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Verbal Scaffolding in Children's Theory of Mind

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by

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Abstract

For nearly 30 years, researchers have been proposing and testing theories of the cognitive mechanisms that underlie children's abilities to comprehend the mental states of others and to predict behavior on the basis of those abilities. One such theory, the "theory theory," contends that children evaluate their own understanding of others' minds, developing a theory and expanding it when they encounter situations incongruent with their predictions. Wellman and Liu (2004) present a scale of the changes that children's understanding of mental state representations commonly undergo as children develop a mature theory of mind. The present study aims to clarify how children pass from one stage of understanding to the next, employing a training study paradigm to examine the possible role of verbal scaffolding on children's progression in this sequence. Specifically, the present study hypothesizes that verbally emphasizing the connection between one's knowledge and thoughts will advance children's performance on false belief tasks. This hypothesis was not supported. Even though children may appear to be at the same developmental level on Wellman and Liu's (2004) scale, the variation in their performances after training may indicate more nuanced underlying processes than are currently expressed by Wellman and Liu's (2004) scale.

This investigation deals with "theory of mind," or what Rebecca Saxe terms "the problem of other minds": why is it so hard in some cases, but so easy in others, to know what someone wants or believes? What are the processes behind "this amazing human capacity to think about minds" that allow us to predict another's thoughts and their consequential actions? (Saxe, 2009) The development of this capacity in children has been well-documented, beginning with the first study of children's understanding of others' false beliefs by Wimmer and Perner in 1983. Since then, researchers have continued to test the extent to which children comprehend others' mental states and can use them to predict others' behavior. From these studies, it is clear that the ability to make judgments about others' minds usually emerges during a specific developmental period, between three and four years of age (Wellman, Cross, & Watson, 2001). Furthermore, this development manifests as a successive mastery of distinct mental state concepts, which progressively combine to form a mature "theory of mind" (Wellman & Liu, 2004). The present study examines the nature of this theory by investigating whether and how environmental input, in the form of relevant information about mental states, affects children's theory of mind development. It is hypothesized that children's understandings of mental states undergo actual conceptual changes according to the developmental sequence outlined by Wellman and Liu (2004), and that the concepts in this sequence scaffold the understanding of later mental state concepts. If this is the case, providing verbal feedback regarding one concept of the scale should improve children's understanding of not only that particular concept, but also of the following concept in the sequence.

However, whether the emergence of this theory of mind is primarily the result of developing conceptual changes or general performance factors remains to be settled. One proposal, deemed the "theory theory," posits that children are continuously learning about mental state concepts from their experiences, building and revising a conceptual "theory" using general reasoning skills (Slaughter & Gopnik, 1996; Wellman, 1990). According to Slaughter and Gopnik (1996) and the premises of theory theory, children's development of a theory of mind is directly tied to their environment, from which children gather evidence about the properties of mental states which "should lead the child to construct new and more adequate theories" if their findings do not match their expectations (p. 2969). It is this proposed responsiveness to input that Slaughter and Gopnik (1996) state "differentiates theories from other types of cognitive structures, such as modules" (p. 2969).

"Modularity theory" proposes that mental state representations are innate, but that processing factors limit young children's abilities to demonstrate their competence (Scholl & Leslie, 1999). The suggested innate nature of mental representation in modularity theory has led to the interpretation that the theory is "anti-developmental" (Gopnik & Wellman, 1994, p. 283) and cannot account for any effect that environmental input may have on children's theory of mind development (Slaughter & Gopnik, 1996). However, proponents of modularity theory clarify that "modules are not typically thought to exist full-blown in the mind of a neo-nate, but must be triggered by the environment during maturation" (Scholl & Leslie, 1999, p. 136). Scholl and Leslie (1999) argue that environmental input may also "tune the maturation of the ToM [theory of mind] module," speeding up development (p. 139). Overall, however, modularity theory holds that a

theory of mind mechanism is the source of an innate competence in representing mental states, but that the "default" interpretations the mechanism provides must sometimes be suppressed by an inhibitory mechanism (Scholl & Leslie, p. 147). Processing limitations constrain children's capacities to display their underlying theory of mind competence.

In the words of Doherty (2009), these dominant theoretical accounts reveal the "long-standing tension between those who believe theory of mind abilities are innately specified and those who believe they are constructed through interaction with the physical and social world" (p. 4). The current study examines the effect of environmental input on theory of mind by investigating the relationships between the theory of mind concepts laid out in the scale created by Wellman and Liu (2004) to describe the developmental sequence of theory of mind abilities. Based on their meta-analysis analyzing studies that compared children's performances on tasks assessing children's understanding of different mental state concepts, Wellman and Liu (2004) devised and confirmed a scale of the developmental progression of these various concepts. In addition, they provide tasks to empirically determine which concepts children have mastered (tasks relevant to the present study are described in Table 1 below).

Table 1

Brief Description of Tasks

Task	Description
Diverse Beliefs	Child judges that two persons (the child vs. someone else) have different beliefs about the same object, when the child does not know which belief is true or false.
Knowledge Access	Child sees what is in a box and judges (yes – no) the knowledge of another person who does not see what is in a box.
Contents False Belief	Child judges another person's false belief about what is in a distinctive container when child knows what it is in the container.

The present study focuses on one particular segment of the scale in order to examine the relationships between the scale's components. The chosen segment begins with the concept of "diverse beliefs" (DB), or the understanding that different people can have opposing beliefs. The DB stage is followed by the ability to accurately judge a person's state of knowledge or ignorance ("knowledge access", or KA), which is in turn succeeded by the ability to accurately report false beliefs (FB). The first two concepts on this portion of the scale, DB and KA, appear to be necessary for FB understanding: a child must realize that other people do not always believe what the child him/herself believes (DB), in addition to understanding how people arrive at their beliefs (through KA), in order to correctly report false beliefs. Wellman and Liu (2004) view the progression of the scale as "increasing steps in subjectivity" (p. 530), and favor the theory

theory account that preschool-aged children gradually form a working theory of mind by gaining new conceptual insights.

As an explanation of how the different concepts in the sequence might relate, Wellman and Liu (2004) suggest that "the sequence represents one of modification or mediation" (p. 536). Modification indicates that "earlier items represent initial insights that are broadened or generalized to encompass later insights;" accordingly, Wellman and Liu (2004) propose that the concepts that comprise this theory of mind scale can be interpreted as representing a progressive broadening of the ways in which mental concepts are subjective (p. 536). Mediation sequences, on the other hand "go further in claiming that earlier insights enable or aid in the attainment of later insights," such that earlier conceptions of mental states "scaffold a later understanding" of other mental state concepts (Wellman & Liu, p. 536). If children are actively generating and revising a theory of mental concepts according to a mediation sequence of interdependent components, providing effective training on one component of this sequence should then facilitate the development of subsequent concepts. To test this hypothesis, the present study follows a training paradigm consisting of a pre-test, training sessions, and a post-test. First, participants are tested on their ability to demonstrate understanding of DB, KA, and FB concepts and their position on Wellman and Liu's (2004) scale. If they are at the correct stage, they then receive training in the form of verbal feedback on KA task performance, and finally, are re-evaluated on DB, KA, and FB performance during a post-test. If children are constructing an evidence-based theory of mental states, participants in the present study should not only demonstrate better KA task performance as a result of training. Additionally, if each concept plays a mediating role in the further

development of the theory, participants should also display improved performance on tasks measuring FB, the following concept on Wellman and Liu's scale (2004), even though it was not directly trained.

The most common assessment tasks in the theory of mind literature are various types of false belief tasks[1], in which children are asked to state the perspective of another person which conflicts with both reality and the child's own knowledge. For example, in an "unexpected contents" false belief task, children are presented with a recognizable and clearly labeled box, such as a Band-Aids box. They are shown that, contrary to expectation, the box contains something other than its labeled contents, such as a toy. The children are then asked what someone who has never seen inside the box will think it contains. Studies employing false belief tasks demonstrate that four- and five-year-olds are able to accurately report the mental representations of others even when they differ from the child's own and are incorrect representations of reality. However, three-year-olds routinely fail these tasks—not by chance, but by reporting what they themselves know to be in the box (Wellman, Cross, & Watson, 2001). Before the age of four, children systematically misattribute their own perspective to others, consistently predicting that others' beliefs always conform to the reality of a situation.

In addition, they are extremely confident in their mistaken attributions. Ruffman, Garnham, Import, and Connolly (2001) gave children ten tokens to bet on their answers to a false belief task, with more tokens indicating higher confidence that their answer was

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[1] The false belief task originated in response to Premack and Woodruff's (1978) investigation of theory of mind in chimpanzees. In a commentary on their article, philosopher Daniel Dennett (1978) outlined a task to assess false belief in children; Wimmer and Perner (1983) first applied it, and it has since been a major focal point in the theory of mind literature.

correct. Younger children who failed the false belief task bet almost all of their ten tokens on the incorrect answer, while the younger group of children who passed the false belief task was more uncertain, betting an average of six tokens on the correct answer. Older children passing the false belief task were more confident, betting about eight tokens correctly. This may indicate that the younger children who failed the false belief task have not yet developed a fully functioning theory about how others obtain knowledge and represent beliefs about the world, but that the young children who passed the false belief task may be in a state of uncertainty because they are re-evaluating their current understanding of the concept of belief. As they grow older and see that their revised theory works, they become more confident again. As described by the theory theory, children progressively reach more complex understandings of others' beliefs and thoughts through reasoning until they finally reach a mature theory of mind.

Although the theory theory holds that children are actively evaluating their experiences against their current theory of mind, expanding their theory when necessary, it is unclear what exactly prompts the child to progress from one stage of understanding to the next. The present study investigates this question by examining the possible effect of verbal scaffolding, which could prompt children to consider the adequacy of their current mental state understanding and provide a direction for its revision or expansion if they find their current theory lacking. More specifically, the current study examines whether training in the concept of knowledge access (KA) results in an improvement of the understanding of false belief (FB), and under what circumstances. More accurate performance on FB tasks after repeated exposure to KA tasks, paired with feedback reinforcing the core principle of the KA stage (that knowledge is a result of physical

experience), may indicate that improved theory of mind ability results from the

application of prior concepts to new situations. The critical difference between the KA

task and the FB task is that the former asks children to judge another's knowledge or

ignorance, while the latter asks them to then use that judgment to report another's

thoughts. A second condition in the present study combines training in the KA tasks with

feedback explicitly connecting the other's lack of knowledge with their thought process.

This condition may illuminate the possible role scaffolding could play in helping children

move from one conceptual stage to the next.

The scale developed by Wellman and Liu (2004) supports the theory theory

conclusion that children gradually develop a set of concepts and related skills that

contribute to a theory of mind, but the nature of young children's mental representations

of others' thoughts and beliefs has been disputed. Although Wellman (1990) proposes

that children have a working but undeveloped concept of belief, Perner (1988) argues that

an inability to reason about false beliefs by children younger than four years of age is

indicative of an inability to reason about beliefs at all. Perner (1988) suggests that

children develop a theory of representation at age three, but he states that this theory is

not applied to understanding others' minds until age four (p. 151). At this stage, Perner

(1988) writes that "the child gains a theoretical understanding of how the mind relates to

the external world, in particular the role of mental states…in guiding behavior" (p. 151);

before this time, children may apply strategies to respond to belief terms without treating

them as genuine mental representations that influence others' motives and actions

(Perner, 1989). In one strategy, beliefs might be treated as reflections of the real state of

the world; in another, the terms might serve simply as associative links between a person and the objects of their beliefs (Perner, 1989).

Perner (1988) characterizes children's understanding of others' minds as a progression through "three levels of semantic awareness": (1) presentation, where a child "*has a mental model* of the perceived reality," (2) re-presentation, where a child "can construct and use mental models to think about hypothetical situations," and (3) meta-representation, "when the child becomes capable of not just using but *modeling mental models*" (original emphasis, p. 141). During the first stage, presentation, the child models the external world but "has no notion at all that or how" the model is connected to reality—it simply constitutes reality for the child and does not allow for the manipulation of a model to explore hypotheticals or counterfactuals (Perner, 1988, p. 148). The ability to manipulate the model comes at the second stage, representation. This stage allows children to compare two situations, but not a situation and "a model representing that situation," which comes at the third stage, meta-representation (Perner, 1988, p. 149). However, Perner (1988) argues that this third stage is not reached and "mental states are not seen as representational states before about the age of four years" (p. 150). Before this time, children are unable to conceptualize and act on belief, or any other mental state, as a mental representation (Perner, 1988, p. 151-152). According to Perner's (1988) argument, given information about a person's true beliefs and his or her desires, a three-year-old child would not be able to accurately predict that person's resulting action until the age of four, unless the child were using a non-representational strategy as described in Perner (1989).

Although they both support the theory theory, Wellman (1990) rejects Perner's (1988) arguments that children younger than four years old do not see mental states as representational states, as well as Perner's (1989) suggestions that these children may use strategies to appropriately respond to belief statements, either interpreting beliefs as direct reflectors of reality or employing associative strategies. To test whether children think that a belief exactly corresponds to the true state of the world, Wellman (1990) conducted a study in which three-year-old children are shown two locations containing the same item. The children are then told that a character is looking for this item, but that he or she believes it is in only one of the locations. Children are then asked where the character will look for the item. If they are treating beliefs as exactly representative of the real state of the world, the children should name either location at chance (p. 83). Instead, they reply in accordance with the character's belief 67% of the time, significantly higher than chance (p. 85).

A second possible strategy is that children link people with the objects and places mentioned, with no regard to relevance or the character's desire or intention. This would lead to accurate responses to belief statements in cases where a child is told that a person has a belief about a single object in a single location. If asked where the person will look for the object, children simply have to remember the location mentioned in conjunction with the other person and the object. In order to test the associative strategy, Wellman (1990) again showed children an item in two different locations. This time, however, both the child and the character in the story knew that there were items in both locations (p. 83). In addition, an irrelevant belief about an aspect of only one of the locations is attributed to the character (such as the color of the location). If children employ an

associative strategy, they should associate the character with the location specified in the irrelevant belief because it was mentioned in association with the character twice, as opposed to the single mention of the other location. An associative strategy would predict that children choose the location mentioned twice more often than the other. However, a below chance 42% said that the character would search in the location mentioned in the irrelevant belief (p. 85). This task also disconfirms the hypothesis that children interpret belief statements as indications of preference or interest, since the children do not reliably respond according to the location about which the character expresses an irrelevant belief (p. 88). According to Wellman (1990), the patterns of performance on these tasks are evidence that "three-year-olds construe human action in terms of a concept of belief," and that they "know that such mental states are the causes of overt actions," rather than operating on the basis of strategies that do not require a concept of others' mental representations and their effects on behavior (p. 88).

In addition to the evidence from Wellman's (1990) tasks, many investigations of spontaneous speech indicate that young children competently employ language that refers to mental states, including belief, well before they reach four years of age. These studies provide further evidence that 3-year-olds possess some understanding of others' mental representations. The study of contrastives is particularly revealing in this regard. According to Bartsch and Wellman (1995), contrastive utterances distinguish mental states, such as thoughts and beliefs, from other mental states or from reality (p. 44), part of the necessary basis for a theory of mind. Bartsch and Wellman (1995) examined transcripts from the CHILDES database (Brown, 1973; Kuczaj & Maratsos, 1975; and MacWhinney, 2000) of four children from 18 to 72 months of age for their use of

contrastive statements. Often these are explicitly marked with a contrastive conjunction

(i.e., *but*), though not always. For example, in the following conversation, Adam (3;11)

explicitly contrasts reality with the adult's belief, pointing out both the true state of

affairs and the adult's incorrect thought:

> Adam: No, dat not de right wheels.
> Adult: Oh, why isn't that the right one?
> Adam: Dis de right wheel to de bus.
> Adult: Oh.
> Adam: You thought that was the wheel to that. (Bartsch & Wellman,
> 1995, p. 45)

Bartsch and Wellman (1995) also included implicit contrastive statements, where only

one alternative is mentioned explicitly, leaving the contrast to be inferred. The following

transcript of Abe (3;4) illustrates the use of an implicit contrastive:

> Abe: Hey, don't eat it.
> Adult: I'm not.
> Abe: I thought you were. (p. 46)

As Bartsch and Wellman (1995) explain, "even though Abe does not say something like

'I thought you were but you're not,' he expresses the contrast between thought and

reality" (p. 46).

Additionally, Bartsch and Wellman (1995) categorized contrastives based on

whether beliefs are contrasted with other beliefs or with an objective state. "Individual

contrastives" express a difference in mental states between the self and another, while

"thought-reality contrastives" distinguish between a person's thought and the actual state

of the world. In the individual contrastive below, Peter (3;1) implicitly contrasts his

thought with the adult's, suggesting that he recognizes that different people can have

different beliefs:

> Adult: Oh I think so. I think it goes in mommy and daddy's room.

Peter (3;1): I think it goes right here. (p. 46)

The thought-reality contrastive presented below, from Abe (3;6), explicitly differentiates

between others' thoughts about Dracula's personality and the reality:

Abe (3;6): The people thought Dracula was mean. But he was nice. (p. 53)

These contrastives demonstrate that children understand and use statements

reflecting a concept of belief, starting around the age of 3. Bartsch and Wellman (1995)

report that although contrastives were "relatively rare," making up less than 10% of the

total speech data, they still "occurred consistently," beginning at an average age of 39

months and generally increasing in frequency through 72 months of age (p. 46). Both

thought-reality and individual contrastives were present in the data, although thought-

reality contrastives were more frequent than individual contrastives. While thought-

reality contrastives reflect an understanding that beliefs do not necessarily represent

reality, individual contrastives show that children are "directly acknowledging the

subjective character of mental states, that is, their individuation across persons" (p. 50).

The ability to use individual contrastives indicates that children do have a concept of

others' mental states, and are able to correctly refer to these in their everyday speech. In

the scale that Wellman and Liu (2004) created, individual contrastives correspond to the

diverse belief step, a mental representation that precedes both the understanding of KA

and FB.

Other researchers' spontaneous speech data also support Wellman's (1990)

argument that the consistent failure of children younger than four years old to respond

accurately to false belief tasks does not entail that these children have no understanding

of belief at all. In particular, examination of children's explicit use of the contrastive

conjunction "but" reveals that children correctly use language in a manner suggesting

knowledge of others' mental representations at a young age. A longitudinal study of the

spontaneous speech of four children between the ages of two and three by Bloom, Lahey,

Lifter, and Fiess (1979) notes that the conjunction "but" generally appears after

competent use of the additive conjunction "and," and is produced as early as 2;8. French

and Nelson (1985) conducted interviews to elicit narratives from 43 children between the

ages of 2;11 and 5;6. The example below demonstrates their finding that "but" was used

as early as 2;11 to "introduce a statement that modifies a possible implication of the

preceding statement":

> Child (2;11): And you eat apples, and tuna fish, *but* tuna fish not for me.
> Adult: You don't eat tuna fish?
> Child (2;11): No, I eat…
> Adult: Tell me more.
> Child (2;11): I eat chicken. *But* chicken's not good for my teeth. (p. 123)

The type of use above was the most frequent, occurring 28 times (p. 68). In addition,

"but" appeared ten times, beginning at age 3;9, to "introduce information that contrasts

with implicit, shared knowledge":

> Child (3;9): I made some jelly and I made some without jelly. And I ate
> one. *But* not peanut butter and jelly. (p. 122)

Uses of "but" as in the example above signaled an explicit mention of a departure from

what is normal, reflecting "children's assumptions of what knowledge is likely to be

shared" and indicating that they are considering their conversational partner's point of

view (p. 67). According to French and Nelson (1985), these types of statements "indicate

at least an emerging ability to recognize the implications of one's own statements and

possibly to take the listener's perspective and make inferences about her inferences" (p.

70), key components of a developing theory of mind.

Although the data above demonstrate an understanding of multiple, contrasting beliefs before the age of four, children of this age are unable to pass false belief tasks. Wellman (1990) argues that this is because their notion of belief is not "as articulated or developed as an adult's conception" (p. 89). These developing mental concepts are also reflected in developing language use. Peterson (1986) examined the ways in which children's use of the contrastive conjunction "but" changes over time by eliciting narratives from three groups of children ranging in age from 3;6 to 9;6. Like other studies examining children's production of contrastives, Peterson (1986) found that even the youngest children correctly employed "but" in their speech (although they did make some errors that were less likely to appear in older children's speech, such as incorrectly using the conjunction "but" when "and" would have been appropriate, p. 588). In addition, Peterson (1986) found that children's use of "but" evolves in a manner that indicates development of concepts related to those necessary for a false belief task. The "categories that are used more by older children are those involving inferred semantic opposition and a contrast between a state of knowledge and reality" (p. 589). These findings reinforce the picture of developing mental concepts related to understanding implications and mental states that conflict with the true state of the world. Thus, the appearance of contrastives in spontaneous speech around the age of three reveals that children do practice some of the mental tasks necessary for understanding false belief, such as discerning between thought and reality, recognizing that individuals can have different beliefs, and considering the inferences that others may make.

These data contradict the idea that children are not operating with any form of belief understanding before they are able to pass the false belief task, and suggest that

their conceptions of belief evolve. However, if children are operating with some understanding of the concept of belief, the studies of spontaneous speech cannot fully explain what is missing that would cause them to fail false belief tasks. One possible explanation is that the false belief tasks themselves are too cognitively demanding, but Wellman, Cross, and Watson (2001) argue that the cause is a lack of some "genuine conceptual change" (p. 655) as opposed to a result of difficulty or complexity of the tasks. Data from the meta-analysis of false belief task performance demonstrate that factors such as a child's direct participation or the absence of physical objects involved in the task do improve three-year-olds' performance on false belief tasks, but that these manipulations do not increase performance to above-chance levels (Wellman, Cross, & Watson, p. 670). This indicates that although certain manipulations to false belief tasks can improve children's performance, they do not reveal an underlying competence on false belief tasks (which would be indicated by above-chance performance). Wellman (1990) argues that what is missing is a conceptual understanding of false beliefs, and outlines a possible account of the necessary conceptual change in children's understanding of mental representations in *The Child's Theory of Mind*.

Like Perner (1988), Wellman (1990) proposes that development occurring around age four, when preschool children succeed in false belief theory of mind tasks, consists of a change in how children understand mental representations. Contrary to Perner (1988), however, Wellman (1990) argues that three-year-olds have a limited understanding of beliefs as mental representations, allowing them to understand that beliefs are a mental representation that can affect behavior. He bases this on their understanding of fictional representations (e.g., imagination, dreams), their ability to predict others' actions based

on the others' true beliefs, and their capacity to accurately predict a person's actions even if the child knows that the person has incomplete knowledge (pp. 249-252). This last ability was tested by telling children that there are identical items in two different locations and that a character wants this item, but s/he only knows that it is in one of the locations. If children had no representation of another's beliefs and instead responded exactly according to reality, they would predict that the person would look in either location 50% of the time; instead, children are able to correctly predict where the person will look based on his or her beliefs (pp. 83, 85, 252). Wellman (1990) contends that three-year-olds do have a representational theory of mind, but that their difficulties with false belief are due to the limited, "direct copy" nature of their understanding of mental representations. According to this proposal, three-year-olds always understand beliefs as representing a copy of reality. Although it sounds similar, this differs from Perner's (1989) suggestion that children interpret belief as only referring to reality exactly as the child perceives it. Wellman's (1990) copy explanation holds that children understand that people can have beliefs based on partial representations of reality, but still fail to recognize that others' representations can be fundamentally different from reality, explaining three-year-olds pattern of failure on false belief tasks. However, the meta-analysis performed by Wellman, Cross, and Watson (2001) demonstrate "several conditions under which young children do not make systematic false-belief errors, but rather perform at chance level," making it unlikely that children hold an absolute "copy misconception" of belief (p. 677). Wellman, Cross, and Watson (2001) conclude that this data is better explained by hypothesizing that three-year-olds "fail to understand belief altogether and understand human behavior instead via other constructs such as the

person's desires, emotions, or perceptions" (p. 677). Although this is a significant change

from their previous arguments, Wellman, Cross, and Watson (2001) maintain their stance

that three-year-olds have a limited understanding of mental representations which then

develops into a more adult-like understanding at about the age of four.

Wellman and Liu (2004) have provided a concrete way of assessing the steps of

this development with their theory of mind scale; Wellman, Fang, and Peterson (2011)

further support the scale's relevance and "confirm distinct regularities in children's

developing understanding of mind" by applying it longitudinally (p. 789). In addition, the

scale's application to different cultures reveals that these same processes underlie

development regardless of culture, although in a somewhat different order (Wellman,

Fang, and Peterson, 2011). Whereas children from the United States were successful at

diverse belief tasks before knowledge access tasks, Wellman, Fang, and Peterson (2011)

found that the opposite was true for children from China; the rest of the scale remained

the same as the scale originally proposed in Wellman and Liu (2004). Shahaeian,

Peterson, and Wellman (2011) attribute this to a difference in cultural practices. In the

United States, parents emphasize self-expression and developing individual opinions,

highlighting the possibility of diverse beliefs, while in China, parents are more likely to

place emphasis on knowledge and minimizing conflicts between beliefs. Wellman, Fang,

and Peterson (2011) agree that the cultural differences are likely to affect children's

experiences and therefore the order of their theory of mind development, stating that it is

"unlikely that the focal theory-of-mind progressions simply represent childhood

increments in executive function or cognitive complexity" (p. 789). It seems possible,

however, that if there is a different cultural emphasis on certain mental states this might

also differentially affect children's executive function abilities. Nevertheless, Wellman, Fang, and Peterson conclude that there is a sequence of specific conceptual changes that contribute to a full, interpretive representation of belief.

Wellman, Fang, and Peterson (2011) emphasize that the scale "does not necessarily imply a cause-effect relation between earlier and later steps in the [theory of mind] sequence" and that experimental training studies are necessary to investigate any dependence (p. 790). Although there have been previous studies training the understanding of belief, none has been aimed at directly testing the links between the concepts on the scale created by Wellman and Liu (2004). They have, however, been used to support the idea of "conceptual coherence" in children's theory of mind, as indicated by Slaughter and Gopnik (1996) in the first successful training study of belief. Slaughter and Gopnik (1996) explain that if children rely on an "intuitive theory" to explain others' mental states and behavior, the concepts that form the theory should be interrelated in a coherent structure. For example, the concept of belief is connected to additional concepts within the theory: perception leads to belief, which combines with desire and intention to result in action (p. 2967). According to Slaughter and Gopnik (1996), "by linking the concept of belief with mental states for which children have a more accurate or complex understanding, children may be scaffolded into a more sophisticated understanding of belief" (p. 2968). Supporting this statement, Gopnik, Slaughter, & Meltzoff (1994) demonstrate that children perform better on belief tasks when the questions are explicitly connected to other mental state concepts. In one experiment, children viewed a green cat through a red filter so that the cat appeared black, and then moved to the other side of the filter and saw that the cat was green. They

were then asked what color cat they had *seen* before they moved as well as what color

they had *thought* the cat was. Children performed significantly better on these tasks, in

which they were asked about belief in the explicit context of questions about perception,

than on standard "unexpected contents" false belief tasks given in the same test session.

Requiring children to consider questions about perception may have facilitated a

conceptual link to belief that improved children's responses in this context; when the

perceptual link was absent, children displayed a poorer understanding of the concept of

belief.

Additionally, if children build upon mental state concepts to form a working

intuitive theory, strengthening understanding of a foundational concept should bolster the

concepts being supported: "the accumulation of evidence should lead the child to

construct new and more adequate theories" (Slaughter & Gopnik, 1996, p. 2969). In other

words, children's understanding of mental state concepts should improve with training.

Early training studies in the distinction between appearance and reality, however, were

unsuccessful (Flavell, Green, & Flavell, 1986 and Taylor & Hort, 1990). Slaughter and

Gopnik (1996) suggest that this finding may be due to the timing between training and

testing. In the studies of both Flavell et al. (1986) and Taylor and Hort (1990), the post-

test took place immediately after training. Slaughter and Gopnik (1996) predict that "if

training were to induce or accelerate a real conceptual change, it would have to take place

over a more extended period of time" (p. 2969), allowing children to process the tasks

outside of the training session and consolidate what they had learned. Accordingly,

training and testing was conducted over a period of two weeks.

Slaughter and Gopnik (1996) trained children in either the concepts of false belief or in the concepts of desire and perception, giving appropriate feedback to reinforce or correct the child's answers. Before and after the training, all children completed two false belief tasks; only children who failed both tasks on the pre-test were included. Both training groups improved from their pre-test performance, with no difference in effect between the belief or desire/perception conditions. These results are interpreted as support for children's understanding of mental states as a coherent intuitive theory, showing both that training through feedback can improve belief understanding and that training in other mental state concepts affects false belief understanding.

Expanding Slaughter and Gopnik's (1996) findings, Melot and Angeard (2003) present a study comparing the effects of training false belief understanding with training the distinction between appearance and reality. Training consisted of two sessions over a course of two weeks, with three tasks in each session, and children received either positive or negative feedback for each task depending on whether they answered correctly. Although positive feedback reinforced only the targeted mental concept in each task, negative feedback included connections to related concepts. For example, positive feedback when a child correctly responded to an appearance-reality task was of the following form: "Yes, that's right. It looks like a peach but really, it's a piece of stone." While this statement only addresses the difference between the stone's appearance and what it really is, negative feedback included statements about the child's beliefs and knowledge in addition to the appearance-reality distinction: "No, you're wrong. When you looked at that, you believed that it was a peach but when you touched it you knew that it was a stone. It looks like a peach but really, it's a piece of stone." Similarly,

negative feedback in the false belief task included information about both the other's

knowledge and resulting beliefs, while positive feedback only reinforced information

about the other's beliefs.

Both children trained in the false belief task and those trained in the appearance-

reality distinction improved in their respective task on a corresponding post-test.

Additionally, training in both concepts transferred to the other set of concepts; training in

false belief understanding improved performance on the appearance-reality distinction,

and vice versa, even if children received training in a condition they had passed at pre-

test. Children who successfully passed the appearance-reality tasks but failed the false

belief tasks at the pre-test improved their false belief performance after receiving training

only in the appearance-reality distinction. In the same manner, those who passed the false

belief tasks but failed the appearance-reality tasks at pre-test and were subsequently

trained only on false belief improved their performance on appearance-reality tasks.

Melot and Angeard (2003) interpret their bi-directional results as support for Slaughter

and Gopnik's (1996) description of a theory of mind consisting of interdependent

concepts.

Furthermore, Melot and Angeard's (2003) results demonstrate that "confirming

feedback is at least as effective as disconfirming feedback" (p. 183). Negative feedback

adds new information that children can potentially incorporate into their theory of mental

states, but positive feedback adds nothing that the child does not already understand.

However, although positive feedback supplies no new information, it makes the concepts

that children rely upon explicit. According to Melot and Angeard (2003), this indicates

that feedback is not simply effective by providing new knowledge that children can

integrate into a theory, but also by focusing attention on mental states and triggering "metacognitive experiences," allowing children to reflect upon and reshape their theories (p. 184).

The present study further explores the impact of mental state feedback on children's theory of mind, as well as the effect of training in one conceptual area on another. Adopting the format of Melot and Angeard's successful training study (2003), the present study examines whether training three-year-olds in the knowledge access task will positively affect their performance on the false belief task, thereby corroborating Wellman and Liu's (2004) scale of progressive conceptual development of understanding others' minds. In addition, the current study compares the effect of feedback emphasizing the connection between the knowledge and thought with the effect of feedback emphasizing only the concept being trained (knowledge access). If the hypothesis is correct that children rely on a coherent theory that can be modified by bringing explicit attention to relevant mental state concepts, both feedback conditions should result in improved false belief performance. However, feedback that highlights the connection between knowledge and thought should strengthen children's false belief even further by providing a verbal scaffold that directs children to consider the importance of knowledge on another person's beliefs, a necessary step in the false belief task.

Method

Participants

Overall, 17 participants from preschools in Claremont, California participated in the pre-test. Nine participants did not meet the inclusion criteria after the pre-test, and were ineligible for the remainder of the study. Eight participants met the inclusion criteria

at pre-test (see procedure); one of these eight did not complete the second training session

and post-test because of absence, and is not included in any of the data below. The seven

participants that completed all four sessions ranged in age from 3;2 to 4;10, and the

average age of these participants was 3;10.

Tasks

The tasks used included the Diverse Beliefs task (DB), the Knowledge Access

task (KA), and the Contents False Belief task (FB) from the scale created by Wellman

and Liu (2004). Brief descriptions are given in Table 1, with an expanded description in

the Appendix (Wellman & Liu, 2004). In each task, the child was asked about a

character's mental state that differed from the child's own, with a doll as the character.

Each task included a target question about the character's mental state and a control

question about the child's own belief (for DB) or reality (for KA and FB).

Two versions of the KA task were given during training. All presentations

followed the format of KA used by Wellman and Liu (2004) as in the Appendix, but they

included feedback after the child's completion of the task. One training condition

emphasized the process of knowledge access alone. In this "Knowledge Access Only"

(KAO) training condition, it was emphasized that the character could not know what was

in the box because they had not seen its contents ("[Name] did not see in the box, so s/he

does not know what is in it"). The other training condition emphasized both the process

of knowledge access and the corresponding result on a person's thoughts. In this

"Knowledge Access and Thought" training condition (KAT), children were provided the

same feedback as in the KAO training; however, they were additionally told that because

the character did not know what was in the box, they could think that it contained

anything ("[Name] did not see in the box, so s/he does not know what is in it. S/he could think anything is in the box because s/he does not know what is inside").

Procedure

At Time 1 (pre-test), each child completed three of every task category (DB, KA, and FB). At pre-test, the KA task did not include feedback. To be included in the study, a child had to answer two of the three DB tasks correctly and two of the three FB tasks incorrectly. Each child who met the inclusion criteria met with the experimenter three additional times. Times 2 and 3 consisted of training in KA; every child completed three KA tasks at both Times 2 and 3. At both these training sessions, children received feedback on each task according to their training condition (KAO or KAT). At Time 4, each child was again tested on the DB, KA, and FB categories, completing three tasks for each. No feedback was provided at Time 4. The pre- and post-tests were approximately two weeks apart for all participants.

<div align="center">

Results

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Scoring

On each individual task, participants were scored 0 if incorrect and 1 if correct. For each category of task (DB, KA, or FB) participants could therefore receive a score of 0, 1, 2, or 3. They were considered to have passed a category if they answered at least two of the three individual tasks in that category correctly (scored at least 2).

Pre-test

Four participants passed all three categories, three did not pass any, one passed only the KA category, and one passed only the FB category. These nine participants were ineligible for further study.

Seven participants passed the DB tasks but not the FB tasks, meeting the inclusion criteria and completing the rest of the training sessions and post-test. Of these participants, four passed only the DB category at pre-test, while three passed both DB and KA. The participants were assigned to the KAO and KAT training conditions. The KAO condition had four participants: two who passed KA at pre-test, and two who did not. The KAT condition had three participants: one who passed KA at pre-test, and two who did not.

Training Effects: Comparison of Pre- and Post-test Scores

Across both conditions, KAO and KAT, training had a 50% success rate for improving KA performance: two of four participants that failed KA tasks at pre-test passed the KA tasks at post-test. Out of the seven participants (who all failed FB at pre-test), one passed the FB tasks at post-test; this participant was in the KAT training condition. Below are the comparisons of pre- and post-test performance in KA and FB by feedback condition.

      KAO feedback.

      Effect on KA post-test score (see Table 2).

The two participants who passed KA at the pre-test also passed at the post-test. Of the two that did not pass KA at pre-test, one passed at post-test.

Table 2

KA Pre- and Post-test Scores after KAO Training

		KA Pre-test	
		Pass	Fail
KA	Pass	2	1
Post-test	Fail	0	1

Effect on FB post-test score (see Table 3).

All four participants that failed the FB tasks at pre-test also failed at post-test.

Table 3

FB Pre- and Post-test Scores after KAO Training

		FB Pre-test	
		Pass	
		Fail	
FB	Pass	0	0
Post-test	Fail	0	4

KAT feedback.

Effect on KA post-test score (see Table 4).

The one participant that passed KA at the pre-test also passed at the post-test. Of the two that did not pass KA at pre-test, one passed at post-test.

Table 4

KA Pre- and Post-test Scores after KAT Training

		KA Pre-test	
		Pass	Fail
KA	Pass	1	1
Post-test	Fail	0	1

Effect on FB post-test score (see Table 5).

Of the three participants that failed FB at pre-test, one passed at post-test.

Table 5

FB Pre- and Post-test Scores after KAT Training

		KA Pre-test	
		Pass	Fail
KA	Pass	0	1
Post-test	Fail	0	2

Discussion

This study aimed to determine whether direct training in one component of theory of mind would improve performance on a second component which developmentally follows the first, as would be expected under a theory theory account of a developing, conceptually interdependent theory of mind. Effective training in the first component (in this case, knowledge access) is necessary to examine a transfer of training effects to the following component (false belief). However, in the present study, the effectiveness of direct KA training was not consistent: of the participants who failed the KA set of tasks at pre-test, exactly half of participants demonstrated improved KA performance on the post-test, while the other half showed no improvement. This data demonstrates that even children who can be placed at the same stage on the scale created by Wellman and Liu (2004) are not equally affected by the same experiences. This could be due to individual differences in executive control or language ability, neither of which were controlled for in the present study. Alternatively, it could indicate that there are nuanced stages between those included on Wellman and Liu's (2004) theory of mind scale, perhaps related to how recently a child reached the broad conceptual stage. Expanding the betting method of measuring children's confidence on false belief tasks created by Ruffman et al. (2001) to apply to all of the tasks in Wellman and Liu's (2004) scale in a longitudinal study might indicate a relation between children's confidence and how close they are to reaching the next conceptual stage on the scale. If such a pattern does exist, this would support that children with lower confidence in their current conceptual understanding are "testing out" revised theories of mind, and then becoming more confident once they achieve mastery of their current conceptual stage. This possible relation between confidence and

assessment of one's own conceptual understanding might be able to explain why children who appear to be at the same stage of their theory of mind based on Wellman and Liu's (2004) scale show different likelihoods to progress to a new stage of mental state understanding after receiving verbal information about mental state concepts.

Additionally, the three participants who passed the KA tasks at both the pre-test and the post-test all failed the FB tasks at the post-test, while one of the participants who passed the KA tasks at post-test but *not* at the pre-test was the only individual to also demonstrate improvement in FB performance. This finding is contrary to that of Melot and Angeard (2003), who found that "training in an already-mastered task substantially improved performance on another task" and suggested that feedback triggered a "re-elaboration" of the child's theory of mind even if it did not provide any information about mental states that the child did not already possess (p. 183-184). The data from the present study also appear to contradict Wellman and Liu's (2004) hypothesis that the developmental sequence in theory of mind is one of mediation, which would expect that "earlier insights enable or aid in the attainment of later insights" (Wellman & Liu, p. 536). Based on Melot and Angeard's (2003) reasoning and Wellman and Liu's (2004) mediation hypothesis, children who were already at the KA stage at the pre-test should have been more likely than those who did not initially pass KA to demonstrate FB improvement after training. According to a theory theory explanation, participants who passed the KA tasks at the pre-test were presumably operating with a richer knowledge of mental states and therefore had more to draw from in order to succeed at the FB tasks; these conditions should have been expected to make them more likely to pass than those who had not yet demonstrated KA understanding.

Previous studies successfully training mental state concepts, such as Slaughter and Gopnik (1996) and Melot and Angeard (2003), emphasize the importance of a sufficient length of time between the pre-test, training sessions, and post-test; both studies spread the tasks out over two weeks. In a theory theory framework, children will need time to incorporate new evidence into their existing theory, re-evaluating their mental state concepts and devising a suitable alternative. Although the present study also had participants complete the pre-test and the post-test approximately two weeks apart, direct training was unsuccessful for half of the participants. One difference between the present study and these previous studies is the form in which feedback was given. Both Slaughter and Gopnik (1996) and Melot and Angeard (2003) provide either positive or negative feedback according to the child's responses, saying "Yes," or "You're right," or "No," and "That's wrong" in addition to stating the correct response using mental state terms. In the current study, however, the feedback given was exactly the same whether the child responded accurately to the task or not, explicitly stating the correct response and appropriate relations between mental state concepts, but not directly informing the participant whether they had provided a correct or incorrect answer to the task question. While some of the participants did improve their KA performance, indicating that they may have been able to appropriately adjust their understanding of KA based on the feedback provided, those who failed might have benefited from either more training sessions over a longer period of time, or from feedback that also directly called attention to the content of their own response.

The singular participant that improved their FB performance was in the KAT training condition, which explicitly linked the concept of knowledge to thought. It was

predicted that this condition would be the most likely to result in FB improvement, and it is possible that verbal scaffolding did prompt improved understanding of FB in this particular case. However, since this pattern was not apparent in any of the other participants' results and the present study found inconsistent effects of direct training in KA, the theory theory tenet that children are actively incorporating mental state information and continuously revising their theories about thoughts is not supported by the data from this study.

Appendix

Diverse Beliefs

Children see a toy figure of a girl and a sheet of paper with bushes and a garage drawn on it. "Here's Linda. Linda wants to find her cat. Her cat might be hiding in the bushes or it might be hiding in the garage. Where do you think the cat is? In the bushes or in the garage?" [This is the own-belief question.]

If the child chooses the bushes: "Well, that's a good idea, but Linda thinks her cat is in the garage. She thinks her cat is in the garage." (Or, if the child chooses the garage, he or she is told Linda thinks her cat is in the bushes.) Then the child is asked the target question: "So where will Linda look for her cat? In the bushes or in the garage?"

To be correct the child must answer the target question opposite from their answer to the own- belief question.

Knowledge Access

Children see a nondescript plastic box with a drawer containing a small plastic toy dog inside the closed drawer. "Here's a drawer. What do you think is inside the drawer?" (The child can give any answer he or she likes or indicate that he or she does not know). Next, the drawer is opened and the child is shown the content of the drawer: "Let's see…it's really a dog inside!" Close the drawer: "Okay, what is in the drawer?"

Then a toy figure of a girl is produced: "Polly has never ever seen inside this drawer. Now here comes Polly. So, does Polly know what is in the drawer?" (the target question). "Did Polly see inside this drawer?" (the memory question).

To be correct the child must answer the target question "no" and answer the memory control question "no."

Contents False Belief

The child sees a clearly identifiable Band-Aid box with a plastic toy pig inside the closed Band-Aid box. "Here's a Band-Aid box. What do you think is inside the Band-Aid box?" Next, the Band-Aid box is opened: "Let's see…it's really a pig inside!" The Band-Aid box is closed: "Okay, what is in the Band-Aid box?"

Then a toy figure of a boy is produced: "Peter has never ever seen inside this Band-Aid box. Now here comes Peter. So, what does Peter think is in the box? Band-Aids or a pig? (the target question). "Did Peter see inside this box?" (the memory question).

To be correct the child must answer the target question "Band-Aids" and answer the memory question "no."

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