
Pretend	27	19	25	19	32	28
Imagine	9	7	10	6	22	23
Dream	32	20	30	19	29	33
Try	33	22	31	22	36	31
Decide	13	10	16	10	25	25
Want	37	34	36	33	33	24
Believe	12	7	15	5	28	30
Think	34	30	32	25	35	33
Know	33	32	37	35	36	33

When comparing the frequency of processed mental words between children who speak English as their primary language and children who speak another language as their primary language, it seems that the difference lies in the parent report and the self-

report assessment. For the words *real, pretend, dream, try*, and *believe,* it seems that more children who speak English as their primary language understood these words than did children who speak another language as their primary language. In the context assessment, only the word *want* seems to favor the children who speak English as their primary language.

Chi-Square Tests

Chi-square tests were applied for the relationship between FALSEBELIEF-TRADITION, FALSEBELIEF-CURRENT1, FALSEBELIEF-CURRENT2, INTENTION-ACTION, INTENTION-THINK, INTENTION-WHY and APPEARANCE-REALITY with AGE-GROUP and SEX. Among these tests, the test for FALSEBELIEF-CURRENT2 with AGEGROUP wa s significant, Chi-square value (3, 72)=13.69, p=.003. In addition, the test for INTENTION-THINK with SEX was also significant, Chi-square value (1, 72)=5.01, p=.025. (See Tables 4.7, 4.8, and 4.9)

The test results indicated that children's performance on the second false belief question in the current study was related to their age and that their performance on the second intention question was related to sex.

Table 4.7

The Chi-square Test and Results

Analyses	Result
FALSEBELIEF-TRADITION x AGE	Non-significant
FALSEBELIEF-CURRENT1 x AGE	Non-significant
FALSEBELIEF-CURRENT2 x AGE	**Significant**
INTENTION-ACTION x AGE	Non-significant
INTENTION-THINK x AGE	Non-significant
INTENTION-WHY x AGE	Non-significant
APPEARANCE-REALITY x AGE	Non-significant
FALSEBELIEF-TRADITION x SEX	Non-significant
FALSEBELIEF-CURRENT1 x SEX	Non-significant
FALSEBELIEF-CURRENT2 x SEX	Non-significant
INTENTION-ACTION x SEX	Non-significant
INTENTION-THINK x SEX	**Significant**
INTENTION-WHY x SEX	Non-significant
APPEARANCE-REALITY x SEX	Non-significant

Table 4.8

Observed Frequencies Table for FALSEBELIEF-CURRENT2 X AGE-GROUP

Score	Age in Group				Total
	1	2	3	4	
0	7	3	1	2	13
1	7	14	27	11	59
Total	14	17	28	13	72

Table 4.9

Observed Frequencies Table for INTENTION-THINK X SEX

Score	Age in Group		Total
	Boy	Girl	
0	8	2	10
1	26	36	62
Total	34	38	72

ANOVA

The first set of ANOVA was run for the dependent measures INTENTION-SECOND, FALSEBELIEF-TOTAL, INTENTION-TOTAL and NAÏVE TOTAL, with AGE-GROUP and SEX as independent variables. The overall ANOVAs indicated that the main effect of AGE-GROUP was significant for FALSEBELIEF-TOTAL, F (3, 64)=4.757, p=.005, and NAÏVE-TOTAL, F(3, 64)=4.024, p=.011. The main effect of SEX was significant for INTENTION-TOTAL, F (1, 64)=7.427, p=.008.

Following the overall results obtained from ANOVA, the multiple comparison procedure with Tukey's honest significant difference (HSD) tests and simple contrast, were applied to identify the significant source. For the dependent measure FALSEBELIEF-TOTAL, the results of the Tukey test indicated that the mean for children aged from four and a half to five (age group three, mean=1.86) was significantly greater than the mean for children aged from three and a half to four (age group one, mean=.93), mean difference=.93, p=.005. In addition, for the same dependent measure, the mean for children aged from five to five and a half (age group four, mean=1.77) was

higher than the mean for children aged from three and a half to four (age group one, mean=.93), mean difference=.84, p=.047. For the dependent measure INTENTION-TOTAL, the simple contrast procedure revealed that the mean for girls (mean=1.84) was significantly greater than that for boys (mean=1.50), mean difference=.34, p=.008. For the dependent measure NPSYCHOLOGY-TOTAL, the results of Tukey test indicated that the mean for children aged from four and a half to five (age group three, mean=4.25) was higher than the mean for children aged from three and a half to four (age group one, mean=3.00), mean difference=1.25, p=.029.

The summary of the first set of ANOVAs is presented in Table 4.10. The means for the dependent measures with AGE-GROUP and SEX are presented in Table 4.11, Table 4.12, and Table 4.13.

Table 4.10

Summary of the First Set of ANOVA

Analysis	Significant Effect	Contrast Result
Intention-second x Age x Sex	None	
Falsebelief-total x Age x Sex	Age	Age 3 > Age 1, Age 4 > Age1
Intention-total x Age x Sex	Sex	Girls > Boys
Npsychology-total x Age x Sex	Age	Age 3 > Age 1

A second series of two-way ANOVAs was applied to the total mental words understood by children and obtained through three types of assessment methods. In this series of analyses, the dependent variables were WORD-PARENT, WORD-DIRECT, WORD-CONTEXT, and the four combined scores for the mental words:

Table 4.11

Mean Table: Independent Measure AGE-GROUP, Dependent Measure FALSEBELIEF-TOTAL

AGE-GROUP	Mean	N	Std. Deviation
3 ½ - 4	0.93	14	0.829
Beyond 4- 4 ½	1.53	17	0.874
Beyond 4 ½ - 5	1.86	28	0.756
Beyond 5 – 5 ½	1.77	13	0.832
Total	1.58	72	0.868

Table 4.12

Mean Table: Independent Measure SEX, Dependent Measure INTENTION-TOTAL

SEX	Mean	N	Std. Deviation
Male	1.50	34	0.663
Female	1.84	38	0.370
Total	1.68	72	0.552

Table 4.13

Mean Table: Independent Measure AGE, Dependent Measure NPSYCHOLOGY-TOTAL

AGE	Mean	N	Std. Deviation
3 ½ - 4	3.00	14	1.301
Beyond 4- 4 ½	3.53	17	1.375
Beyond 4 ½ - 5	4.25	28	1.323
Beyond 5 – 5 ½	4.15	13	1.405
Total	3.82	72	1.407

DIRECT1CONTEXT1, DIRECE1CONTEXT0, DIRECT0CONTEXT1 and DIRECT0CONTEXT0; the independent variables were AGE-GROUP and FIRST-LANGUAGE. The main effect of AGE-GROUP was significant for WORD-DIRECT, $F(3, 64) = 4.055$, $p = .011$; for WORD-CONTEXT, $F(3, 64) = 5.056$, $p = .003$; for DIRECT1CONTEXT1, $F(3, 64) = 4.656$, $p = .005$; for DIRECT0CONTEXT0, $F(3, 64) = 7.092$, $p < .000$. The main effect of FIRST-LANGUAGE was significant for WORD-DIRECT, $F(1, 64) = 7.883$, $p = 0.007$; for DIRECT1CONTEXT1, $F(1, 64) = 4.695$, $p = 0.034$; and for DIRECT0CONTEXT1, $F(1, 64) = 7.440$, $p = 0.008$.

Based on these overall ANOVAs, the multiple comparison procedure with Tukey's honest significant difference (HSD) tests and simple contrasts, was applied to identify the groups that significantly differ from each other. For the dependent measure, WORD-DIRECT, the results of Tukey test indicated that the mean for children aged from four and a half to five (age group three, mean=7.179) was significantly greater than the mean for children aged from three and a half to four (age group one, mean=5.143), mean difference=2.036, p=.008, and for children aged from four to four and a half (age group two, mean=5.647), mean difference=1.532, p=.048. In addition, for the same dependent measure, the simple contrast procedure indicated that the mean for children whose first language is English (mean=7.108) was significantly greater than that for children whose first language is not English (mean=5.600), mean difference=.1.508, p=.007For the dependent measure, WORD-CONTEXT, the results of Tukey test indicated that the mean for children aged from four and a half to five (age group three, mean=8.964) was

significantly greater than the mean for children aged from three and a half to four (age group one, mean=7.429), mean difference=1.535, p=.019. For the combined score DIRECT1CONTEXT1, the results of Tukey test indicated that the mean for children aged from four and a half to five (age group three, mean=6.64) was si gnificantly greater than the mean for children aged from three and a half to four (age group one, mean=4.29), mean difference=2.35, p=.003. In addition, for the same dependent measure, the simple contrast procedure showed that the mean for children whose first language is English (mean=6.32) was significantly greater than that for children whose first language is not English (mean=5.03), mean difference=.1.29, p=.034. For dependent measure, DIRECT0CONTEXT1, the simple contrast procedure revealed that the mean for children whose first language is English (mean=3.29) was significantly greater than that for children whose first language is not English (mean=2.03), mean difference=.1.26, p=.008. For the dependent measure DIRECT0CONTEXT0, children in age group one (mean=1.71) had a greater mean score than children in age group three (mean=.50) and age group four (mean=.38), with p=.012 and p=.022, respectively. Children in age group two (mean=1.65) also had a greater mean score than children in age group three and four as well, with p=.011 and p=.024. The summary of the second series of ANOVA is presented in Table 4.14. The means for the dependent measures in terms of AGE-GROUP and FIRST–LANGUAGE are listed in Table 4.15 – Table 4.21.

Table 4.14

Summary of the Second Set of ANOVA

Analysis	Significant Effects	Contrast Result
Word-parent x Age x Language	None	
Word-direct x Age x Language	Age, Language	Age: Age 3> Age 1, Age 3> Age2 Language: English > Non-English
Word-context x Age x Language	Age	Age 3 > Age 1
Direct1context1 x Age x Language	Age, Language	Age: Age 3 > Age1 Language: English > Non-English
Direct1context0 x Age x Language	None	
Direct0context1 x Age x Language	Language	English > Non-English
Direct0context0 x Age x Language	Age	Age 1> Age3, Age1 > Age 4, Age 2> Age3, Age 2 > Age 4

Table 4.15

Mean Table: Independent Measure: AGE-GROUP, Dependent Measure:

WORD-DIRECT

AGE-GROUP	Mean	N	Std. Deviation
3 ½ - 4	5.143	14	2.143
Beyond 4- 4 ½	5.647	17	1.902
Beyond 4 ½ - 5	7.179	28	2.038
Beyond 5 – 5 ½	6.923	13	2.060
Total	6.375	72	2.165

Table 4.16

Mean Table: Independent Measure: AGE-GROUP, Dependent Measure: WORD-CONTEXT

AGE-GROUP	Mean	N	Std. Deviation
3 ½ - 4	7.429	14	2.209
Beyond 4- 4 ½	7.765	17	1.751
Beyond 4 ½ - 5	8.964	28	1.232
Beyond 5 – 5 ½	8.692	13	1.377
Total	8.333	72	1.703

Table 4.17

Mean Table: Independent Measure: AGE-GROUP, Dependent Measure: DIRECT1CONTEXT1

AGE-GROUP	Mean	N	Std. Deviation
3 ½ - 4	4.29	14	2.164
Beyond 4- 4 ½	5.06	17	2.164
Beyond 4 ½ - 5	6.64	28	2.215
Beyond 5 – 5 ½	6.00	13	1.732
Total	5.69	72	2.268

Table 4.18

Mean Table: Independent Measure: AGE-GROUP, Dependent Measure: DIRECT0CONTEXT0

AGE-GROUP	Mean	N	Std. Deviation
3 ½ - 4 (group 1)	1.71	14	1.816
Beyond 4- 4 ½	1.65	17	1.367
Beyond 4 ½ - 5	0.50	28	0.882
Beyond 5 – 5 ½	0.38	13	0.650
Total	0.99	72	1.327

Table 4.19

Mean Table: Independent Measure: FIRST-LANGUAGE, DependentM easure: WORD-DIRECT

FIRST-LANGUAGE	Mean	N	Std. Deviation
English	7.108	37	1.712
Non-English	5.600	35	2.341
Total	6.375	72	2.165

Table 4.20

Mean Table: Independent Measure: FIRST-LANGUAGE, DependentM easure: DIRECT1CONTEXT1

FIRST-LANGUAGE	Mean	N	Std. Deviation
English	6.32	37	1.973
Non-English	5.03	35	2.395
Total	5.69	72	2.268

Table: 4.21

Mean Table: Independent Measure: FIRST-LANGUAGE, DependentM easure: DIRECT0CONTEXT1

FIRST-LANGUAGE	Mean	N	Std. Deviation
English	2.03	37	1.607
Non-English	3.29	35	1.903
Total	2.64	72	1.856

Regression

In order to investigate the relationship between the children's understanding of naïve psychology and some influential factors such as age, sex and mental words possessed by children, a regression analysis was conducted. In the regression analysis, NPSYCHOLOGY-TOTAL was dependent variable, with age in months , sex and mental words assessed in three methods as predictors. The stepwise procedure yielded a model with WORD-CONTEXT and WORD-DIRECT as significant predictors. The correlation matrix of the dependent variable, NPSYCHOLOGY-TOTAL, with the independent variables, WORD-PARENT, WORD-DIRECT, WORD-CONTEXT, AGEINMONTH and SEX, is presented in Table 4.22., and the R square change statistic is presented in Table 4.23.

Table 4.22

Pearson Correlation of the Dependent and the Independent Variables in the Regression Analysis (N=72)

Pearson correlation and Significant level (one-tailed)	NPSY CHOLOGY -TOTAL	AGEIN MONTH	SEX	WORD-PARNT	WORD-DIRECT	WORD-CONTEXT
NPSYCHOLOGY-TOTAL	1.000	.314	.117	.129	.378	.490
		(.004)	(.165)	(.140)	(.001)	(.000)
AGEINMOM		1.000	-.137	.135	.304	.315
			(.125)	(.128)	(.005)	(.004)
SEX			1.000	.167	.074	.005
				(.081)	(.267)	(.482)
WORD-PARENT				1.000	.378	.240
					(.001)	(.021)
WORD-DIRECT					1.000	.351
						(.001)
WORD-CONTEXT						1.000

Table 4.23

Change Statistic of Stepwise Regression for NPSYCHOLOGY-TOTAL Predicted by AGEINMONTH, SEX, WORD-PARENT, WORD-DIRECT, and WORD-CONTEXT

Variable	R Square	R Square Change	F Change	Sig. of F Change
Step 1: WORD-CONTEXT	.240	.240	22.066	.000
Step 2: WORD-CONTEXT & WORD-DIRECT	.288	.049	4.711	.033

Among the three methods, the self-report and contextual assessment had a high correlation with the total score of naïve psychology and the correlations were statistically significant. However, the correlation between parent report and naïve psychology was low and the correlation was not significant. In general, the regression results indicated that the mental words assessed with the parental report was not a significant predictor of the total score of naïve psychology. However, the mental words obtained by self-report and the context questions were significant predictors.

Response Pattern for Theory of Mind Questions

To identify the response pattern for the theory of mind questions, i.e., FALSEBELIEF-TRADITION, FALSEBELIEF-CURRENT1, FALSEBELIEF-CURRENT2, INTENTION-THINK, INETNTION-WHY and APPEARANCE-REALITY, each child's response was compared to the hypothesized model of the six questions. The hypothesized order of the six questions, from the most difficult to the

easiest, is as follows: FALSEBELIEF-TRADITION→ FALSEBELIEF-CURRENT1→ FALSEBELIEF-CURRENT2 → INTENTION-THINK → INTENTION-WHY →APPEARANCE-REALITY. If a child answered the difficult question correctly, he or she would be expected to correctly answer the questions that were easier as well. For example, if a child passed the traditional false belief questions, he or she was expected to pass the rest of the questions. If he or she passed the first false belief question in the current study, he or she was expected to fail the traditional false belief question, but pass the questions after the first false belief question in the current study. If a child's response matched the hypothesized pattern, he or she was scored one point; otherwise, he or she was scored a zero. In addition, the items that failed to fit the hypothesized order were identified. Compared to the hypothesized pattern, there were 25 out of 72 (34.7%) children whose response pattern matched the hypothesized pattern. Based on the observed passing rate of the theory of mind questions, it seems that the appearance-reality distinction question lies between the false belief and the intention questions. Thus, a second order of the six theory of mind questions is hypothesized as follows (from the most difficult to the easiest): FALSEBELIEF-TRADITION→ FALSEBELIEF-CURRENT1→ FALSEBELIEF-CURRENT2 →APPEARANCE-REALITY → INTENTION-THINK → INTENTION-WHY. Compared to this second hypothesized order, there were 32 out of 72 children (44.4%) whose response pattern matched the hypothesized pattern. The frequency of the questions that did not fit the hypothesized pattern is presented in Table 4.24.

Table 4.24

Frequency of the Questions That Did Not Fit the Hypothesized Difficulty Order of the Six Theory of Mind Questions

	FALSE BELIEF-CURRENT1	FALSE BELIEF-CURRENT2	INTENTION-THINK	INTENTION-WHY	APPEARANCE-REALITY
Order 1	13	7	8	13	32
Order 2	12	5	7	14	24

Based on the passing rate, the observed difficult order of the six theory of mind questions (from the most difficult to the easiest) was FALSEBELIEF-TRADITION → FALSEBELIEF-CURRENT1 → APPEARANCE-REALITY → FALSEBELIEF-CURRENT2 → INTENTION-WHY → INTENTION-THINK. The Kendall's Tau-b correlation between the observed and the first hypothesized order is .333. This rank order correlation is p=.348 and it was not significant.

CHAPTER 5

DISCUSSION AND CONCLUSION

The focus of the current study was to investigate children's understanding of naïve psychology, the developmental trend associated with this construct and the relationship between naïve psychology and language, i.e., the understanding of mental words. In addition, a new task to study naïve psychology was applied and the appropriateness of the new task was evaluated.

First is the evaluation of the research tool. An animated movie was used to study naïve psychology for the first time. The content of the movie seemed age appropriate for three to five year olds. Most of the children enjoyed watching the movie and liked the character, a naughty little bear who wanted to skip the meal and play with his friend. With all the children tested (N=75), only three of them failed to answer all the questions designed for intention and false belief; the remaining 72 were successful in answering all the questions. The children's performance on the task, in which they were prompted to press the space bar to help the little bear to hide in the tree branches, was informative. Out of 72 children, 46 (63.9%) pressed the space bar within one minute. However, there was neither an age nor a sex difference in the likelihood they could successfully press the space bar. An interesting finding was that, although some children initially failed to press the space bar, when they were further prompted by the question, "Is there anything you can do to help the baby bear?" they were able to provide a appropriate answer, such as "To hide," "To run away from his mom," or "To cover with the leaves." Moreover, the

successful rate of pressing the space bar was much lower than the percentage of correct answers (N=62, 86.1%) that children provided for the intention question, “What is Baby Bear thinking?” The answers for these questions showed that children understood what the Baby Bear was thinking, but had difficulties using the space bar to express the understanding. Perhaps this action required thatthe children to shift the focus from the story to the actual setting in front of them, which was a demanding task for children who are still very egocentric at this age. Switching from the story to reality remained a challenging task for these preschoolers. In other words, while children may have the ability to comprehend other’s intentions, putting themselves in the position of others and activating the plan directed by the intention remained a difficult task for children at this age. In addition, for those children who had successfully pressed the space bar, the speed in which they did so did not differ significantly among the four age groups and the two gender groups. This implies that the speed in which this action was completed was not related to age or gender. Therefore, the children’s demonstration of understanding may be a more meaningful measure of intention for the research question than the speed in which they completed the action of pressing the space bar.

Second, there is the issue of children’s performance on the theory of mind tasks. For the traditional false belief task, 62 (86.1%) children passed the control question. The passing rate increased for the first three age groups, the percentages of which were 78.6%, 88.2%, 89.2% respectively, but decreased for the last age group, with 84.6% passing. For children who had passed the control question in the first three age groups, the percentage (based on the number of children in each age group) of children who passed

the test question increased as they got older (14.3%, 29.4%, 53.6% for the three age groups respectively). However, the passing rate dropped for the fourth group, which was 38.5%. The results of the Chi-square test indicated that the children's performance on the traditional false belief task was not related to either age or gender.

For the first false belief question based on the story in the current study, the Chi-square test indicated that the performance on this question was not related to age or gender. The percentage of children (based on the number of children in each age group) who answered the question correctly across the four age groups was 28.5%, 41.2%, 35.7% and 53.9%, respectively. However, for the second false belief question in the current study, the Chi-square test indicated that the children's performance was related to their age. The passing rate (based on the number of children in each age group) for the four age groups was 50%, 82.4%, 96.4% and 84.6%, respectively. The first false belief question asked, "What does Mommy Bear think this is?" when children were shown the Baby Bear changing himself into a "tree" and Mommy Bear looking for him. The second false belief question asked, "Does she (Mommy Bear) know where Baby Bear is now?" at the same scene. The passing rate of the first question was much lower than that of the second one, prompting the question, "Why did the children's performance on these questions differ?" It is possible that the difference was a result of the similarity between the first false belief question in the current study and the traditional false belief question. Children had to suppress the fact that they knew what was inside the "tree" and answered the question from Mommy Bear's perspective. For the second false belief question in the current study, children were asked directly if Mommy Bear knew what happened, which

was shown more clearly on the screen by Mommy Bear's looking and searching action. The transparency of Mommy Bear's behavior helped the children provide situation appropriate responses during the inferring process. Thus, children were more likely to come up with a correct answer for this question.

Although age and sex differences were not observed in all of the individual false belief questions, the three scores of the false belief questions combined together differed significantly across age groups. The result of ANOVA and the follow up Tukey test indicated that children aged from four and a half to five performed better than children aged from three and a half to four. In addition, children aged five to five and a half also performed better than those children aged from three and a half to four.

In response to the question, "Is age four the magical time for children to master the traditional false belief task?" the data from the current study showed that only 44.4% of the four-year-olds passed the traditional false belief question and 37.8% of the four-year-olds passed the first false belief question in the current study. If the test question is similar to the one in traditional false belief task, more than half of the four-year-olds had difficulty in predicting the character's belief correctly. The traditional false belief task was even challenging for five-year-olds (the passing rate was 38.5% and 53.8% for the traditional false belief and the first false belief question in the current study). Thus, the data from the current study do not support the claim that most of the four-year-olds have mastered the concept of false belief. When children who failed the traditional false belief question were asked why they thought Mommy Bear would look for the apple in the bucket (where Baby Bear had put the apple), most of them answered, "Because Baby

Bear put it there." However, when some of them were asked if Mommy Bear knew Baby Bear had moved the apple from the basket to the bucket, some of them answered, "No." Children's responses to the false belief question seemed to be in conflict with what they knew. This further suggests that children might understand the setting or what is going on in a false belief situation, but they lack the capability to infer the false belief of others by suppressing their own belief. The data obtained from the second false belief question in the current study provided evidence that reducing the difficulty level of the question facilitated the children's performance. Four- and five-years olds' passing rate on this question was 91.1% and 84.6% respectively.

For the appearance-reality question, the Chi-square test indicated that the children's performance did not differ across the four age groups. The passing rate (based on the number of children in each age group) was 50%, 47.1%, 60.7% and 61.5%, respectively. Gender was not related to performance either. This result implies that at preschool age, children's understanding of the difference between appearance and reality is almost the identical. The difficulty of the question may be due to the fact that after Baby Bear covered himself with leaves, he *did* look like a tree. When the question, "What do you think this is?" was asked, children naturally replied, "A tree." For this reason, following the first question, children were also asked, "Is this a tree or a bear? Did the bear become a tree?" However, some of the children failed to recognize that the "tree" was actually a bear. It seemed that children's receptive channel of information was quickly filled with the fact that was most currently available to them. Even when the

children had observed the disguising process, it was still difficult forthe children to ignore the disguised appearance and adhere to the biological essence of the character.

For the two intention questions derived from the animated movie, age was not a significant factor related to the performance on these questions. The percentage of the children who provided appropriate answers to the first intention question "What is baby bear thinking?" was 85.7%, 76.5%, 92.8% and 84.6% for the four age groups respectively, and to the second intention question "Why does baby bear do this?" was 71.4%, 76.5%, 85.7% and 92.3% respectively. However, for the first intention question, the Chi-square test indicated that the girls had higher scores than the boys. The results of the ANOVA on the combined scores of the two intention questions revealed the same pattern. The gender effect on theory of mind performance is controversial. Some studies with post-hoc gender comparison showed no significant advantage for girls or boys (Holmes, Black & Miller, 1996; Jenkins & Astington, 1996). However, some studies have suggested that gender is an important factor in the evaluation of children's understanding of theory of mind. Bosacki and Astington (1999) found that 11-year-old girls were better at assessing a story character's motives and feelings than were boys. Charman, Ruffman and Clements (2002) also reported a slight advantage for girls on false belief task performance with a post-hoc analysis of large datasets (1468 children in total) from two laboratories in London and Brighton. The result from the current study provided evidence for a gender effect on intention comprehension but not on false belief understanding. For the overall performance on theory of mind tasks, the ANOVA of the

current data revealed that age was related to performance. Children aged from four to four and a half performed better than children aged from three and a half to four.

Based on the data derived from the children's performance on the three theory of mind tasks, it is helpful to identity the developmental trend of the children's knowledge of naïve psychology. Before the study was conducted, it was expected that the children's understanding of the mental world would follow the line in which the order is from appearance-reality distinction to intention and then to false belief. The passing rate of the three tasks, however, revealed a different pattern. Instead of appearing at the lowest end of the line, the appearance-reality distinction shifted to the middle among these three concepts. The analysis comparing the hypothesized and the observed model also revealed that the middle position of the appearance-reality item provided a better fit with the current data, as indicated by the matching rate increase from 34.7% to 44.4%. Some researchers (Wellman & Liu, 2004) have exerted effort to provide a developmental scale for naïve psychology or theory of mind measurement. They believe that developing a theory of mind includes understanding multiple concepts, such as intentions, emotions, desires, knowledge and other states. In Wellman and Liu's (2004) study, they first selected the theory of mind scale tasks from published papers between 1987 and 2002. The meta-analysis results supported the claim that children generally correctly judge other people's desires and diverse beliefs before they correctly judge false beliefs (Astington, 2001; Wellman & Woolley, 1990). The data also demonstrated that children understand ignorance (e.g., that the character in the content false belief task does not know what is in a container) before they understand false belief. Based on the findings of

their first study, Wellman and Liu (2004) conducted a scaling study that included seven tasks assessing diverse desires, diverse beliefs, knowledge and ignorance, and false belief. In a *Diverse Desire* task, children were tested to examine whether they understood that two persons (the child versus someone else) may have different desires about the same objects. In a *Diverse Belief* task, children were tested to determine whether they understood that two persons (the child versus someone else) may have different beliefs about the same object, when they did not know which belief was true of false. In a *Knowledge Access* task, children saw what was in a box and were asked to judge the knowledge (yes or no) of another person who had not seen what was in the box. In a *Content False Belief* task, children were asked to judge another person's false belief about what was in a distinctive container when children themselves knew what it was in the container. In an *Explicit False Belief* task, children were tested how someone would search, given that person's mistaken belief. In a *Belief Emotion* task, children were asked to judge how a person would feel if that person was given a belief that was mistaken. In a *Real-Apparent Emotion* task, children were tested to determine whether they understood that a person could feel one thing but display a different emotion. Wellman and Liu tested 75 children aged from three to five, and a five-item Guttman scale was derived from the data. The tasks included in the scale, from easiest to most difficult, were *Diverse Desire, Diverse Belief, Knowledge Access, Content False Belief and Real-Apparent Emotion*. In Wellman and David's study, the tasks were mainly designed for testing desire and the belief understanding. In the current study, in addition to false belief questions, intention and appearance-reality questions were included in the experiment. And the order of the

three types of tasks revealed a likely developmental trend for the children's theory of mind understanding: the children comprehended others' intentions earlier than that of appearance-reality distinction as well as the false belief. Although the developmental pattern that was detected from the current study was very primitive due to the limited number of tasks and subjects, it nevertheless provides a useful reference in terms of the order of the mental states which children can capture at preschool age. In addition, the tasks for the three mental concepts also provided possible alternatives for future study. It will be helpful for future studies to include appearance-reality distinction, intention, belief and emotion as part of the item pool in order to investigate the development trend of naïve psychology.

To summarize, the current study's primary goal was to investigate preschoolers' understanding of selected mental concepts, such as false belief, intention and the appearance-reality distinction. In general, the children's performance on the intention questions was superior to their performance on the false belief and their ability to distinguish the original identity of a character from his appearance seemed to be in the middle between their ability to understand false belief and intention. Age was a significant factor related to the children's performance in false belief understanding, but not in intention. Children aged four and a half scored higherin false belief questions than did children aged around three and a half. Gender was a factor associated with children's understanding of intention. The results from the current study showed that girls were more likely to comprehend others' intentions than were boys.

Another focus of the current study was the exploration ofthe relationship b etween children's understanding of naïve psychology and the number of mental words they possess. The assessment of the possession of the mental words itself revealed interesting insights. Three methods were adopted in orderto assess this proficiency. For the measure from the parent report, the total number of mental words did not differ significantly across age groups or genders. However, age was related to the number of words that children understood as assessed by the self-report and contextual questions. Children aged from four and a half to five reported that they knew more target mental words than did children aged from three and a half to four. And children aged from four and a half to five answered more contextual questions correctly than did children aged from three and a half to four. In addition, children whose first language was English reported that they understood more target mental words than did children whose first language was not English. To further investigate the consistency of the self-report and the contextual questions, four combined scores were generated based on these two methods. The number of the words that children both obtained score one from the self report and contextual question (DIRECT1CONTEXT1) was more for children aged from four and a half to five than children aged from three and a half to four. In addition, children who spoke English as their first language knew more of this same type of word than did children who spoke another language as their first language. For the second combined score, DIRECT1CONTEXT0, where children reported thatthey understoo d the word but failed the contextual question for the word, neither age nor gender were related to the number of this type of word that the children possessed. The third combined score was

DIRECT0CONTEXT1, which was applied in the situation where children did not report that they understood the word, but that they passed the contextual question for the word. The manifestation of this type of word was more frequent for children whose first language was not English than children whose first language was English. The fourth is DIRECT0COMTEXT0, which was applied in the situation where children did not report that they understood the word and neither did they pass the contextual question for the word. The occurrence of this type of word was more frequent among children in the two younger age groups than children in the two older age groups.

Given the limited vocabulary of preschoolers, it was a challenging task to assess the target mental words that the children understood. The self-report method was weighted heavily on the children's ability of verbal expression, which might be the weakness for children whose first language was not English. The contextual method required more cognitive ability to comprehend the question settings. And therefore this measure relied less on the children's ability to express their understandings in English. The analyses on the four combined scores revealed that with increase of age, children's self-report was more consistent with the contextual assessment; and children whose first language was English also performed more consistently across the two assessment methods. For children who spoke another language as their first language, they were more likely to answer the contextual question correctly but fail to report that they understood the word.

To explore the relationship between theory of mind and the target mental words, a regression was run on the total naive psychology score with age (in month), sex, and the

number of mental words obtained from the three assessments as predictors. The regression model showed that parental report of the mental words was not a significant contributor to predict naïve psychology. However, the self-reported mental word and the contextual assessment of mental words were significant predictors. Neither age nor gender was a significant contributor for theory of mind knowledge.

The relationship between false belief and language has typically been studied by including children with specific language impairment (Miller, 2004), autistic spectrum disorders (Leslie & Firth, 1996; Tager-Flusberg 2001; Tager-Flusberg & Sullivan, 1996), or intellectual disability (Abbeduto, Short-Meyerson, Benson & Dolish, 2004). Other researchers have focused on the linguistic demand of the false belief tasks. They reduced the linguistic demand by using more specific, less ambiguous language and made the events more salient (Atance & O'Neill, 2004; Freeman & Lacohee, 1995; Lewis & Osborne, 1990; Siegal & Beattie, 1991). Some have even designed non-verbal false belief tasks (Carlson & Wong, 2005). The findings of these studies have been mixed. Some of them found that reducing linguistic requirement helped children perform better in the false belief tasks (Freeman & Lacohee, 1995; Lewis & Osborne, 1990; Siegal & Beattie, 1991). But some of them disagreed (Atance & O'Neill, 2004; Zelazo & Boseovski, 2001). The results of these studies showed that language proficiency is closely related to false belief performance. However, few of them examined the relationship between children's understanding on false belief and language ability by asking children questions directly. The current study attempted to fill in this information by directly asking children the mental words that they believed they understood. With the self-report method only, it is

difficult to determine whether the failure of reporting a known mental word is due to the fact that the child does not understand the word or the child does not want to tell the word. However, in the current study, in addition to the self-report, children were also examined to determine whether they truly understood the meaning of the words in a contextual setting. As children got older, they were more able to report the mental words that they knew, and they were more likely to pass the contextual questions for mental words. More importantly, the four combined scores derived from the self-report and contextual assessment revealed that children might have the ability to understand a mental state but failed to report that they understood the word corresponding to the situation.

Previous studies have focused on the phonologic, syntactic, semantic-pragmatic, or grammatical aspects of language and their relationship to false belief performance. The current study approached the question from another perspective, i.e., the vocabulary of the mental words and its relationship to naïve psychology, where the latter construct included false belief, intention understanding and the appearance-reality distinction. The findings from the current study also provide important information on the relationship between children's understanding of the mental world and the vocabulary that they possess about mind.

In conclusion, there are several important findings derived from the current study that are helpful to understand how children understand two important domains within naïve psychology, false belief and intention, as well as its relationship to language. First of all, children's performance on the traditional false belief tasks show that four years of age does not seem to be the dividing point where children can master the task. On the

contrary, even some children older than five have difficulty in passing the traditional false belief question successfully. However, in a similar setting, if the question was asked more directly concerning what the third party was thinking, children were more likely to pass the test, as in the example of the second false belief question in the current study. Secondly, children's understanding of intention was very impressive, with 55.6% of the children answering the two intention questions correctly, compared to only 15.3% of the children who passed the three false belief questions. Children's performance on the appearance-reality distinction question was also impressive, with 55.6% of the children providing correct answer for the question. The data from the current study showed that it was more difficult for children to accomplish the false belief task than the intention and the appearance-reality tasks. Finally, the current study also provides evidence that one aspect of language proficiency, the vocabulary of mental states, is related to children's development of naïve psychology. The children's understanding of the target mental words predicted how well they performed on the naïve psychology tasks.

Besides aforementioned findings, some methodological issues were also worth noting. The assessment of the mental word with different methods revealed that parents' report is less accurate than children's self-report and the contextual assessment. In addition, the children's performance on the last two methods showed that children might not have the vocabulary to describe certainmental states; however, they did have the ability to comprehend those states and the activities related to the human mind. This result provides evidence that cognitive understanding facilitates the formation of vocabulary that describes some mental states. Another important point derived from the

current study is the non-verbal response that required children to press the space bar as an indicator that they can comprehend the intention of the character. It seems that recording whether or not they can press the space bar is more important and more meaningful than how quickly they canpress it .

There are also a few considerations that are recommended for future studies. First of all, in the current study, the sample size of the four age groups was not equal; neither was the sample size for gender. And some cells of the age x gender table were small, such as the one for the males in the age group from three and a half to four. This might make the sample in the current study less representative. It would be desirable for future studies to recruit more subjects in the younger age group. Second, for the contextual questions designed to test the mental words, some of them could directly induce the target mental word when children answered the questions (for example, the question for *try* and *want*), but most of them do not provide this advantage. Thus, in future studies, it is important to elaborate the contextual questions for the mental word assessment so that the context can directly induce the elicitation of the target mental word. Third, after the test question of the traditional false belief task, it would be helpful to ask children why they make the choice in order to clarify whether the choice they make reflects the true understanding of the false belief situation. The follow up question might reveal the true understanding of the false belief situation. Finally, in order to detect a developmental trend or a valid protocol of native psychology, it would be helpful to include more tasks that encompass several aspects of naïve psychology, such as ontological knowledge,

desire, belief, intention understanding, and emotional reaction to a mental state, as well as the action that is directed by the mental state.

APPENDIX A

SCREENING QUESTIONNAIRE FOR PARENTS

Please provide the following formation about your child. The main purpose of these questions is to compare the performance of children across ages, genders, and different spoken languages. Thank you very much for your time!

Name of child: _____

Name of School:_____ Rm#: _____

Date of Birth: mon.__ day ___ yr. ___

Sex: Male ___ Female ___

Screening questions:

1. Does your child have experience of playing with computer? Yes __ or No__.
2. Can your child press the space bar of a computer? Yes ____ or No _____.
3. What is the first language of your child? _____. Do you use this language with your child on a daily bases? Yes __ No __
4. Has your child ever said sentences that begin with following words? The "I" can be substituted with other terms. Please check all that apply.

___ I want ….
___ I know ….
___ I believe …
___ I think …
___ I am thinking…
___ I pretend …
___ I imagine …
___ I dream of …
___ I had a dream.
___ This is a real (something) …
___ This is not real …
___ I decide to (do something)…
___ I am trying to (do something)…

Print: _____ Signature: _____ Date: _____

Your contact information: Tel.: ( ) E-mail:

APPENDIX B

MENTAL WORD ASSESSMENT

1) Real: Do you know the word *real*? What does *real* mean? What is this? Is this real? (**Present an apple eraser**)

2) Pretend: Do you know the word *pretend*? What does *pretend* mean? What is this? Is this a pretend one? (**Present a real apple**)

3) Imagine: Do you know the word *imagine*? What does *imagine* mean?

(**Put an apple on the floor. A circle of star sticker are put on top on the apple**) Can you see the stars on top of the apple? Have you ever seen an ant? (**Show children a piece of rice**) An ant is smaller than this rice. Imagine you are an ant, standing at the bottom of the apple, can you still see the stars on top of the apple? Yes or No Why?

4) Dream: Do you know the word *dream*? What does *dream* mean?

(Present two pictures: one describes a child asleep, dreaming of a monster; one describes a child awake, sitting beside a table, thinking of a cake)
Could you tell me which child is thinking something real? Why?
Which child is dreaming? Why?

5) Try: (**Show a doll trying to jump over a bar for 3 times)**
This is Kathy. Watch what she does. Could you tell me what she is doing?
Do you know the word *try*? What does *try* mean?

6) Decide: Do you know the word *decide*? What does *decide* mean?

Kathy needs to change her dress and Kathy decides to wear the same color as her sister today. If her sister wears yellow, what color will Kathy wear? Yellow or other_____ Why?

7) Want: Kathy is in the classroom now and these are things she picked for free play (**Present paper with picture, and crayons**). Could you tell me why she picked these things? Do you know the word *want*? What does *want* mean?

8) Believe: Do you know the word *believe*? What does *believe* mean? **(Show children a stuffed dog)** Kathy said this is a ducking. Do you believe in her? Why?

9) Think: Do you know the word *think*? What does *think* mean? (**Ask the kids to identify numbers 1-5**, **show number "3"**) Kathy said this is "1". Do you think she is right? Why?

10) Know: Do you know the word *know*? What does *know* mean? (**Show children a picture of two groups of strawberries, in one group, there are two strawberries, in the other group, there are three strawberries**) Could you help Kathy to pick the group that has more strawberries? How do you know you are right?

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