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Young Children's Understanding Of Learning And Its Relation To Their Own Learning

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Abstract
The current dissertation examines how young children aged from 3 to 6 years come to understand learning from a mentalistic perspective, and how this understanding is related to their own learning. Study 1 found that preschoolers' prediction of learning is influenced by the informant's knowledge state, and that there is an age-related increase in the expectation of learning from another and sensitivity to an informant's knowledge state. Children's prediction of another's learning was applied to their actual learning in Study 2, showing that children's perception of an informant's knowledge state affects how much information they themselves accept from the informants. Overall, the findings from Studies 1 and 2 demonstrated that children's judgment of another's knowledge affects not only their predictions about learning from him, but also their actual learning.

Studies 3 and 4 broadened the framework to see how children consider not only the informant's but also the learner's mental states. Findings from Studies 3 and 4 indicated that young children come to understand that a person's knowledge state influences the formation of the intention to learn, and that the judgment of the occurrence of learning requires a change in the learner's knowledge. Study 5 further examined whether the knowledge-based judgments of another's learning are applied to judgments of children's own learning, and whether these judgments are related to how much and how they actually learn. As children judge another's learning based on the learner's knowledge, they judged the necessity and desire for their own learning based on their own knowledge state, and they determine whether they have learned based on the presence of knowledge change. Moreover, this knowledge-based reasoning about learning was uniquely related with how much they learned from an example learning situation, and with teacher ratings of their learning related-behavior in schools.

The overall findings across five studies indicated that in early childhood, children come to understand learning on the basis of mental states, and that this emerging understanding has important implications for their metacognitive knowledge to regulate their learning as well as their actual learning.

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YOUNG CHILDREN'S UNDERSTANDING OF LEARNING AND ITS RELATION TO THEIR

LEARNING

To my family

ACKNOWLEDGEMENT

When I first started my graduate study at Penn, I had written my several wishes in my journal, and I recently had a chance to read it again. Surprisingly, I found that many of them came true, and that I have learned and gained much more through my journey than I expected and hoped. This journey, however, would not have been possible without many people's help and care.

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ABSTRACT

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The current dissertation examines how young children aged from 3 to 6 years come to understand learning from a mentalistic perspective, and how this understanding is related to their own learning. Study 1 found that preschoolers' prediction of learning is influenced by the informant's knowledge state, and that there is an age-related increase in the expectation of learning from another and sensitivity to an informant's knowledge state. Children's prediction of another's learning was applied to their actual learning in Study 2, showing that children's perception of an informant's knowledge state affects how much information they themselves accept from the informants. Overall, the findings from Studies 1 and 2 demonstrated that children's judgment of another's knowledge affects not only their predictions about learning from him, but also their actual learning.

Studies 3 and 4 broadened the framework to see how children consider not only the informant's but also the learner's mental states. Findings from Studies 3 and 4 indicated that young children come to understand that a person's knowledge state influences the formation of the intention to learn, and that the judgment of the occurrence of learning requires a change in the learner's knowledge. Study 5 further examined whether the knowledge-based judgments of another's learning are applied to judgments of children's own learning, and whether these judgments are related to how much and how they actually learn. As children judge another's learning based on the learner's

knowledge, they judged the necessity and desire for their own learning based on their own knowledge state, and they determine whether they have learned based on the presence of knowledge change. Moreover, this knowledge-based reasoning about learning was uniquely related with how much they learned from an example learning situation, and with teacher ratings of their learning related-behavior in schools.

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CHAPTER 1

INTRODUCTION

Human beings experience diverse learning situations from very early ages, but it may not be the case that individuals are always aware of their learning and control the process from the beginning. Theory of mind literature has shown that individuals' awareness of learning and understanding of means of knowledge acquisition start to develop in early childhood (Esbensen, Taylor, & Stoess, 1997; Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Taylor, Esbensen, & Bennett, 1994; Wimmer, Hogrefe, & Perner, 1988). For instance, young preschoolers usually do not closely attend to their own learning, but start to recognize their learning experience and the process in early childhood. Taylor et al. (1994) found that when 4-year-olds learned a piece of knowledge, they tend to claim they have always known the information. In contrast, 5-year-olds better recognized they learned something new, which indicates that children come to recognize a change in their own knowledge from early childhood.

If children start to recognize their own learning with age, one fundamental question is how they come to conceptualize learning. Sobel and Letourneau (2015) found that when children aged from 4 to 10 years were asked what the word 'learning' means, and what and how they learned things, many 4- and 5-year-olds had difficulty giving a definition of learning, and had a lack of awareness about the nature of learning. On the other hand, older children started to describe learning as a kind of process to gain knowledge, which implies they may come to recognize learning from a metacognitive perspective. Similarly, even though young children aged from 2 to 6 more frequently talked about contents of knowledge they learned (i.e., what they have learned) rather than

the source (i.e., where or when they learned) or process of learning (i.e., how they learned), 4- to 5-year-olds more frequently described the knowledge source or process than 2- to 3-year-olds (Bartsch, Horvath, & Estes, 2003; Sobel, Li, & Corriveau, 2007). Thus, the findings from the literature indicated that there is evidence of a developmental change in awareness of learning experience and understanding of nature of learning in early childhood.

Given learning involves a change in knowledge (Wang, 2010), and learning is one of representative mental enterprises that individuals frequently experience, children's growing understanding of learning might be fundamentally related with their reasoning about mental states of individuals engaged in learning. Specifically, in social situations, informant(s) and learner(s) are the main participants, thus, understanding of learning should involve understanding of an informant' and a learner's mental states and their exchange of knowledge. Then, how do young children understand social learning based on mental states of an informant and a learner? For instance, what mental states of a learner do young children think would lead him to try to learn knowledge? In which situation do young children think a learner needs to learn knowledge from other? How do young children judge if a person learns something? Even though young children may learn enormous amounts of knowledge from social situations with others, how children understand social learning situations and the underling mechanism based on mental states of participants has rarely been examined.

Another issue that the existing literature has frequently missed is what implications young learner's understanding of learning has for their own learning.

Children's understanding of learning is important because it may influence their identification and prediction about situations that can bring about learning and judgment of their own learning. This insight, consequently, can influence how they treat and behave in a prospective learning situation, how they learn from it, and how they evaluate their own learning. Their emerging understanding of learning may become important pieces of their metacognitive knowledge. Metacognitive knowledge refers to our knowledge and beliefs about what factors influence and interact in the process and outcome of cognitive enterprise and how these factors influence our thinking and learning (Flavell, 1979; Pintrich, 2002; Pintrich, Wolters, & Baxter, 2000). Children's growing understanding of learning, such as what learning is, when individuals try to learn something, and what makes a difference in our learning, could form a naïve, but fundamental basis of metacognitive knowledge. Given children's learning is enhanced when they have personal insight into their own thinking and learning (Pintrich, 2002; Paris & Winograd, 1990), it should be important to examine how young children's understanding of learning develops and what implications this process has for children's own learning.

Thus, the current dissertation aims to investigate children's development of an understanding of learning, especially social learning, and how that understanding is related with their learning. Specifically, I intend to examine how young children understand learning based on the main participants'-- an informant's and a learner's-- mental states, such as knowledge and intention, and how that understanding is related to their own learning and behaviors.

The current research is divided into two parts. In Part 1, children's understanding of learning and its relation with their own learning based on an informant's mental states was examined, and Part 2 expanded the investigation to include not only the informant's but also the learner's mental state. The first study in Part 1 looked at how young children predict another's learning—whether a person will try to learn knowledge and whether learning would be successful when there was information about the informant's knowledge state and teaching intention. In the second study, whether children's prediction of another's learning was applied to their own learning when the same information was given was investigated.

Part 2 examined how children predicted and judged another's learning on the basis of the informant's as well as the learner's mental states and how that understanding was related with their own learning and learning-related behaviors. In Studies 3 and 4, children's understanding of another's learning based on the informant's teaching intention and the learner's knowledge state was examined through hypothetical learning stories. In Study 5, in addition to children's understanding of another's learning based on a learner's knowledge state, how children determined and judged their own learning based on their own knowledge state was investigated. Further, whether children's knowledge-based understanding of another's and their own learning was respectively related with how much they learned from experimental learning situation and general learning-related behaviors was examined as well.

CHAPTER 2

LITERATURE REVIEW

1. Young Children's Understanding of an Individual's Knowledge

1-1. Development of understanding of other's and one's own knowledge

Given that learning involves a change in knowledge (Wang, 2010), literature on how children understand individuals' knowledge and knowledge state could offer a good starting point to investigate children's understanding of learning. In fact, children's understanding of knowledge, ignorance, and false belief is the topic that theory of mind research has focused on extensively (Friedman, Griffin, Brownell, & Winner, 2003; Hogrefe, Wimmer, & Perner, 1986; O'Neill, 1996; Pillow, 1989; Pratt & Bryant, 1990; Sullivan & Winner, 1991). Literature showed that it is not the case that children come to understand diverse mental states at the same time. For instance, during a transitional period from age 3 to 4, children understand that the absence of perceptual access (e.g., an individual does not see an object is moved from A to B) causes the person's ignorance (e.g., the person does not know where the object is) (Pillow, 1989; Pratt & Bryant, 1990), but they still have difficulty appreciating that it may also cause a person's false belief (e.g., the person may believe the object is still at the original place A) (Hogrefe et al., 1986; Wellman & Liu, 2004). Given this finding, basic understanding of ignorance seems to develop earlier than understanding of false belief.

Some research has shown that children's basic concept of knowledge and ignorance starts to develop even earlier in life. O'Neill (1996) found that 2-year-olds communicate differently with their parents depending on the parent's knowledge state. When they request help from their parents to reach a desirable toy, they more often

named the toy, talked about its location and pointed to its location, especially when their parent did not see the location of the toy (e.g., because parent left the room before or had covered her or his eyes and ears). Other studies suggest that even infants are aware of another's ignorance caused by the absence of perceptual assess (Knudsen & Liszkowski, 2012; Liszkowski, Carpenter, Striano, & Tomasello, 2006; Liszkowski, Carpenter, & Tomasello, 2008). For instance, in Liszkowski et al. (2008), 12-month old infants observed that an experimenter either did or did not see objects slide onto the floor. When the experimenter looked for the disappeared object, infants rarely pointed out the object when the experimenter saw it slide onto the floor, but they were likely to point at the missing object when the experimenter did not see where it went. This result may indicate that human beings recognize another's ignorance or knowledge caused by the absence or presence of perceptual access from very early ages, and that they are willing to provide necessary information for the ignorant person.

Young children are known to be able to directly evaluate and talk about their own and other's knowledge and ignorance in structured experimental settings (Esbensen, Taylor, & Stoess, 1997; Taylor, Cartwright, & Bowden, 1991). For instance, Esbensen et al. (1997) found that 4-year-olds are able to identify their ignorance or knowledge correctly. When 4-year-olds were asked whether they know something familiar (e.g., how to jump, any counting words), they could answer they knew them, and when the knowledge was novel (e.g. how to count in Japanese, how to hink and zwib) they could report their ignorance. Taylor et al. (1991) also found that 4- and 5-year-olds have reasonable expectation about the knowledge of others based on their ages. For instance,

children understood a baby may not know what a square looks like, but their peer and an adult may have this knowledge.

Children's evaluation or judgment of their own and other's knowledge state is also found in their everyday life as well (Bartsch & Wellman, 1995; Harris, Yang, & Cui, 2017). It is known that children spontaneously talk about their own knowledge state. Bartsch and Wellman (1995) found that 'know' is a mental state verb that is most frequently said for English-speaking children. They found that from age 3 years and upward children's talking and referencing mental state such as 'know' increase. In a recent work (Harris et al., 2017) based on children's spontaneous utterance in natural family contexts across 16 to 39 months, children were reported to say 'know' sometimes in their everyday life. Those young children talked about their own as well as other's knowledge spontaneously (e.g., I already know that, you know that), but utterances about another's ignorance (e.g., you don't know that) were much less common. Taken together, the overall results indicate that young children may have a basic concept of ignorance and knowledge, possibly from infancy, and they already think and talk about their own and other's knowledge state before their third birthday.

1-2. Children's understanding of other's knowledge and its relation to their learning

Children's understanding of other's knowledge state is important because it influences their own learning from others and interaction with them. First of all, it allows children to judge the reliability of information given by others, and thus to learn selectively and effectively. Much research on children's understanding of testimony has

shown that an informant's previous accuracy and children's judgment about an informant's knowledge state affect children's decision of whom they want to ask new information, and whose information they endorse (Birch, Vauthier, & Bloom, 2008; Clément, Koenig, & Harris, 2004; Ganea, Koenig, & Millett, 2011; Koenig & Harris, 2005; Pasquini, Corriveau, Koenig, & Harris, 2007).

The usual testimony paradigm to assess young children's selective trust based on an informant's knowledge state has children watch two informants who exhibit a difference in accuracy or knowledge state, and then novel objects or unclear situations are presented. Subsequently, children's preference for or endorsement between the two informants is examined. Using this paradigm, Clément et al. (2004) found that when children did not see the actual property of an object in a box, so that they had to rely on the information given by others, 4-year-olds more often accepted the color stated by a previously accurate speaker than an inaccurate one, whereas 3-year-olds did not readily discriminate information based on previous accuracy.

Subsequently, Koenig and Harris (2005) found that if children only have information about who was previously accurate or inaccurate, 4- but not 3-year-olds reliably preferred to ask and endorse the previously accurate informant. However, if children have information not only about the informants' previous accuracy, but also about their knowledge state both age groups preferred to ask and endorse the previously accurate informant. Meanwhile, using a similar procedure that two informants who differed in accuracy about familiar objects appeared without explicit information of whether they are knowledgeable or not, Birch et al. (2008) found no difference in

endorsing the labeling of novel objects and novel object functions between 3- and 4-year-olds. Thus, overall, although there were some inconsistent findings about 3-year-olds' ability, even 3-year-olds seem to have a relatively good capacity to judge trustworthy informants from less reliable ones using accuracy information, and their selective trust based on speaker's accuracy and knowledge state may continue to develop during early childhood.

However, although the testimony research is relevant, often social learning situations only have a single informant and we are rarely given the opportunity to choose among multiple informants. Thus, looking at how children react to and learn from a single informant could show a different picture of their learning (Jaswal, Croft, Setia, & Cole, 2010; Koenig & Echols, 2003; Koenig & Woodward, 2010; Krogh-Jespersen & Echols, 2012; Sabbagh & Shafman, 2009; Sabbagh, Wdowiak, & Ottaway, 2003). In fact, some research findings show that children still accept information even from previously inaccurate or ignorant speakers if there is no alternative, conflicting testimony. For instance, Krogh-Jesperson and Echols (2012) found that when objects are familiar to 2-year-olds (e.g., a dog), they are more willing to accept a different label for the object (e.g., calling a dog a 'Gep') if the new label was given by a speaker who was accurate previously or who claimed good knowledge, rather than speakers who were inaccurate or claimed ignorance. However, when the object was a novel toy, children still accepted the novel labeling, regardless of the speaker's previous accuracy or knowledge state. Similarly, Vanderbilt, Heyman and Liu (2014) found with a single informant that if a label for a novel object is given by a previously inaccurate speaker, 3- and 4-year-olds just endorse the inaccurate speaker's labeling.

In contrast, some other studies show that children actually learn less from ignorant informants. Koenig and Woodward (2010) found that when 2-year-olds are presented with novel object-word links (e.g., "blicket") either by a previously accurate or inaccurate speaker, they are more likely to accept the label given by the previously accurate informant. Similarly, Sabbagh and his colleagues (2001, 2003, 2009) compared how preschoolers' learning differs depending on the informant's knowledge. For instance, when the speaker was confident in his knowledge (e.g., "I know right where her blicket is…"), both 3- and 4-year-olds learned the novel word – object link better than when the speaker was ignorant (e.g. "I don't know what a blicket is. Hmm… Maybe it's in this box") (Sabbagh & Baldwin, 2001). In their second experiment, the informants in both conditions expressed uncertainty about the novel objects by saying, "I don't know which one. Maybe this one," but one informant consistently stated she made the object and the other stated it was made by a friend. The results showed that 4-, but not 3-year-olds, learned more novel words in the informant-made condition.

Taken together, even though children still seem to be willing to accept information given by a previously inaccurate or ignorant informant in the absence of an alternative, their judgment of informants' knowledge states appears to make a difference in how much they accept information from them.

1-3. Children's understanding of other's knowledge and its relation with their social interaction

Children's understanding of other's knowledge state also affects their judgment of whether the other needs to be taught (Bensalah, Olivier, & Stefaniak, 2012; Strauss,

Ziv, & Stein, 2002; Ziv & Frye, 2004). Theoretically, as Olson and Bruner (1996) suggested, recognition of the knowledge difference between teacher and learner could be a prerequisite for teaching. Unless we are aware of another's ignorance or false belief about something, we will not have a reason to teach him. Ziv and Frye (2004) empirically found that 3- and 4-year-olds understand that teaching occurs when there is a gap between a teacher and a learner. They judged that a knowledgeable person should teach an ignorant other, not someone who is already knowledgeable. Nevertheless, before the age of 5, children did not seem to understand that the teacher's *belief* about the knowledge gap between teacher and learner is actually critical in the formation of teacher's teaching intention. For instance, only 5-year-olds, but not 3- and 4-year-olds, understood that when a teacher overestimates a learner's knowledge state, she will not try to teach, even though the learner is actually ignorant. This understanding of the role of belief about the knowledge gap between the learner and the teacher in teaching was related to their theory of mind performance.

Knowing about another's knowledge state also affects how children communicate with another, as well as what and how they actually teach him. As addressed earlier, infants and toddlers are willing to and able to give necessary information to fulfill their own goal (O'Neill, 1994) as well as another person's goal (Liszkowski et al., 2006; 2008). Moreover, recent emperical studies have shown that children's appreciation of another's knowledge develops with age and influences how they teach others (Ronfard & Corriveau, 2016; Wood, Wood, Ainsworth, & O'Malley, 1995; Ziv, Solomon, Strauss, & Frye, 2016). Contingent teaching—the practice in which a teacher provides more intervention and assistance when a learner did not succeed in

learning and reduces intervention if the learner succeeds--was more frequently found with 5- to 7-year-olds than 3- to 5-year-olds (Wood et al., 1995). In a subsequent study, Ziv et al. (2016) found that 4-and 5-year-olds better recognized the learner's ignorance than 3-year-olds did, and the 5-year-olds provided more contingent teaching than younger children. In a similar study, Gweon, Shafto, and Schulz (2014) found that when 5- to 7-year-olds were supposed to teach other, they provided the learner with less information when they shared background knowledge with them compared to when they did not share any common information. Thus, with age children come to understand that they need to adjust the amount of information they give to another depending on the interlocutor's knowledge state.

One relevant question about children's understanding of another's knowledge and its relation to their interaction with the person is whether knowing the other's knowledge is enough to govern their behavior in social situations. For instance, in previous studies (Liszkowski et al., 2008; Ronfard & Corriveau, 2016; Wood, Wood, Ainsworth, & O'Malley, 1995; Ziv, Solomon, Strauss, & Frye, 2016) when children teach others or were asked to teach others, we may ask why children provide relevant information. Is it simply because they are aware of the other's knowledge state, or do they also consider other things? Children might give relevant information to another because they understood what the person knew and did not know, but they might also think the person needed that information or would want to learn it. It is an open question whether children will try to teach when they know a person does not want or intend to learn. Even if someone has a specific knowledge state, we are likely to interact differently with him depending on what he wants, needs, or attempts to do. Which of these mental

states children consider in addition to the other's knowledge, and how they influence children's interaction with others is an interesting question that should eventually be examined.

2. Young Children's Understanding of an Individual's Intention

2-1. Development of the understanding of an individual's intention

In addition to other's knowledge state, another's intention could be another aspect children need to consider to behave and learn effectively in social situations. For instance, if another does not have any intention to let us know knowledge, or even has a bad intention to deceive us, we may need to re-think whether it is a good idea to learn from him. Also, self-aware and active learning usually involves a learner's intentional efforts to regulate ones' own learning, thus being aware of one's own intention could be critical to become a successful learner.

Initial studies of children's understanding of intention looked at whether children consider intention in making moral judgments. Early works inspired by Piaget (1948) generally concluded that children younger than 8 or 9 years were not able to understand intention or did not see the necessity to use intention to make a moral judgments (Grinder, 1964; Johnson, 1962; Whiteman & Kosier, 1964). In general, this research showed that when an intended action caused a few harmful outcomes and an unintended action caused many harmful outcomes, younger children tended to judge which action is worse based on the outcome. That is, they are likely to judge a person who caused many harmful outcomes unintentionally is worse than the character who caused a few harmful outcomes intentionally. However, subsequent research started to show that the studies in this

tradition may have underestimated children's understanding of intention (e.g., Buchanan & Thompson, 1973; Costanzo, Coie, Grumet, & Famill, 1973; Farnill, 1974). For instance, Nelson (1980) found children as young as 3-year-old can consider intention in moral judgments when the information is explicit and obvious.

Later research also started to look at children's understanding of intention outside of the moral domain. Other developmental research directly investigated how children distinguish an intended action from a non-intended one (Shultz & Wells, 1985; Shultz & Shamash, 1981; Shultz, Wells, & Sarda, 1980; Smith, 1978). Shultz et al. (1980) found that when an actor's (and their own) desire and intention match, children as young as 3 years could distinguish the actor's and their own intentional and non-intentional actions. When they were asked to pick a shiny penny over a dull one, but they picked the dull one because they were wearing distorting glasses, they could answer that they did not intend to pick the dull one. They also made the same judgment when someone else did the same thing. On the other hand, when they picked the shiny one without the glasses they could answer they meant to pick that one. However, this response could be because children use a desire-outcome matching strategy (Schult, 2002; Shultz & Wells, 1985) —in other words, when the outcome satisfies other's or their own desire (e.g., they picked the shiny penny), children can simply judge the action was intended one whereas when the outcome does not satisfy the desire, they can judge the action was not intended. Even if children use this desire-outcome matching strategy, it does not necessarily mean they really understand intention as a separate mental state from desire.

Subsequent studies have looked at how children understand intention when desire does not necessarily match with intention. For instance, Feinfield, Lee, Flavell, Green, & Flavell (1999) presented a situation in which a character had a preference for one activity (going to a mountain), but his mother asked him to do a disliked activity (playing football), and so he decided to do the activity. However, because of unexpected circumstances, the character finally happened to go to the location he initially preferred. Thus, the desire was satisfied, but his intention was not. When children were asked about desire and intention, only 4-year-olds, but not younger children, could say where the character wanted to go (desire), and where he was trying to go (intention). Similarly, Schult (2002) presented stories in which a character's desire was fulfilled, but intention was not, and vice versa. She found that 3- and 4-year-olds were not able to differentiate desires and intentions, whereas 5-, 7-year-olds and adults could. Taken together, during the preschool years, children start to understand intention as a separate mental state from desire, thus start to be able to distinguish intended and non-intended actions, even when the desire is not congruent with intention.

2-2. Understanding of other's and one's own intention

One question we can ask in relation to children's understanding of intention is whether there is any difference between children's understanding of their own and other's intention. One hypothesis would be that we have direct awareness of our own intention, whereas understanding of other's intention is only possible when we can infer it from available evidence (Anscombe, 1957; Stuart & Hart, 1958). That is, understanding of own intention is generalized to understanding of other's intention. Keasey (1977) gave

kindergarten children and 1st graders stories to have them make a moral judgment either in an other-oriented condition, in which a story character had a common name for the participant's sex, or a self-oriented condition, in which the participant was told 'pretend you were ~~' where the character had participant's own name so that the story character was the participant's agent. When children were asked to make a moral judgment (i.e., which one is naughtier), they used intention information more frequently in self-oriented condition than in other-oriented condition.

However, subsequent studies that directly compared children's understanding of another's and their own intention outside a moral judgment, found no other vs. self-oriented condition difference (Shultz & Shamash, 1981; Shultz et al., 1980). For instance, in a similar comparison as described above, Shultz et al. (1980; Experiment 1) had 3- to 8-year-olds perform intentional (picking a shiny penny) as well as mistaken actions (picking a dull penny) and they also observed other people completing the actions. When they were asked to identify whether the action was intended or not, children in all age groups could identify the presence of intention, regardless of whether they performed the action or observed someone else do it.

Schult (2002) also tested how children understand intention when the desire does not match intention in both story version tasks in which children needed to understand whether a character intended to do a certain behavior (Experiment 1) and a target-hitting tasks in which children themselves participated in a game in which the intended or not-intended outcomes occurred (Experiment 2). In the Experiment 1, 4- and 5-year-olds had difficulty tracking a character's intention when his intention was fulfilled but desire was

not satisfied although older children and adults could do so. In the Experiment 2, 4- and 5-year-olds, but not 3-year-olds, could correctly recall their own intention (e.g., which color they tried to hit) when they did not hit a target, but their desire was nonetheless satisfied. The 3-year-olds claimed they tried to hit the unintended target, when they accidentally hit it and it unexpectedly produced the right result. Overall, the findings indicated that 3- and 4-year-olds may have difficulty correctly understanding an intention when the intention and a desire do not match. However, these results make it difficult to directly compare whether children's awareness of their own intention is easier than understanding of other's intention because Experiments 1 and 2 differed significantly in their designs.

Thus, taken together, while some philosophical perspectives (Anscombe, 1957; Hampshire & Hart, 1958) and empirical evidence (Keasey, 1977) suggest that awareness of one's own intention appears first and is then applied to the understanding of other's intention, there is no unequivocal evidence for a difference in the rate of understanding of the two aspects of intention.

2-3. Infants' understanding of other's intention and its relation to their learning and social interaction

The studies above indicate that young children come to appreciate intention as a mental state that is distinctive from desire and action in early childhood. However, substantial research has also shown that even infants have an implicit or basic understanding of intention, and that it influences their reaction to and imitation of other's actions (Behne, Carpenter, Call, & Tomasello, 2005; Carpenter, Akhtar, & Tomasello,

1998; Meltzoff, 1995) and word learning (Baldwin, 1991; 1993). Meltzoff (1995) found that when 18-month-olds observe a person's failed attempt to do something (e.g., an experimenter tried to push a button using a stick tool, but missed), they could imitate the intended action, rather than the mistaken action. This finding indicates that infants can understand a goal-directed action, and imitate that action based on the understanding. Baldwin (1991, 1993) found that 16- to 19-month-olds consider a speaker's nonverbal cues (e.g., where the speaker looks while saying a new name) to interpret the referent of novel labels. This finding indicates that even infants consider what the other person intends to refer to, and they pay attention to the world-object link based on the reference.

In addition to infants' awareness of others' intention, some research indicates that a basic capacity to share intentional relations with others appears from very early ages (Bakeman & Adamson, 1984; Brownell, Ramani, & Zerwas, 2006; Gräfenhain, Behne, Carpenter, & Tomasello, 2009; Ross & Lollis, 1987; Warneken, Gräfenhain, & Tomasello, 2012). For example, Warneken et al. (2012) found that when a partner who was engaged in a shared activity using an apparatus suddenly stops the social game, 21-month-olds encourage the partner to start again, regardless of whether the partner is physically needed or not. Furthermore, they more frequently encouraged the partner when the partner was *unable* to continue than when she was *unwilling* to do, and the authors interpreted that infants consider another's intention and they want to encourage him when there is no evidence that the person is not willing to continue.

In a similar vein, Grafenhain et al. (2009) demonstrated that 3-year-olds reacted differently to a joint-commitment situation in which the researcher explicitly explained

that she would play a game with the child and collaborated contingently compared to when no explicit commitment had been made. When the explicit joint commitment was made and the child had to quit the game, both 3- and 4-year-olds were more likely to leave the researcher by saying something like, “I am not playing with you anymore” or by giving the tool used in the activity to the researcher. These results indicate that children are able and willing to engage in shared intentional activities with others from early ages, and their participation in social situations may vary depending on the degree of joint involvement.

To sum up, while explicit understanding of intention as a separate mental state from other mental states or outcomes in the physical world may appear at the end of early childhood, human beings may have some implicit understanding of other’s intention and the capacity to participate in joint-intentional relation with others using physical objects from infancy or toddlerhood.

2-4. Children’s sensitivity to pedagogical situations

Children’s understanding of intention, especially awareness of another’s intention to convey information or knowledge could be important to learn effectively from social situations. A recent growing body of literature has shown that from very early ages human beings have sensitivity to pedagogical situations in which someone conveys information intentionally with certain cues. This line of inquiry proposes that human babies have a kind of innate tendency to regard certain information that is transmitted by others with ostensive and communicative cues as a generalizable and kind-relevant (Natural pedagogy; see Csibra & Gergely, 2009). From this perspective, much research

showed that children generalize information further (Topal, Gergely, Miklosi, Erdohegyi, & Csibra, 2008; Träuble & Bätz, 2014; Egyed, Király, & Gergely, 2013), imitate actions more (Gergely & Csibra, 2005;Southgate, Chevallier, & Csibra, 2009), and transmit novel function of object to other persons longer (Vredenburgh, Kushnir, & Casasola, 2015) when the target information is accompanied by adults' communicative and pedagogical cues such as eye contact, child-directed speech, and generic language, name referral and gaze shifting.

For example, when 8-month-olds were presented with how to use a given tool accompanied by an experimenter's communicative cues of eye contact, child-directed speech, and gaze shifting, they showed a better tool use sequence than then when they saw the same information without those cues (Sage & Baldwin, 2011). Similarly, Träuble and Bätz (2014) found that 12-month-olds treat certain emotions as more generalizable to a specific object when the emotion was conveyed in a communicative context accompanied by eye contact. In their experiment, experimenter 1 showed her emotion to a new object (e.g., the person was disgusted) with or without eye contact and communicative cues, and then a second experimenter chose the object that previously disgusted experimenter 1. They found infants were more surprised and looked at the situation longer when the first experimenter previously showed her negative emotion with the communicative cues than without them. This difference indicates that human babies are sensitive to other's communicative cues to convey knowledge, and they regard the information given with those cues as more generalizable one to other contexts.

Butler and Markman (2012, 2014, 2016) investigated how older children react to and learn under similar pedagogical situations. In their initial study (Butler & Markman, 2012), 3-year-olds exhibited less generalization of a novel object property (e.g., blicket's magnetic property) in an accidental condition in which the property was accidently presented by the adult without any communicative cue including eye contact, than in the intentional condition that the property was intentionally shown but without the cues or in the pedagogical condition in which it was presented with eye contact and researcher's statement of, "Look, watch this." However, they did not show any difference in generalization between the intentional and pedagogical conditions. On the other hand, 4-year-olds' generalization of object properties was comparable between accidental and intentional conditions, but higher in the pedagogical condition. This result indicated that 4-year-olds differentiate pedagogical conditions from other social conditions in which an intentional action is shown but without an attempt to teach.

Nonetheless, their study did not answer the question of why infants were sensitive to pedagogical conditions in previous studies, but 3-year-olds were not in their study. In order to address this issue, they conducted another study (Experiment 2 in Butler & Markman, 2016) in which a cover story was involved so that the intentional and accidental conditions did not give children any implicit impression that they were being invited to the experimental situation to be taught something. In this way, they made the difference between the pedagogical condition and non-pedagogical conditions (accidental and intentional) clearer. The results showed that both 3- and 4-year-olds exhibited more generalization of the object property in the pedagogical condition than in the other two. The authors concluded that 3-year-olds are already sensitive to pedagogical contexts, but

they seem not to know how to apply this sensitivity selectively. Between the ages of 3 to 4 years, children come to develop the capacity to differentiate social situations more selectively so that they are better able to learn from others.

2-5. Development of explicit understanding of teaching intention

One question in relation with children's pedagogical cues is whether infants really perceive someone's pedagogical cues as signs to teach something, or their understanding is implicit. In other words, the reason why infants accept and generalize more information when it is conveyed with another's pedagogical cues could be because there are some social signs and sounds, so they regard the moment as one that is worth paying attention to rather than as teaching. Thus, examining children's understanding of teaching intention after occurrence of early sensitivity to pedagogical cues could give some information of whether there is a developmental change in terms of children's understanding of teaching.

Some studies have found that an explicit differentiation between teaching and no teaching situations develops during early childhood (Jeong & Frye, 2018; Cavadel & Frye, 2017; Ziv et al., 2008; Ziv et al., 2016). In these studies, only older preschoolers, but not younger ones, seem to be able to distinguish which situations involve the intention to teach and which ones do not, regardless of the success of learning. That is, older preschoolers, especially 5-year-olds could correctly judge teaching and no teaching based on whether there was an informant's intention to teach no matter whether the learning was successful or failed. In contrast, younger preschoolers tend to attribute successful learning to teaching, even when the informant does not have an intention to

teach. In addition, only older preschoolers could understand that instructional goals can be hidden in teaching activities.

Jeong and Frye (2018) also found that the better understanding of intentionality of teaching that preschoolers had, the better they learned when they were told the specific goal of a teaching activity. This study assessed how well young children were able to judge an informant's teaching intention, and it also measured how much novel information they learned either in a direct condition in which the goal of teaching activity was stated or in an indirect condition in which the goal was not stated at all. The results showed that the direct condition in which the specific teaching goal was stated caused better learning but only for the children who could judge the intentionality of teaching situations. This finding indicates that children's explicit understanding of the intentional aspect of teaching that occurs in early childhood may allow children to better appreciate and cooperate with the specific goal of a teaching activity, thus learn better when they are told the instructional goal.

Taken together, while there is a growing body of work that addresses how human beings are sensitive to others' cues to convey knowledge from very early ages, more research is needed to understand whether there is any qualitative change across early sensitivity to pedagogical situations and children's understanding of teaching situations that involve specific instructional goals.

3. Development of Children's Understanding of Learning

3-1. Children's awareness of own learning and source monitoring

As addressed above, recent developmental research indicates that children come to understand the intentional aspect of teaching in early childhood. Given teaching is one of most frequently experienced means of learning (Skerry, Lambert, Powell, & Mcauliffe, 2013; Strauss et al., 2002), the development of children's understanding of teaching in early childhood also indicates that children also become better at understanding the nature of learning in this period as well. In fact, the theory of mind literature has shown that children's awareness of their own knowledge acquisition and understanding of different means of learning develop in early childhood (e.g., Astington & Pelletier, 1996; Esbensen et al., 1997; Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Taylor et al., 1994; Wimmer et al., 1988). Early on, young preschoolers do not closely attend to a change in their own knowledge or the sources of that knowledge, but with age their understanding of knowledge acquisition and the ways through which knowledge is gained develops.

For instance, 4-year-olds claim they have always known recently learned information after being taught it, whereas 5-year-olds better understand that their knowledge has changed (Taylor et al., 1994). Children's difficulty with recognizing knowledge acquisition seems to be more pronounced when the knowledge is about vocabulary or factual information (e.g., the meaning of Japanese counting words) than when the knowledge is behavioral (e.g., how to count in Japanese) (Esbensen et al., 1997).

In addition, even if young children can recall what they have learned, they seem to have much more difficulty reporting the source of the knowledge (Gopnik & Graf,

1988; O'Neill & Gopnik, 1991; Wimmer et al., 1988; Whitcombe & Robinson, 2000). For instance, Gopnik and Graf (1988) found that 3-year-olds have more difficulty recalling how they gained a piece of knowledge–-whether they saw, heard, or inferred it from some clues, although they could easily recall the knowledge itself (e.g., what was inside of several drawers). In contrast, 5-year-olds could answer correctly not only what they have learned, but also how they came to have the knowledge.

Young children's difficulty in recalling where their knowledge came from could be relevant to their lack of source monitoring ability. Source monitoring refers to the cognitive process through which individuals recognize and distinguish memories from different sources of information (Lindsay, 2002; Roberts, 2000). For instance, children can remember someone told them chocolate is in a living room, but they may not be certain whether the person who told that was their mother or father. If they want to decide correctly, they need to recall particular sources or origins of where the memory came from, which requires source monitoring.

Research on children's source monitoring has indicated that even very young children's memory about past experiences tends to be accurate if their experiences of the procedures make sense or are meaningful (Fivush & Hamond, 1990; Jones, Swift, & Johnson, 1988; Perris et al., 2017). Jones et al. (1988) found that when the researcher asked about specific objects that were used during an experimental session, 4-year-olds could recall more about the objects than 3-year-olds. However, when they were asked about what occurred during the session, there was no age difference in how much the

children could recall. Such results suggest that the type of memory solicited from children makes a difference for their memory and source monitoring.

However, numerous findings show there is an age-related increase in recall ability and source monitoring (Foley & Johnson, 1985; Lindsay, Johnson, & Kwon, 1991; Markham, 1991; Markham, Howie, & Hlavacek, 1999; Parker, 1995). These studies demonstrate that with age children's capacity to distinguish sources of information improves substantially. For example, when children heard stories from speakers who physically resembled each other, older children were less confused than preschoolers in distinguishing events (Lindsay et al., 1991). Also, when 3- to 8-year-olds were asked to do certain everyday actions (e.g., talking on the phone) using a substitute object (e.g. a wooden block), older children more correctly recalled that they used the substitute, whereas preschoolers frequently made the inaccurate claim that they used the relevant object (e.g., a toy telephone) (Foley, Harris, & Hermann, 1994). The authors explained that functional similarity may cause young children's difficulty in source monitoring judgment.

Researchers have claimed that there is a qualitative change in source monitoring ability that appears between the ages 3 to 8 years (See Quas, Schaaf, Alexander, & Goodman, 2000). During this period children's understanding of whether and how they themselves gained knowledge also develops (e.g., Astington & Pelletier, 1996; Esbensen et al., 1997; Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Sobel & Letourneau, 2015, 2017; Taylor et al., 1994; Wimmer et al., 1988). Thus, even though how children's source monitoring is relevant to children's awareness of their own learning has not been

examined directly, given that the two develop around the similar period, and that core parts of source monitoring involve children's recall of where knowledge or memory comes from, these two aspects could be relevant to each other theoretically and developmentally.

3-2. Children's understanding of learning during early childhood

Recent studies have directly examined how young children recall their own leaning (Bartsch, Horvath, & Estes, 2003;Sobel, Li, & Corriveau, 2007; Sobel & Letourneau, 2015; Tang, Bartsch, & Nunez, 2007; Tang & Bartsch, 2012). In natural conversations about learning, young children more frequently talked about the contents of learning (i.e., what they learned) rather than the process (i.e., how they learned) or the sources of knowledge (i.e., where or when they learned) (Bartsch et al., 2003; Sobel et al., 2007). However, children aged from 4 to 5 years more frequently talked about the source or process of knowledge than 2- to 3-year-olds, which suggests that there is an age-related change in the recognition of own learning and the process of learning (Sobel et al., 2007).

Sobel and Letourneau (2015) asked children aged from 4 to 10 years what the word 'learning' means, what they learned, and how they learned certain things. They found that 4- and 5-year-olds still have difficulty offering a definition of learning (39.53% of the group gave no answer), and 41.86% of this group gave process-based responses that identified learning as involving a source (e.g. ''when your teacher tells you something'') or a strategy (e.g. "when you practice again and again until you know it''). In comparison, the older groups exhibited less difficulty giving a definition (10.26 % and

0% of 6- to 7-year-olds and 8- to 10-year-olds gave no response) and more frequently exhibited process-based responses (66.67% and 94.74% of 6- to 7-year-olds and 8- to 10-year-olds respectively). Not surprisingly, older children could give more examples of what they have learned, and they also generated more source examples (e.g., from my teacher, in school) and strategy examples (e.g., active process through which knowledge is acquired--practicing, reading etc.) for the question, "How did you learn that?" These results based on open-ended questions are meaningful in that it increases our understanding of children's natural awareness of their own learning. However, given much language or other cognitive capacities might be needed to answer such open-ended questions, especially when the questions ask children to recall abstract cognitive phenomena, it could be needed to consider if young children's appreciation of learning is undermined in the research procedures.

Some studies also investigated bow children recognize and judge learning, using hypothetical learning stories (Sobel, 2015; Sobel & Letourneau, 2017; Sobel et al., 2007). When children were asked to judge whether learning occurred or not in vignettes, younger preschoolers mainly considered the learner's desire (i.e., whether the individual wanted to learn) or the learner's ability to demonstrate his knowledge, whereas older preschoolers tended to consider more diverse mental states, such as the learner's desire, attention and intention (Sobel et al., 2007; Sobel, 2015). Sobel and Letourneau (2017) also found that when preschoolers were told a set of stories in which a character learns about a new toy, either through his own action (e.g., by pushing a button etc.) or by being taught by an adult, older children compared to younger ones, better distinguish learning through a learner's action and another's instruction. When they were asked how the

learner learned how the toy works in the stories, younger preschoolers aged from 3 to 4.5 years, compared to older ones, more frequently overemphasized a learner's action (e.g., He pushed the button) even in the stories that the learner was just taught by an adult. These results indicate that young children's understanding of learning from a mentalistic perspective develops and their recognition of teaching as a means of learning also may increase in early childhood.

However, even though there has been research investigating children's development of the awareness and understanding of learning, whether young children understand learning as a change in mental states has typically not been asked. One definition of learning from a mentalistic perspective is that learning involves a change in knowledge or belief. Wang (2010, p.15) explained that a "knowledge change is necessary and sufficient condition for learning." In contrast, a definition of teaching from the same perspective (Frye & Ziv, 2005; Ziv & Frye, 2004; Ziv, Solomon, & Frye, 2008) specifies that teaching depends on a belief of knowledge difference between a teacher and a learner (i.e., the teacher should believe there is a gap between a learner and himself) and the teacher's intention to increase the learner's knowledge, skills or understanding of something.

According to these definitions, for learning, a learner does not necessarily need to be aware of the difference in knowledge between himself and the teacher, and sometimes the learner can learn something without the specific intention to learn it. For instance, a baby can learn that there is a toy is in a drawer by seeing someone put it there, but he may acquire the information without the awareness that he does not know it so

needs to learn it. Also, the baby may learn the location of toy incidentally without specific intention to learn—he could have just learned simply because the information is shown. Similar cases of learning can happen to adults as well. While waiting at a bus stop, we may hear that there will be an interesting social event in our town, and learn this information without any intention to learn. Thus, even though teaching and learning are complementary human activities, participants' mental states that are engaged or needed to make them occur could be different.

Going back to the definition that learning involves a change in knowledge, Wang (2010) found that 5- and 6-year-olds, but not younger children, judge whether learning occurred based on the presence of change in knowledge. Only the older children understood that even if a teacher teaches something, if a person already has that knowledge, then we cannot judge the person learned it now. The change in children's responses indicates that in early childhood children come to understand that learning is dependent on whether a change in knowledge occurs. Nevertheless, except for Wang's studies, to date there has been no research that directly examined how children come to understand learning as a change in knowledge or representation of the world, and how this knowledge-based understanding of learning is related to their own learning.

4. Children's Metacognitive Development and Learning

4-1. Metacognition and its constructs

If children come to be aware of their own learning, and understand the nature of learning from early childhood, an important question might be what implication this emerging understanding has for their own learning. Research on metacognition may give

some clues to examine this issue because the understanding of learning such as what learning is, when learning occurs and what is important to learn successfully could form an important basis for metacognitive knowledge. Despite many attempts to identify the constructs of metacognition, there has been little agreement on its definition (Hacker, Dunlosky, & Graesser, 1998; Tobias & Everson, 2000). Nevertheless, in general, metacognition refers to the individual's ability to monitor, evaluate, and plan for their thinking and learning (Tobias & Everson, 2000).

Flavell (1979) theorized that metacognition consists of metacognitive knowledge and metacognitive experiences. According to him, metacognitive knowledge is knowledge or beliefs about what factors affect and interact with our cognitive enterprise and how they do so. He identified three major categories of those factors--person, task and strategy. Metacognitive knowledge of person includes any beliefs or knowledge about myself and others as a cognitive agents. For instance, if a child has a belief that he is better at math than reading, it might be one piece of person-related metacognitive knowledge. The task category includes knowledge about which variables or factors should be managed to fulfill a certain goal. For instance, knowing task A is more demanding cognitively than task B could be an example of task-related metacognitive knowledge. Metacognitive knowledge in the strategy category involves understanding which strategies are better or effective in achieving goals. Flavell argues that most metacognitive knowledge actually involves a combination of multiple categories out of three.

Metacognitive experience is any cognitive or affective experiences that involve the intellectual enterprise (Flavell, 1979). For instance, being aware where I am located in my enterprise, how much I have done or how much I am confident about certain tasks are some examples. Metacognitive experiences can modify a person's metacognitive knowledge. For instance, if a person experiences that a certain strategy does not work for a certain task, he may need to adjust or modify his belief about the strategy.

Sometimes researchers also identify two other constructs of metacognition--knowledge about cognition and control of cognition (Mccormick, Dimmitt, & Sullivan, 2012; Veenman, Van Hout-Wolters, & Afflerbach, 2006). Another similar, but a slightly different framework conceptualizes metacognition as involving three components--knowledge of metacognitive processes, monitoring of metacognitive processes, and control of metacognitive processes (Pintrich et al., 2000).

Knowledge of metacognitive process is similar to Flavell's concept of metacognitive knowledge. It involves knowledge about any specific cognitive task that individuals need to deal with, awareness of own ability, and some strategies that can be used (Serra & Metcalfe, 2009), as Flavell identified.

In comparison to metacognitive knowledge, monitoring of metacognitive process involves more process-related and ongoing metacognitive activities that people engage in. Pintrich et al. (2000) identified four general process: judgment of task difficulty/ease (e.g., judging whether a certain task will be easy or difficult), monitoring or judgment of learning/own comprehension (e.g., knowing that one does not understand the thing that he was just told), feeling of knowing (e.g., recognizing that one knows something but

cannot recall it on demand), and judgment of confidence (e.g., determining how likely a response or answer is appropriate or correct).

Third, self-regulation and control refer to activities that people engage in and use to change their behavior or cognition. Some regulation and control activities include planning (e.g., plan and set up a goal for learning, time use), strategy selection and use (e.g., deciding which strategies to use and change), allocation of resources (e.g., control and regulation of time use, efforts), and volitional control (e.g., control of regulation, motivation and emotion). In many models of metacognition, control and monitoring are dependent on each other, but metacognitive control and monitoring can be conceptualized as separate process as well (Nelson & Narens, 1990; Zimmerman, 1990). Even though it is empirically difficult to distinguish monitoring activities (evaluating own learning, assessing own comprehension) and regulating activities (changing cognition or behavior to perform a task), it is possible to distinguish them conceptually (Pintrich et al., 2000).

4-2. Theory of mind and early metacognition development

Flavell (1992) indicated that it was Piaget's developmental stage of formal operational thinking that allows children to understand cognitive enterprises, hypotheses, and representation of the world that make possible metacognitive ability development. That is, in this stage, children become to construe or think about the representational world beyond physical phenomena. Piaget also suggested that young children's egocentrism hinders them from using their own thoughts and thinking processes as objects of thought (Inhelder & Piaget, 1958). Thus, traditional developmental

perspectives regarded young children before the stage of formal operational thinking as not being ready to understand one's own thinking and processes metacognitively.

However, from the1980's, a wave of studies on young children's mental state understanding, so called theory of mind research, started to shed light on how children come to understand the mental representation of events, which give some clues or early indicators of metacognitive development (see Schneider, 2008). The main findings of the theory of mind literature showed that there is a significant change in children's cognitive capacity to take another's perspective between the ages of 3 and 5 years. At this point, children come to understand representation of the physical world or events do not necessarily correspond to the reality (see Perner, 1991). The theory of mind research has also investigated young children's understanding of their own thinking as an mental activity (Flavell, Green, Flavell, & Grossman, 1997; Flavell, Green, & Flavell, 2000), the understanding of biased interpretation (Pillow & Weed, 1995), and awareness of knowledge change or acquisition (Esbensen et al., 1997; Gopnik & Graf, 1988; O'Neill & Gopnik, 1991), which are conceptually related to parts of metacognition. Thus, even though the connection between metacognition and theory of mind was not often directly addressed in literature, both areas certaintly shared research domains (Schneider, 2008).

Lockl and Schneider (2007) identified three steps in theory of mind development in relation to metacognition, especially metamemory, and these steps may give some clues to understand early metacognitive development. Metamemory refers to people's knowledge about memory and the needed skills to monitor and control their own memory activities. First, children may need to understand knowledge is gained through a certain

informative experience. This understanding includes children's ability to infer another's knowledge or ignorance based on the presence of perceptual access, a capacity which seems to appear by 4 years (Knudsen & Liszkowski, 2012; Liszkowski et al., 2006, 2008; Pillow, 1989; Pratt & Bryant, 1990). The development of false belief understanding is also a change that could occur in this step. That is, children come to understand that knowledge and false belief are products of particular informative or misleading experiences.

According to Lockl and Schneider (2007), in the second step, children gain a fuller understanding of the mnemonic conceptions as children's understanding of mental verbs such as "remember" and "forget" implies (Wellman & Johnson, 1979). In Wellman and Johnson (1979), children aged from 3 to 7 were told several stories in which a character initially had knowledge or not (e.g., knew where their coat was hanging or not) and successfully performed a certain task or not (e.g., picking the right location of the coat or not). When they were asked whether the character forgot or remembered where the coat was, 4-year-olds only considered the character's performance, but older children could consider not only the performance but also the previous knowledge. The authors explained that there is a developmental progression in understanding of mental verbs, which indicates that children come to understand verbs that are based on cognitive states rather than overt behaviors. Such understanding may allow children to better recognize their own mental states, and what status they have.

In the third step, or simultaneously with the second step, Lockl and Schneider (2007) explained that as children gain a conception of individuals' memory, they start to

be able to understand how their memory works and what variables affect their memory. For instance, children may understand it is difficult to remember many items rather than just a small number of ones. Studies on the development of metamemory showed that children become able to understand some factors that influence the difficulty or ease of memory performance in early childhood, and this ability continues to develop over several years (Kreutzer, Leonard, & Flavell, 1975; Wellman, 1977, 1978). For instance, in Wellman (1977), children aged from 3 to 5 were presented with pairs of drawings that compared factors that can influence memory performance (e.g., boy with 18 objects to remember vs. a boy with three objects, a boy trying to remember items by himself vs. a boy with someone who can help him), and then the children were asked to rate the relative memory difficulty of the drawings in each pair. Results showed that by 5 years children were able to identify most of the variables that can influence memory, such as number of items, age, noise, help, and cues.

Several recent studies have further examined how children's theory of mind is related with children's metacogntion empirically (Lockl & Schneider, 2007; Lecce, Bianco, Demicheli, & Cavallini, 2014; Lecce, Demicheli, Zocchi, & Palladino, 2015; Lecce, Zocchi, Pagnin, Palladino, & Taumoepeau, 2010). In a longitudinal study, Lockl & Schneider (2007) investigated the relations among language abilities, theory of mind, and metamemory of young children aged from 3 to 5 years. For the metamemory measurement, children were asked which memory strategy is better between two alternatives (e.g., systematic search of some places where he went to find a missing object vs. comprehensive search of all the rooms to find a missing object), and which conditions help them better memorize information (e.g., child A who has more time to

study vs. child B who has little time). The results showed that both early language and theory of mind made unique contributions to metamemory at age 5.

Similarly, Lecce et al. (2010) found that 2nd and 4th graders' metaknowledge about reading (e.g., knowing that understanding the content of the text is more important than simply reading loudly or quickly, knowing it is better to use rest of the sentence to understand unclear text rather than trying to guess or skipping) is related with their mental state knowledge. They also found that children's mental state knowledge predicts metaknowldge about reading one year later, controlling for childrne's verbal ability. Thus, the research findings indicated that childrne's general mental state understanding may have unique relations to metacongition development.

Taken together with theory of mind development, metacognition seems to be already present in early childhood, even though both continue to develop substantially over the elementary and secondary school years (see Schneider, 2008). However, the research on how theory of mind contributes to early metacongition development is still scarce (Lockl & Schneider, 2007; Schneider, 2008). Given that theory of mind research could contribute to the understanding of human development and learning when it is connected to other lines of theoretical and empirical inquiry and broader lifespan contexts (see Khun, 2000), it would be certainly meaningful to examine how children's growing mental state understanding is related to metacongnitive development, and how it impacts children's thinking and learning.

4-3. Metacognition and academic achievement

Given that metacognitive knowledge is children's knowledge about cognitive enterprises and factors that interact with and influence cognitive tasks (Flavell, 1979; Serra & Metcalfe, 2009), children's understanding of learning, such as what learning is and what factors influence learning, could become an important part of early metacognition. Much research has shown how learners' metacognition is related with academic achievement in diverse domains. Even though most research involved older children rather than preschoolers, or adolescents and adults, such research can give some clues to investigate how emerging understanding of learning can influence children's own learning and development.

Successful readers know how to read texts effectively, judge the purpose of reading, and are able to judge whether they understand and remember the texts, and all these abilities involve metacognition (Kamil, Mosenthal, Pearson, & Barr, 2000; National Reading Panel, 2000; Pressley & Afflerbach, 1995). Research has also shown that readers without these metacognitive strategies have difficulty understanding and remembering what they have read (Brown, Armbruster, & Baker, 1986; Dunlosky & Lipko, 2007; Griffin, Wiley, & Thiede, 2008). For instance, in a study on college students' reading and monitoring of their own comprehension, readers with low comprehension ability also had less monitoring accuracy, so they had difficulty monitoring how well they understood the texts they just read (Griffin et al., 2008).

Metacognition is important in problem solving in math and science as well (Carr, 2010; Davidson & Sternberg, 1998). In Davidson and Sternberg (1998)'s model, an important first step in problem solving is to identify problems to solve, and this step

includes formation of mental representation of the problem so that the person can organize and combine information and decrease memory demand to solve the problem. The mental representation of the problem allows individuals to monitor solution strategies and generalize the problems beyond superficial feature of the task. Then, an appropriate strategy can be chosen and be monitored. One main difference between experts and novices in math is in their use of metacognitive ability in problem solving (Carr, 2010). Whereas unskilled solvers just read problems and use trial-and-error strategies to answer math questions, skilled solvers spend enough time to analyze given problems, plan and confirm the results of strategy they choose. It has been shown that students who are good at mathematics were also good at predicting outcomes, planning ahead, monitoring, and evaluating their work (Lucangeli & Cornoldi, 1997; Lucangeli, Cornoldi, & Tellarini, 1998). Similarly, elementary school students who were able to calibrate their own math performance also had higher mathematics achievement (Desoete & Roeyers, 2006),

One common feature of successful learners is that they monitor whether they understand or do not understand something, and know when and how to use effective strategies to learn (Mccormick, Dimmitt, & Sullivan, 2012). Findings show that students' recognition and monitoring of what they know and do not know is closely related with their academic achievement (Isaacson & Fujita, 2006; Tobias & Everson, 2002). Through a dozen studies with learners in diverse age groups, Tobias and Everson found that learners who can differentiate what they know and do not know are likely to be academically better and learn more than ones who have difficulty identifying their own level of ability or knowledge. For instance, college students who have more accurate

metacognitive judgments about whether they did or did not know certain vocabulary items received better scores in a vocabulary comprehension test (Tobias & Everson, 2002). Similar results were found regarding elementary children's mathematical ability, indicating that children who better estimated whether they could solve certain math problems or not scored better in math tests, and children's metacognitive knowledge monitoring ability to estimate their own performance appears to increase from grades four to six (see Tobias & Everson, 2000).

Such results are plausible because if learners do not differentiate what they know and do not know, they will have difficulty determining whether they need to invest more effort and cognitive resources to understand the task or find some other ways to solve the problems (Tobias & Everson, 2000, 2002). In other words, accurate differentiation between what they know and what they have yet to learn allows learners to better focus their attention and efforts on the material they need to learn.

However, we need to note that the appropriate allocation of cognitive efforts and resources to knowledge to be learned is possible only when the learner can identify the knowledge that they do not know yet as what they need to learn. If the person does not think in this way, even if he recognizes his ignorance correctly, he may not find a reason to put more effort or resources to learn the task or knowledge that he does not know. Rather, the person could just want to focus on the task or knowledge that he already knows or is confident about. Thus, along with a correct recognition of one's own knowledge or ability, a fundamental question may be when children identify knowledge that they do not know yet (not the knowledge that they already know) as what they need

to or want to learn. Also, another important point is whether and how learners benefit from gaining this knowledge-based reasoning.

4-4. Self-regulated learning

Metacognition is frequently considered in relation to self-regulated learning. In some respects, self-regulated learning could be a kind or subcategory of metacognition. It may be a part of metacognitive experience that Flavell, 1979 identified or of monitoring and control that Pintrich et al. (2000) conceptualized. However, Zimmerman (1995) argues that self-regulation is broader than metacognition. Thus, the literature frequently distinguishes metacognition and self-regulated learning as separate terms. Self-regulated learning generally refers to learning in which learners set their own goal for learning, actively monitor and adjust their own cognitions, affect and behaviors to gain their goals (Pintrich, 2000; Zimmerman & Schunk, 2011). Self-regulated learning not only includes individualized forms of learning, but also active learning from others, including seeking help from others.

Many models of self-regulated learning propose a time-oriented sequence or steps that individuals go through in regulating their learning (Azevedo, 2009). For instance, Winne and Hadwin (1998) identified four steps of studying: 1) task definition stage in which a learner identifies what the task is and what resources the person has, 2) goal and plan stage in which the learner sets up the goals and plans to do the task, 3) enactment stage in which that the person carries out the plans, and 4) adaptation stage in which the person updates and makes some changes to his/her cognitive structures, such as motivation and beliefs based on his experiences of previous three stages.

Similarly, Pintrich identified four phases of self-regulated learning (Pintrich, 2000; Schunk, 2005). They are: 1) forethought, planning and activation phase, 2) monitoring phase, 3) control phase, and 4) reaction and reflection phase. In the forethought, planning and activation phase, a learner sets goals, and activates prior content knowledge (e.g., think about what I know about this domain or subject area), and employs metacognitive knowledge including declarative knowledge (e.g., think about learning strategies such as rehearsal or note taking), procedural knowledge (e.g., how to use appropriate strategies) and conditional knowledge (e.g., when and why use different strategies).

The second phase, cognitive monitoring, involves cognitive awareness and monitoring of diverse aspects of cognition, which was labeled 'metacognition' classically (Flavell, 1979; Koriat & Goldsmith, 1996). In this phase, a learner makes metacognitive judgments, such as judgments of learning (JOL), and comprehension monitoring, such as thinking whether I understood the text that I just read or whether I am ready to take a test. Feeling of knowing (FOK; Nelson & Narens, 1990; Koriat, 1993) is another kind of metacognitive awareness that occurs in this phase. It occurs when a person cannot recall information explicitly, but nonetheless feels he knows it.

In the cognitive control phase, individuals adapt and change their cognition. Controlling activities is closely related to cognitive monitoring. Thus, in many empirical works, the controlling (phase 3) and monitoring (phase 2) are not clearly distinct from each other (Pintrich et al., 2001). However, the central aspect of cognitive control might be that a learner actually uses diverse cognitive strategies to memorize, learn and solve

problems. For instance, a learner can use various strategies, such as rehearsal, elaboration, note taking, paraphrasing, and organizational strategies, depending on the particular task.

Lastly, in the reaction and reflection phase, a learner judges and evaluates their performance on the task, and makes attributions for their performance. Weiner (1979) identified several frequent attributions for performance, including ability, effort, task difficulty, and luck. It is known that learners who attribute their success to ability and effort are likely to make more effort in future tasks and individuals who attribute failure to a lack of effort are likely to think they can do better if they try harder in the future (Weiner, 1979; Graham & Williams, 2009). Also, in this phase, individuals may make a decision about how to do the next task after checking their performance.

Even though Pintrich (2000) identified four phases for self-regulated learning, he also explained that those phases are not necessarily sequential, and may frequently occur simultaneously. In addition, not all learning occurs following these phases. Sometimes, individuals learn knowledge in more implicit or unintentional ways without specific monitoring or control.

As addressed in the above section, the research has shown that self-regulatory processes in learning allow students to learn better in diverse academic domains, and succeed in school (See Tobias & Everson, 2002; Wigfield, Klauda, & Cambria, 2011). That is, learners who can proactively manage their own learning through goal setting, monitoring and regulating their cognition and resources, and evaluating learning can learn more effectively and be successful academically. Consequently, a developmentally important question might be when children can start self-regulated learning, and what

understanding of learning or prerequisites are needed to manage and regulate their learning. Answering this question could be helpful not only to understand children's learning, but also to determine appropriate educational practices and support children's self-regulated learning based on children's development.

The Present Study

Based on the existing literature, the current dissertation aims to examine children's understanding of learning based on the mental states of an informant and a learner, and to examine the relation of this understanding to children's own learning. To be specific, Part 1 will explore how children construe social situations with others as prospective learning contexts based on an informant's knowledge state and teaching intention, and whether this understanding is actually applied to their own learning through Studies 1 and 2. Part 2 will broaden the framework to include not only the informant's but also the learner's mental state through Studies 3 to 5. It will look at how children judge a person's intention to learn and whether learning occurred based on the informant's teaching intention and the learner's knowledge state. It will also investigate whether this judgment is applied to their own learning and behaviors.

The following are more specific research questions of each study.

Part 1

1. Study 1-- How do young children predict a character's intention to learn and judge the learning outcome of a learning situation when there is information about both the informant's knowledge state (knowledgeable, neutral, ignorant)

and teaching intention (tries to teach, does not have intention to teach)?

2. Study 2 -- How well do young children actually learn when they have information about an informant's knowledge state (knowledgeable, ignorant) and his teaching intention (tries to teach, does not have an intention to teach)?

Part 2

3. Studies 3and 4 -- How do young children judge another's learning based on the learner's knowledge state and an informant's teaching intention? To be specific, how do children predict a character's intention to learn and judge whether learning occurred when information of the character's knowledge state (knowledgeable, neutral, ignorant) and an informant's teaching intention (tries to teach, does not have intention to teach) are given?

4. Study 5 -- How do young children judge not only another's but also their own learning based on knowledge state? To be specific, how do children predict a learner's intention to learn and whether he has learned knowledge when there is information about the learner's knowledge state? Is this knowledge-based reasoning used to judge their own learning, such as the necessity and desire for learning and whether learning occurred? Moreover, do children's knowledge-based judgments of another's and their own learning contribute to their actual learning from an experimental learning situation and to their everyday learning related behaviors?

CHAPTER 3

PART 1_ CHILDREN'S PREDICTION OF LEARNING AND ACTUAL LEARNING BASED ON AN INFORMANT'S KNOWLEDGE STATE AND TEACHING INTENTION

Study 1

1. Research Questions and Design

Study 1 aimed to see how children evaluate social situations as learning contexts when there is information of an informant's knowledge and teaching intention. Even though children learn much knowledge from social situations with others, it may not be the case that all kinds of social interactions with others are beneficial for their learning. Given learning requires a change in knowledge (Knutsen et al., 2014; Wang, 2010), some situations should be beneficial for increasing knowledge, but others should not. Study 1 intended to look at how children evaluate the value of learning from others and how they expect the learning outcome when there is information of the informant's knowledge state and teaching intention.

To be specific, Study 1 examined how children predict whether a person will try to learn knowledge from an informant and whether the person can learn successfully based on an informant's knowledge state and intention to teach. Young children were told six stories that crossed three levels of teacher's knowledge (knowledgeable, neutral, ignorant) with the presence or absence of the intention to teach (intention to teach, no intention to teach) yielding: knowledgeable teacher's teaching, knowledgeable teacher's no teaching, neutral teacher's teaching, neutral teacher's no teaching, ignorant teacher's

teaching and ignorant teacher's no teaching. After hearing each story, children were asked the ***learning intention question*** of whether a child character will try to learn from the informant or continue to do his own ongoing activity (e.g., drawing a picture, reading a story book), and the ***learning outcome question*** of whether the character can learn the knowledge successfully or not. The character's ongoing activity was included as an alternative to trying to learn from the teacher so that children would consider available options rather than simply answering 'yes' to the questions.

If children judge the value of learning based on a possibility of an increase in knowledge, they would answer the character will try to learn knowledge from the knowledgeable teacher, but he will not try to learn from the ignorant teacher. Similarly, if children understand learning occurs when there is a positive change in knowledge, they would predict successful learning will occur when the character learns from the knowledgeable teacher, but not from the ignorant teacher. Also, if children think that a person needs to consider another's teaching attempt, and that the learning outcome would also vary depending on whether another is teaching or not, children's prediction of the intention to learn and learning outcome would be also different between teaching vs. no teaching stories. In addition to the learning stories, children's theory of mind was assessed with a standard set of tasks (Gopnik & Astington, 1988).

2. Participants

Twenty-one 3-year-olds (eight boys and 13 girls, Mean age = 44.67 months, range = 43-47 months), twenty-four 4-year-olds (16 boys and eight girls, Mean age = 53.79, range = 49-59 months) and twenty-four 5-year-olds (12 boys and 12 girls, Mean

age = 67.67, range = 61-72 months) participated. Children were recruited from three kindergartens in an urban area in South Korea, and were generally from middle class families. All participants were proficient in Korean.

3. Procedures

All the learning stories were presented to each child individually by a female researcher in a quiet place in their schools. The stories were presented using props and small figures for teachers and children. Brief descriptions of the six learning stories are shown in Table 1. (See the Appendix for the entire stories.) In each story, children were told about the teacher's knowledge state and saw her demonstration of knowledge. For instance, in the ignorant teacher stories, the researcher said, "The teacher does not know how to make a boat well. Look how she makes a boat." and then the teacher awkwardly attempted to make a boat. On the other hand, the knowledgeable teacher stories started with the explanation that, "The teacher knows how to make a house well," and then showed the teacher making a house. Whenever the teacher's knowledge state was demonstrated the child character was always present so that the participants could see that the character was also aware of the teacher's knowledge state. In the neutral teacher stories, no information was given about the teacher's knowledge state. Meanwhile, in the teaching stories, the teacher explicitly revealed her teaching intention by saying, "I want to teach you how to make a house." In the no teaching stories, children were told that the teacher was just doing the activity by herself without any awareness of being seen by the child character.

After hearing each story, children were asked control questions to check their understanding of the story. For the knowledgeable and ignorant teacher stories, they were asked, “Does this teacher know how to make a house well?” to test whether children remembered the teacher’s knowledge state. This question was not asked for the neutral teacher stories because no knowledge state information was given in those stories. In the teaching stories, the researcher emphasized the teacher’s teaching intention again at the end of the stories by stating, “She said she wants to teach how to make a house.” For the no teaching stories, the researcher asked a control question, “Does the teacher know Minho sees she is making a house?” to test if children understand that the teacher could not have any teaching intention toward the child character. In order to pass this question, children had to answer the teacher did not know she was being seen by the child character. Only two 3-year-olds had difficulty answering this question, but after being told the story again, they answered correctly.

Table 1. Brief description of learning stories in Study 1

	Teaching	No teaching
Knowledgeable teacher	A knowledgeable teacher reveals a teaching intention (“I want to teach you how to make a house”) when a child is drawing a picture.	A child who is drawing a picture happens to see a knowledgeable teacher making a house without the teacher’s awareness of being seen.
Neutral teacher	A teacher whose ability is unknown reveals a teaching intention (“I want to teach you how to make an airplane”) when a child is reading a story book.	A child who is reading a story book happens to see a teacher whose ability is unknown making an airplane without the teacher’s awareness of being seen.
Ignorant teacher	An ignorant teacher reveals a teaching intention (“I want to teach you how to make a boat”) when a child is reading a picture book.	A child who is reading a picture book happens to see an ignorant teacher making a boat without the teacher’s awareness of being seen.

After the control questions, the two test questions of learning intention and learning outcome were presented. For the learning intention question, the researcher asked, “Will Minho try to learn how to make a house or continue to draw the picture?” For the learning outcome question, the researcher asked, “Can Minho learn successfully how to make a house or can’t he learn it successfully from the teacher?”

In addition, the children’s theory of mind was assessed by a standard set of tasks (Gopnik and Astington, 1988) using two deceptive objects, a sponge that looked like a rock and a Band-Aid box that actually contained colored paper. For each task, after showing the true property of the objects, children were asked how it looks (appearance), what it was really (reality), what they thought the object was when they first saw it (representational change), and what someone who did not see the real identity will think it is (false belief). The presentation order of questions was counterbalanced.

4. Results

Scoring. In the learning stories, for the learning intention question, responses of “will try to learn it” were coded as 1, whereas “will not try to learn it” received 0. For the learning outcome question, responses of “can learn successfully” and “cannot learn successfully” were coded as 1 and 0 respectively.

In the theory of mind tasks, because there were two versions for each question for appearance-reality, false belief and representational change, the scores for each were totaled. In the appearance-reality task, the child had to answer both the appearance and reality questions correctly to receive a score of 1. Thus, when the scores were totaled for

each task, they ranged from 0 to 2 for appearance-reality, false belief and representational change, and the total theory of mind score ranged 0 to 6.

Prediction of learning. Because children's responses were binominal for each learning question, and each child was presented with six stories, in order to analyze children's responses that might be correlated to each other, Generalized Estimating Equation method (GEE; Liang & Zeger, 1986; Zeger & Liang, 1986) was used. GEE is an extension of generalized linear mixed models and it is appropriate to analyze repeated categorical responses that could be correlated to each other. In the current study a teacher's intention and knowledge were entered as within-subject variables, and age group was a between-subject variable.

The mean percentages of children's responses of "will try to learn it" for the learning intention question are shown in Figure 1. When the children's responses were regressed onto age group, teacher knowledge, teacher intention, and all interactions, main effects of teacher knowledge and age group on children's prediction of learning intention were found. The main effect of teacher knowledge, χ^2 (2, 69) = 11.558, $p < .01$, showed that children most frequently answered "will try to learn it" in the knowledgeable teacher stories, followed by the neutral teacher and ignorant teacher stories in that order. The main effect of age, χ^2 (2, 69) = 11.558, $p < .01$, revealed that 4- and 5-year-olds more often answered "will try to learn it" than 3-year-olds. This pattern indicates older children are more likely than the younger ones to choose trying to learn from others.

Each age group's response to the learning intention question was compared to chance by individual story. Three-year-olds' responses of "will try to learn it" were below chance in neutral teacher teaching and ignorant teacher no teaching story. Four-year-olds' responses were not different from chance in all stories. Five-year-olds' predictions of learning intention were above chance in knowledgeable teacher teaching, neutral teacher teaching, knowledgeable teacher no teaching, but not different from chance in ignorant teacher teaching, neutral teacher no teaching, and ignorant teacher no teaching stories.

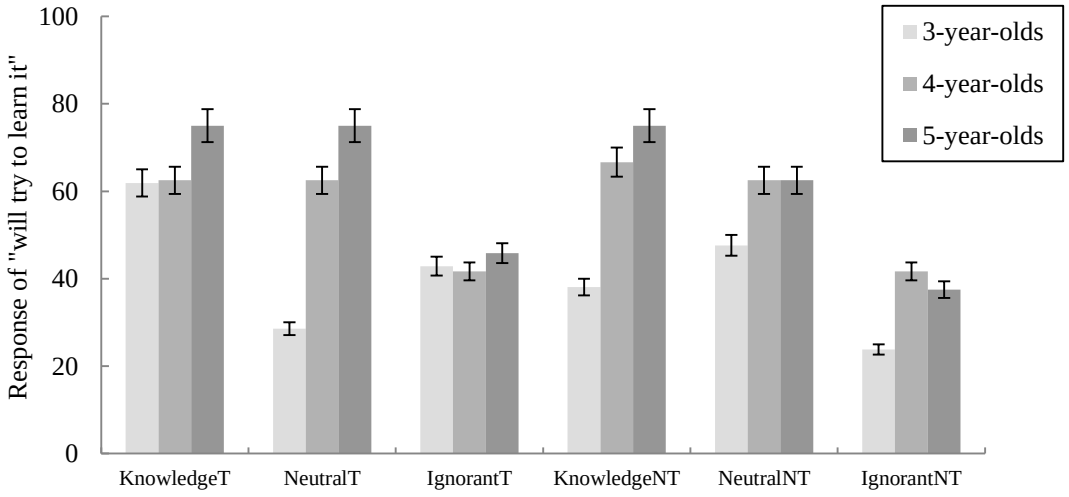

Figure 1. Mean percentage of "will try to learn it" responses by age for the six learning stories. (Note. Knowledge T means knowledgeable teacher teaching and knowledge NT means knowledgeable teacher no teaching)

Children's responses to the learning outcome question are shown in Figure 2. When children's responses were regressed onto age group, teacher knowledge, teacher intention, and all interactions again, a main effect of teacher knowledge and an

interaction between age and teacher knowledge were found. The teacher knowledge effect, χ^2 (2, 69) = 77.167, p < .001, revealed that children more often expected that characters can learn successfully from a knowledgeable or neutral teacher than an ignorant teacher. The interaction between teacher knowledge and age, χ^2 (6, 69) = 15.527, p < .05, was examined by testing the age effect in each teacher's knowledge states separately. These analyses revealed age effects in the knowledgeable teacher, χ^2 (2, 69) = 5.890, p =.053, and neutral teacher stories, χ^2 (2, 69) = 8.118, p < .05, establishing that 5-year-olds' response of "can learn successfully" in those two situations was higher than those of the 3-year-olds.

When children's responses to the learning outcome question were compared to chance, 3-year-olds' responses were above chance level in the neutral teacher teaching and neutral teacher no teaching stories. Four-year-olds' predictions of learning outcome were above chance in knowledgeable teacher teaching, neutral teacher teaching, knowledgeable teacher no teaching, and neutral teacher no teaching conditions. The 5-year-olds' responses were above the chance in knowledgeable teacher teaching, neutral teacher teaching, knowledgeable teacher no teaching and neutral teacher no teaching, whereas they were below the chance in ignorant teacher teaching.

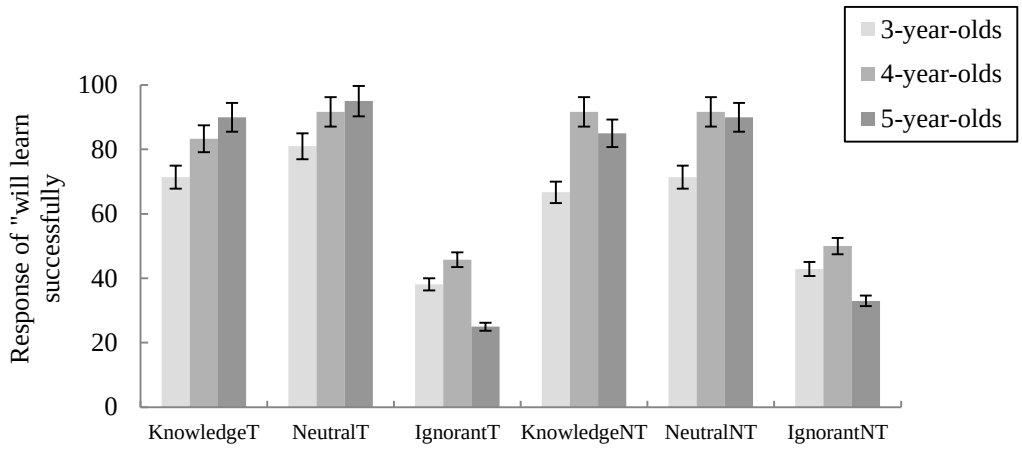

Figure 2. Mean percentage of "will learn successfully" responses by age for the six learning stories. (Note. Knowledge T means knowledgeable teacher's teaching and knowledge NT means knowledgeable teacher's no teaching)

Theory of mind. The mean percentage scores for each of the theory of mind tasks are shown in Figure 3. When age effects for the appearance-reality, false belief, and representation change questions were analyzed in a one-way MANOVA with age group as an independent variable, children's performance revealed an age effect, F (6, 69) = 7.812, $p < .001$, $\eta_p^2 = .165$. In the appearance-reality task, the 3- and 4-year-olds' performances were lower than 5-year-olds', but did not differ from each other, F (2, 69) = 15.134, $p < .001$, $\eta_p^2 = .193$. For false belief, 3-year-olds' performance was lower than 5-year-olds, and 4- and 5-year-olds were not different from each other, F (2, 69) = 5.118, $p < .01$, $\eta_p^2 = .113$. In representational change, 3-year-olds scored lower than both 4- and 5-year-olds, but the 4- and 5-year-olds did not differ F (2, 69) = 8.387, $p < .001$, $\eta_p^2 = .153$.

When the children's theory of mind performance was compared with chance, 3-year-olds' responses were below the chance in appearance reality, and at chance level in false belief and representational change. Four-year-olds' performance was not different from chance in appearance reality, but above chance for the false belief and representational change questions. Five-year-olds performed above the chance level for all appearance-reality, false belief and representational change questions.

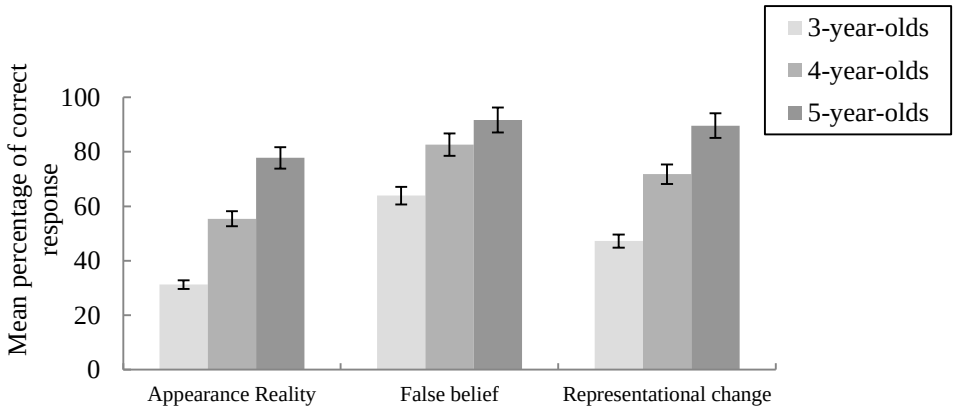

Figure 3. The mean percentage scores of the three theory of mind tasks by age.

Relations among the measures. To examine the relations among measures, children's responses in teaching and no teaching stories were combined for each teacher's knowledge state because the teacher's teaching intention did not reveal any difference. There were several correlations among responses within the learning stories. (See Table 2.)

For both the learning intention and learning outcome questions, children's responses in the neutral teacher situations were correlated with answers in the knowledgeable teacher and ignorant teacher situations respectively, even when age was

controlled. This pattern indicates that regardless of age, children who expected characters will try to learn and can learn successfully in the neutral teacher situations were likely to show similar responses in the ignorant and knowledgeable teacher's conditions.

Table 2. Correlations among theory of mind questions and responses in learning stories. (Note. Coefficients in parenthesis are age partialled.)

Question	Variable	1	2	3	4	5	6	7	8
Learning intention question	1.Age	-	.411**	.227*	.368**	.475**	.287*	.321**	.038
	2. Appearance reality		-	.233** (.143)	.367** (.317*)	.792** (.768**)	.108 (-.053)	-.007 (-.092)	.016 (-.021)
	3. False belief			-	.213* (.165)	.624** (.578**)	.240* (.149)	.039 (-.133)	.024 (-.009)
	4. Representation change				-	.728** (.707**)	.162 (.034)	.049 (-.103)	.219 (-.211)
	5. Total ToM					-	.213 (.048)	.033 (-.155)	.109 (.089)
	6. Knowledge teacher						-	.407** (.436**)	.206 (.236)
	7.Neutral teacher							-	.321** (.353**)
	8.Ignornat teacher								-
Learning outcome question	1.Age	-					.227	.229*	-.176
	2. Appearance reality		-				.220 (.131)	.113 (.038)	.053 (.142)
	3. False belief			-			.172 (.104)	.050 (.127)	.064 (.165)
	4. Representation change				-		.196 (.114)	.166 (-.035)	.070 (.147)
	5. Total ToM					-	.262* (.172)	.154 (.059)	.081 (.219)
	6. Knowledge teacher						-	.456** (.410**)	.194 (.200)
	7.Neutral teacher							-	.261* (.265*)
	8.Ignornat teacher								-

Correlations among the responses to the learning stories and the theory of mind tasks were also examined. In the learning intention question, children's responses in knowledgeable teacher situations were correlated with false belief score, but once age was controlled, the correlations disappeared. In the learning outcome question, children's responses in knowledgeable teacher situations were correlated with total theory of mind score, but not when age was partialled.

5. Discussion

In a learning situation, when information was available about both an informant's knowledge state and intention to teach, young children's predictions of whether a character would try to learn and learn successfully was influenced by the informant's knowledge state. Children most frequently thought that the character will try to learn when the informant was knowledgeable, and that was followed by the neutral informant, and then the ignorant one. Similarly, children's expectation of the outcome of learning was higher in the knowledgeable and neutral situations than in the ignorant informant ones. The results also showed a developmental increase in predictions about learning. Overall, the 5-year-olds were more likely to predict a character would try to learn from the other. Furthermore, unless there was clear evidence for the teacher's ignorance, the 5-year-olds more often predicted that successful learning outcomes would occur.

The current results show that children's prediction of an intention to learn from others and the expectation of the learning outcome are influenced by informants' knowledge state—whether they have enough knowledge or not. It is especially noteworthy, given that the current stories involved teachers as informants, that young

children seriously consider the teacher's knowledge state, rather than her authority and teaching intention. In addition, the results showed that older children may have more interest or expectation about learning from adults and better discrimination of whether a particular adult is a useful source for learning. Older children generally expected that a character will try to learn from teachers rather than continue to do an existing activity, and more often predicted that the character will learn successfully unless there was clear evidence for the teacher's ignorance. However, once they know the teacher is ignorant, 5-year-olds expected that learning from her would not be successful.

Children's theory of mind development was related to their predictions of learning, but most relations between the two diminished once age was controlled. On the other hand, there were some strong relations among children's responses within the learning stories. Children's prediction of the character's intention to learn and learning outcome in the neutral teacher stories were correlated with their prediction in both the knowledgeable and ignorant teacher stories, even after age was controlled. This pattern implies possible individual differences in predictions of learning from others. Some children might have higher expectations about learning from others regardless of age.

In Study 1, the overall analysis did not reveal a teacher intention effect on children's prediction of the intention to learn and learning outcome. However, a comparison to chance for the prediction of learning intention showed that in the neutral teacher stories, which did not involve any specific information about the teacher's knowledge state, the age groups answered differently depending on the teacher's teaching intention. Most of the 3-year-olds answered the character would not try to learn from the

teacher, whereas most of the 5-year-olds responded the character would try to learn in the neutral teaching story. A comparable age difference was not shown in the neutral teacher no teaching story where the teacher did not have an intent to teach. These results suggest that when a learning opportunity is presented by a teacher, older preschoolers are more likely to react to and accept her teaching intention.

Study 2

1. Research Questions and Design

Study 1 that examined young children's predictions of learning indicated that children, especially older ones' predictions of another's learning intention and the consequent learning outcome varies depending on the informant's knowledge state. Study 2 examined whether this judgment as a third party is applied to children's own learning. That is, it investigated whether children's understanding of social situations and actual learning from them are influenced by the informant's knowledge state and intention to teach.

Children were randomly assigned to one of the four conditions of knowledgeable-teaching, knowledgeable-no teaching, ignorant-teaching, and ignorant-no teaching conditions. In each condition, whether the informants are knowledgeable or ignorant, and whether they reveal a specific teaching intention or not were manipulated respectively, and after such manipulation, children watched videos presenting identical novel information in each condition. After watching the video in the assigned condition, how children understood the given situation and how much they learned from each condition were examined. If children's learning is influenced by whether they perceive an

informant is knowledgeable or not, they would learn more when they judge informants are knowledgeable than ignorant. Also, if children pay attention to somebody's specific teaching intention and learn in accordance with it, their learning would be better in teaching over no teaching conditions.

2. Participants

Fifty 4-year-olds (23 boys and 27 girls, Mean age = 53.18 months, range = 48-60 months), thirty-two 5-year-olds (17 boys and 15 girls, Mean age = 64.93 months, range = 60-71 months) and twenty-six 6-year-olds (17 boys and nine girls, Mean age = 74.31 months, range = 71-77 months) participated. Children were recruited from three kindergartens and a daycare center in urban areas in South Korea and were generally from middle class families. All children were proficient in Korean.

3. Procedures

A female researcher met the individual child in a quiet room located in their schools. The researcher introduced a video saying "I happened to find some videos in the computer. Do you want to see what is going on in the video?" Children were then presented with a video that consisted of three phases: familiar animal phase, confirmation phase, and novel animal phase. Regardless of the condition assignment, all children first watched the same familiar animal phase with three familiar animal cards that showed which informant was knowledgeable and which one was ignorant about familiar animals. The process to show informants' knowledge state was very similar to Koenig and Harris (2005). In this phase, three female informants appeared in the video. The one at the center asked two others on both sides to pick cards from three familiar animals (e.g., puppy,

tiger, rabbit). One informant picked up and showed the correct animal cards as requested (Knowledgeable Informant), whereas the other one picked and showed incorrect cards consistently (e.g., showing a cat picture, saying "here is a puppy.") (Ignorant Informant). After this phase, we asked children, "Did this person pick up the right animal cards?" pointing to each informant in the screenshot. All children were able to answer correctly based on the informants' accuracy.

The child then watched the confirmation phase. This phase had different content depending on the child's assignment to condition based on the informant's knowledge state. Children in the Knowledgeable Informant conditions watched the previously knowledgeable informant and the one who was at the center in the familiar animal phase. In this confirmation phase, the paired informants again named three familiar animal cards shown in the previous phase correctly. For instance, the person at the center in the previous phase said, "You gave me a puppy card," picking up the card with a puppy picture, and then the previously accurate informant said, "Yes, it is a puppy card." On the other hand, in the Ignorant Informant condition, the previously ignorant informant and the person who was at the center in the familiar animal phase appeared together, and named the familiar animals incorrectly again (e.g., showing a monkey picture saying, "You gave me a tiger card"). This confirmation phase was designed to make sure that the informant located at the center shared the same knowledge state with the knowledgeable or ignorant informant. After watching the confirmation phase, the researcher asked children again, "Do they know the animals well?" and all children answered correctly based on the informants' accuracy. After hearing the child's answer, the researcher

reinforced the child's correct judgment about informant's knowledge state by saying, "Yes, they know the animals well" or "No, they don't know the animals well."

The novel animal phase was shown last. In this phase, the pair of informants shown in the confirmation phase played a game with seven novel animal cards. The pair of informants were either both knowledgeable or both ignorant depending on condition as shown in the confirmation phase. At the beginning, one informant suggested playing an animal game with the other informant, and explained how to play. The game was sending animals to their homes. In this game, if an informant asked the other for novel animal cards like, "Can you pass me 'Ali'?" the other informant had to find and select the 'Ali' card and pass it along, saying, "Ali? Here is Ali." Then, the requester who received the card put the 'Ali' card under the animal's house, saying "Yes, Ali. I will send Ali to its home." In this way, each novel name (e.g., Ali, Toma, Upa) that does not exist in Korean was stated five times, and seven novel animal pictures on the cards were shown on the screen across the game. This process was repeated until all seven novel animals were sent to their respective houses.

In the novel animal phase, the one difference between the teaching and no teaching conditions appeared--whether the informants did or did not reveal their teaching intention before starting this game. In the teaching conditions (i.e., knowledgeable-teaching and ignorant-teaching conditions), the informants stated, "While playing the game, we want to teach children who are watching the video new animal names. Let's play the game then." When informants in the teaching conditions spoke like this, they both looked at the screen to convey that the message was for the children. In contrast, in

the no teaching conditions (i.e., knowledgeable-no teaching and ignorant-no teaching conditions) the informants did not state any information about a teaching intention, but just started the game by saying, “Let’s play the game then.” In both the teaching and no teaching conditions, the two informants in the screen mainly looked at each other while playing the game, but sometimes one of the informants looked at the screen in order to make the conditions seem natural.

Before watching the informants’ game, the researcher paused the video in all conditions. The researcher then asked the children a control question to test their perception of informants’ knowledge state by saying, “Do they know the animals well?” All the children answered correctly based on informants’ previous accuracy in the familiar and confirmation animal phases. Also, the researcher briefly reinforced the children’s judgment about informant’s knowledge state by saying, “Yes, they know the animals well.” or “No, they don’t know the animals well.” After that, for the teaching conditions, the researcher stated, “They said while playing the game, they want to teach new animal names.” For the no teaching conditions, the researcher stated, “They said they will play an animal game.” After these statements, the child started to watch the informants’ game.

After watching the novel animal phase, the researcher assessed children’s understanding of the informants’ knowledge state and intention by asking, “Do these people know the animals well or don’t they know the animals well?” and “Why do you think they did the game in the video? Do you think they did it to teach new animal names

or to play with it?" The order of questions and choice of answers within the questions were counterbalanced.

Finally, how many novel animal names each child learned from the video was assessed through recall and recognition tests. In the recall test, after spreading the animal pictures out on the table, the researcher asked, "Is there any animal that you remember the name of?" If the child did not say anything, the researcher picked up each of the animal cards one by one and asked, "Do you remember what this is called?" For the recognition test, the researcher asked children to pick up the animal card the researcher requested, like "Can you pick up Ali?"

4. Results

Scoring. In terms of children's understanding of the knowledge state of the informants, a response of, "They know animals well" was coded as 1, whereas, "They don't know animals well" scored 0 in knowledgeable informant conditions. In the ignorant informant conditions, "They don't know animals well" was coded as 1, whereas the opposite answer, "They know animals well" received 0. For children's understanding of the intention of the game in the video, because there is no right and wrong answer about the informants' intention in no teaching conditions, "To teach animal names" was coded as 1, and "To play with it" received 0 across all conditions.

Scores on both the recall and recognition tests ranged from 0 to 7. To earn a score of 1 on a recall item, the child had to name the new animal in the picture that the researcher picked up. On the recognition test, the children had to point to the correct animal picture for the name that the researcher stated.

Understanding of informants' knowledge state and teaching intention. How often the children understood the informants' knowledge state and intention for playing the game in the video after the novel animal phase was examined. All children, except two out of 108, answered correctly about the informants' knowledge state based on the previous accuracy in the familiar animal and confirmation phases. Only one 5-year-old in the knowledgeable-no teaching condition and one 6-year-old in the ignorant-teaching condition answered in opposition to the informants' previous accuracy. However, it should be noted that all children, including those two, answered correctly whether the informants knew the animals well or not before the novel animal phase. Thus, there was almost no variance in the children's understanding of informants' knowledge state based on previous accuracy.

In regard to the children's understanding of the informants' teaching intention for playing the game in the video, Chi-square analyses revealed an age effect, $\chi^2(2, 108) = 11.095$, $p < .01$, showing that older children were more likely to perceive that the intention of the game was for teaching, rather than for playing. When we examined children's understanding of the intention of the game based on informants' teaching intention condition (teaching conditions vs. no teaching conditions) and informants' knowledge state (knowledgeable informants' conditions vs. ignorant informants' conditions) respectively, informants' teaching intention showed a marginal effect, $\chi^2(1, 108) = 3.150$, $p = .076$, indicating that children in the teaching conditions tended to perceive the game was for teaching. In other words, those who were told the informant's teaching intention were more likely to think that the game was for teaching. It is notable that even though all children in the teaching conditions were told the informants in the

video would play the game to teach new animal names, some of them still thought the game was for playing after watching videos.

Learning of new animal names. Children's recall and recognition test scores from the video was analyzed in a 3 (Age) x 2 (Knowledge condition) x 2 (Intention condition) MANOVA. A main effect was found for age, Wilks lambda = .168, $F(4,108) = 4.587$, $p < .01$, $\eta_p^2 = .088$. In the recall test, older children performed better than younger ones, $F(2,108) = 3.811$, $p < .01$, $\eta_p^2 = .135$. For the 4-, 5- and 6-year-olds, the mean scores were .333 (SD = .554), .818 (SD = .769) and .885 (*SD* = .952), out of seven respectively. Bonferroni post hoc tests showed that both 5- and 6-year-olds received higher scores than the 4-year-olds. There was also an age effect, $F(2,108) = 7.474$, $p < .05$, $\eta_p^2 = .065$, in the recognition test. Scores on the recognition test were 3.623 (*SD* = 1.574), 4.333 (*SD* = 1.652), and 4.46 (*SD* = 1.556) out of seven for the 4-, 5- and 6-year-olds respectively, and the 5- and 6-year-olds scored better than the 4-year-olds.

In addition, a main effect of informant's knowledge state on children's learning was found, Wilks lambda = .168, $F(2,108) = 9.564$, $p < .001$, $\eta_p^2 = .168$. To be specific, in the recall test, there was an effect of informants' knowledge, $F(1,108) = 3.238$, $p < .05$, $\eta_p^2 = .062$, with children in the knowledgeable informants' conditions scoring better. In the recognition test, scores in the knowledgeable informants' conditions were also better than in the ignorant informants' situations, $F(1,108) = 34.023$, $p < .001$, $\eta_p^2 = .136$. Children's mean scores in the recall and recognition tests are presented in Figure 4.

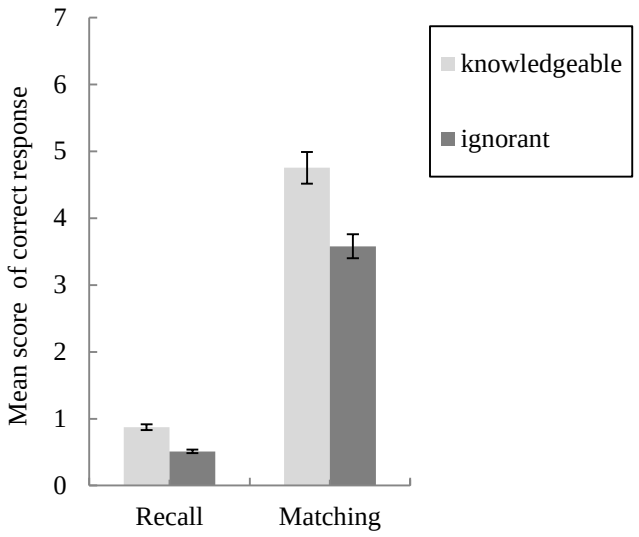

Figure 4. Means of children's learning scores by informants' knowledge state

5. Discussion

In Study 2, children's actual learning was influenced by children's age and whether the information was given by informants the children recognized as knowledgeable or not. However, whether the informants explicitly revealed a specific instructional goal did not make a difference in learning. Even though the same knowledge was stated in the exactly same way, once children judged the speaker was ignorant, they less accepted and remembered the given information. Also, almost all of the children did not have difficulty identifying the informants' knowledge state based on previous accuracy, but their understanding of the informant's intention for playing the game was related to age and to whether the informants explicitly stated the intention to teach.

The results showed that children's judgment of the informants' knowledge state does affect how much they accept and learn information from them. It is worth noting that both the knowledgeable and ignorant informants presented novel animals confidently

and clearly, but their initial perception of the speaker's knowledge state influenced their reaction to the given information and how much of it they learned.

Moreover, the findings indicated that children's judgment of the informant's knowledge state based on a previous accuracy was relatively easier than their understanding of teaching intention of the game. Even though the previously inaccurate, ignorant informants confidently presented novel animals as if they correctly knew them, almost all of the children in ignorant conditions recognized that the speakers were ignorant after the novel animal phase. On the other hand, children's understanding of teaching intention showed more variation. Older children more often answered the game was for teaching, and children who listened to the teaching intention of the informants were marginally more likely to perceive the teaching intention of the game. Even though all of the children in teaching conditions were told the informant would play the game to teach new animal names, some children still answered the game was for playing. Thus, these results suggest that judgment of a speaker's teaching intention may be more difficult than understanding of an informant's knowledge state based on previous accuracy.

CHAPTER 4

PART 2_ CHILDREN'S UNDERSTANDING OF LEARNING AS A CHANGE IN KNOWLEDGE AND ITS RELATION WITH THEIR LEARNING

Study 3

1. Research Questions and Design

Part 1 examined how young children predict social situations with others as prospective learning contexts based on the informant's knowledge state and teaching intention, and whether this prediction is applied to their actual learning. The findings indicated that young children, especially older preschoolers' predictions of learning from another and their actual learning are influenced by their judgment of whether the informant has enough knowledge. However, given learning involves a change in a learner's knowledge (Knutsen et al., 2014; Wang, 2010), a question of whether young children consider not only an informant's but also a learner's mental states to judge whether a certain social situation can result in learning still remains. For instance, even if an informant is very knowledgeable, if a learner already has that knowledge, the interaction with the informant will not cause the learner to learn. Thus, Part 2 aimed to broaden the framework so that it can investigate whether young children consider both an informant's and the learner's side when they judge social learning situations and whether this judgment is applied to their own learning.

In Study 3 in Part 2, a learner's knowledge state and the presence of an informant's teaching intention were manipulated. To be specific, how young children predict a character's intention to learn and judge whether learning really occurred when

there is information of the character's knowledge state and an informant's teaching intention were examined. Children were told six stories that were designed based on different pairings of a child character's knowledge state (knowledgeable, neutral, or ignorant) and a peer informant's teaching intention (teaching or no teaching). Thus, each story involved different combinations of a child character's knowledge state and a peer informant's teaching intention. The reason for involving peer informants in the stories in Study 3 was that the main goal of the study was to examine whether young children consider both a learner's knowledge state and an informant' teaching intention to judge learning. Consequently, it could be useful to reduce other confounding factors like the informant's authority.

All six stories consisted of two parts. In Part 1, a character's knowledge as well as an informant's teaching intention were presented. They were followed by a learning intention question that asked children to predict whether the character will try to learn knowledge or continue to do his/her own activity. In all of the stories, the child character's ongoing activity was included as an alternative to trying to learn from the informant so that children can consider available options of what the character can choose instead of answering unconditionally 'yes'. Afterwards, Part 2 proceeded and this part depicted knowledge that was presented by an informant either intentionally or incidentally, and ended with a judgment of learning question to ask whether learning really occurred.

If children appreciate a person's knowledge state influences the formation of intention to learn, they would answer that an already knowledgeable character will not try

to learn but an ignorant character will try to learn the knowledge. If children also think another's teaching intention influences the formation of the learner's intention to learn, their prediction of intention to learn could be higher in teaching stories than no teaching stories. In terms of judgment of occurrence of learning, if children understand learning involves a change in knowledge, they would judge learning occurred only when the character's knowledge changed (e.g., an initially ignorant character comes to know the knowledge) no matter whether the stories are about teaching or no teaching.

Children's mental state understanding was also measured using standard theory of mind tasks (Gopnik & Astington, 1988). The order of the learning stories and theory of mind assessments was counterbalanced, and within each measurement the sequence of story and theory of mind task was randomly decided.

2. Participants

Twenty-three 3-year-olds (9 boys and 14 girls, Mean age = 44.65 months, range = 43-47 months), twenty-four 4-year-olds (14 boys and 10 girls, Mean age = 53.25 months, range = 49-59 months), and twenty-seven 5-year-olds (15 boys and 12 girls, Mean age = 65.96 months, range = 51-72 months) participated. Children were recruited in a kindergarten and a daycare center in an urban area in South Korea. They were generally from middle class families and proficient in Korean.

3. Procedures

A female researcher told learning stories using figures of peer informants and children and props, and presented standard theory of mind tasks to each child. Table 3

shows a brief description of six stories (teaching a knowledgeable character, teaching a neutral character, teaching an ignorant character, no teaching of a knowledgeable character, no teaching of a neutral character, and no teaching of an ignorant character). See the appendix for the entire description.

Table 3. Brief description of learning stories in Study 3

	Teaching		No-teaching	
	Part 1	Part 2	Part 1	Part 2
Knowledgeable child	A peer informant reveals teaching intention ("I want to teach you how to make a house") to an already knowledgeable child when he was drawing a picture.	The informant shows how to make a house, and then the child makes a house successfully by himself.	An already knowledgeable child who is drawing a picture happens to see a peer informant making a house without the informant's awareness of being seen.	The child sees how the informant makes the house, and then he makes a house successfully by himself
Neutral child	A peer informant reveals teaching intention ("I want to teach you how to make an airplane") when a child is reading a story book.	The informant shows how to make an airplane, and then the child makes an airplane successfully by himself.	A child who is reading a story book happens to see a peer informant making an airplane without the informant's awareness of being seen.	The child sees how the informant makes the airplane, and then he makes an airplane successfully.
Ignorant child	A peer informant reveals teaching intention ("I want to teach you how to make a boat") when an ignorant child is reading a picture book.	The informant shows how to make a boat, and then the child makes a boat successfully.	An ignorant child who is reading a picture book happens to see a peer informant making a boat without the informant's awareness of being seen.	The child sees how the informant makes the boat, and then he makes a boat successfully.

In the Part 1 of each story, a child character's current knowledge state was presented with either the presence or absence of a peer informant's teaching intention. In order to inform children of the character's knowledge state, the researcher explicitly explained whether or not the character knows how to make something with paper (e.g., house, airplane) well with demonstration.

For instance, in knowledgeable character stories, the researcher explained "Jihye knows how to make a house with paper well" and then demonstrated the character made it successfully using a complete house that is nicely made. On the other hand, in ignorant character stories, the researcher said, "Minyoung does not know how to make a boat well" and demonstrated that the character made it awkwardly showing an incomplete house. In neutral character stories, no information about the character's knowledge state was given. Whenever showing the peer informant's knowledge state, the character was present so that he can see the demonstration. Meanwhile, in Part 1 of teaching stories, a peer informant explicitly revealed her teaching intention by saying, "I want to teach you how to make a house" showing a complete work (e.g., house). In no teaching stories, a peer informant neither had nor revealed a teaching intention. A character just happened to see the informant making something (e.g., house) for herself without the informant's awareness of being seen. For knowledgeable character stories, a peer informant's product (e.g., house) she bought and made was identical with the character's own product in both teaching and no teaching so that children can see new information or skills were not needed to make a product for the already knowledgeable characters.

After presenting the first part, the researcher asked control questions to check children's understanding of the stories before presenting a test question. For knowledgeable and ignorant character stories, the researcher asked the control question, "Does this child know how to make a house well?" to test whether children remembered the character's knowledge state. This question was not asked for neutral character stories because any information about the character's knowledge state was not given in the neutral character stories. Also, in teaching stories, the researcher made sure the peer informant's teaching intention was stated again after Part 1 by saying, "The friend told she wants to teach how to make a house." For the no teaching stories, we asked a control question, "Does the friend know Minho sees she is making a house?" to test whether children understand the peer informant did not even know the character is seeing her, so could not have any intent to teach the character. Children who correctly understood the no teaching stories had to answer that the peer informant did not know Minho sees her. Only two 3-year-olds did not answer this question correctly, but once being told the first part again, they did not have difficulty answering the control question.

After the control questions, the first test question, *Prediction of intention to learn* was asked, "Will Jihye try to learn how to make a house or continue to draw the picture?" The order of the choices was counterbalanced. In this question, children had to predict whether the character will try to learn knowledge from the informant or try to keep doing his ongoing activity.

After the learning intention question, children were told the Part 2 of each story. Basically, Part 2 of all the stories was similar in that this portion depicted that knowledge

(e.g., how to make a house) was presented by the peer informant intentionally or incidentally. In teaching stories, the peer informant intentionally showed how to make something to teach the character. Regardless of whether the character already knew it or not, the researcher stated that the friend *showed* the child character knowledge (e.g., how to make a house), and then, the character made the product of knowledge successfully (e.g., a house) after seeing how the friend made it. On the other hand, in no teaching stories, the peer informant was just making a product for herself, and the character just happened to see how the friend makes it without the friend's awareness of being seen. In no teaching stories, the researcher said that the character *saw* how the friend made the product, and then, he made the product of knowledge successfully after seeing how the friend made it. Thus, in the second part of all stories, the character was presented with knowledge regardless of whether he already knew it or not. The difference between teaching and no teaching stories was only whether the knowledge was intentionally presented by the informant or just incidentally presented to the character.

In addition, in Part 2 of the knowledgeable character stories, the researcher made sure that the character's new product was exactly same as his previous product that was shown in Part 1. The experimenter said, "Look! He made the same house as he made by himself before," visually showing the previous and new products looked same. This process was needed to make sure that the new product did not need new knowledge or skills for the characters who were knowledgeable from the beginning. For the ignorant character stories, the researcher explained that, "The child could not make the house at the beginning, but he now can make it." After this part, the researcher asked children the second test question, *judgment of occurrence of learning* by saying, "Did the child really

learn how to make a house from the friend or he did not learn it from her?" The order of choices was counterbalanced.

In addition to the learning stories, in order to assess children's general mental state understanding, standard theory of mind tasks (Gopnik & Astington, 1988) were presented using two deceptive objects, a Band-age box that actually contained colored paper and a sponge that looked like a rock. Children's appearance-reality distinction, false belief, and representational change questions were asked for each object. The presentation order of two objects and each question was randomly decided.

4. Results

Scoring. The response of "will try to learn" in prediction of the intention to learn was coded as 1, whereas "will continue to do his activity (e.g., reading a story book)" received 0 across all six stories. In the judgment of occurrence of learning, "learned from the friend" and "did not learn from the friend" were coded as 1 and 0 respectively. In appearance-reality distinction, only children who were correct in both appearance and reality questions received 1. Since there were two objects for appearance-reality distinction, false belief and representational change respectively, the total score for each task ranged between 0 to 2, and total theory of mind scores ranged from 0 to 6.

Prediction of intention to learn. Because children's responses about prediction of intention to learn were binomial, and each child was given six stories in a row, in order to analyze repeated responses, Generalized Estimating Equation (GEE) method was employed as in Study 1. Character knowledge and informant intention were within subject variables and age group was a between subject variable. Mean percentages of

children's response of "will try to learn" are presented in Figure 5. When children's responses were regressed onto the main effect of informant intention, character knowledge, and age group as well as all possible interactions, the model revealed a main effect of character knowledge and two-way interactions between character knowledge and age group, and between informant intention and age group. The main effect of character knowledge, $\chi^2(2, 74) = 11.760$, $p < .01$, indicated that overall, children more frequently predicted a character will try to learn from a peer informant when he is ignorant than when is neutral or knowledgeable, and children's responses in the neutral and knowledgeable character stories did not differ from each other. However, this pattern should be interpreted with caution considering the interaction effects involving age group.

When the interaction between character knowledge and age group, $\chi^2(4, 74) = 14.345$, $p < .01$, was examined by each age group, only 5-year-olds showed a character knowledge effect. The 5-year-olds most frequently predicted a character will try to learn when he is ignorant, which was followed by neutral, and knowledgeable character stories in that order. Another interaction between informant intention and age, $\chi^2(2, 74) = 7.829$, $p < .05$, indicated that only the 4-year-olds more frequently predicted a character will try to learn in no teaching stories than in teaching stories.

Children's prediction of the intention to learn was also compared to chance for each age group. The 3-year-olds' prediction of learning intention was comparable to chance in all six stories. The 4-year-olds' prediction of intention to learn was above chance in ignorant character-no teaching story, but comparable to chance in all other

stories. The 5-year-olds' prediction of intention to learn was below chance in knowledgeable character-teaching and -no teaching stories, but above chance in ignorant character-teaching and -no teaching stories. Their response was comparable to chance in neutral character teaching and no teaching stories.

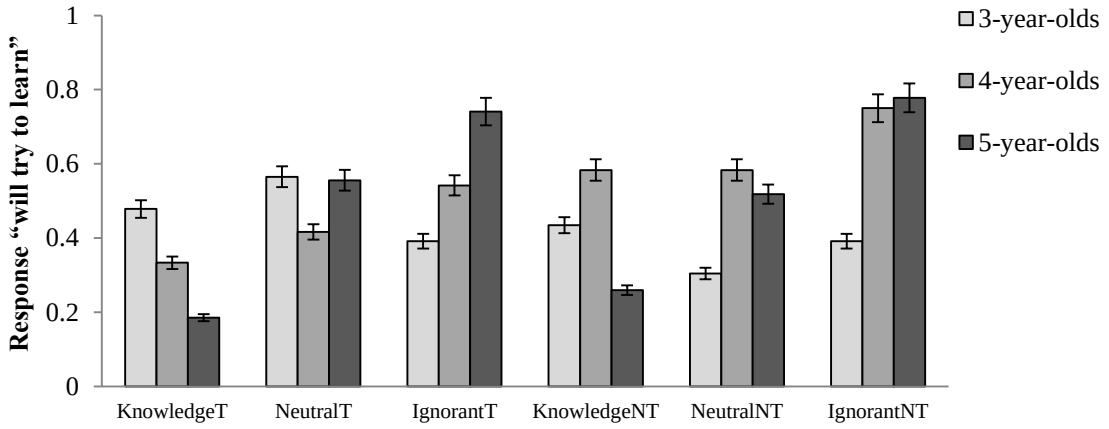

Figure 5. Mean percentage of "will try to learn" responses by age for the six learning stories. (Note. KnowledgeT means knowledgeable child - teaching and NeutralNT means neutral child- no teaching)

Judgment of occurrence of learning. Children's responses in the judgment of occurrence of learning questions were analyzed in GEE again. Mean percentages of children's response of "really learned from the friend" are presented in Figure 6. When children's judgment of whether the child really learned from the friend was regressed onto informant intention, child knowledge, age group and all possible interactions, the model revealed main effects of child knowledge and informant intention, and an interaction between child knowledge and age. The main effect of informant intention, χ^2

(1, 74) = 9.643, $p < .01$, revealed that when an informant explicitly revealed her teaching intention (teaching stories), children more often judged the child character learned knowledge from the informant than in no teaching stories. The main effect of child knowledge, $\chi^2(2, 74) = 80.689$, $p < .001$, showed that children more frequently judged the character learned knowledge when he was initially neutral or ignorant than when he was knowledgeable.

The interaction between child knowledge and age group, $\chi^2(4, 74) = 24.00$ $p < .001$, was examined by each age group, and 4- and 5-year-olds, but not 3-year-olds revealed a child knowledge effect. This pattern indicated the 3-year-olds did not consider the child's initial knowledge state to judge learning, whereas 4- and 5-year-olds judged whether a child character was knowledgeable or not at the beginning to determine whether there was learning. The older children more frequently judged a character really learned knowledge when he was neutral or ignorant at the beginning than when he was knowledgeable.

Children's judgments of learning were also compared to chance by each age group. The 3-year-olds' judgment of whether learning occurred was above chance in the neutral child-teaching and ignorant child-teaching, but was comparable to chance in all other stories. The 4-year-olds judged a child learned from a peer informant in the neutral child- teaching and -no teaching, and ignorant child-teaching and -no teaching stories more frequently than chance, but their judgment was comparable to chance in the knowledgeable child-teaching and no teaching stories. The oldest age group or 5-year-

olds' judgment of learning was higher than chance in neutral child-teaching and -no teaching, and ignorant child-teaching and -no teaching stories, but comparable to chance in knowledgeable child-teaching story, and below chance in knowledgeable child–no teaching story.

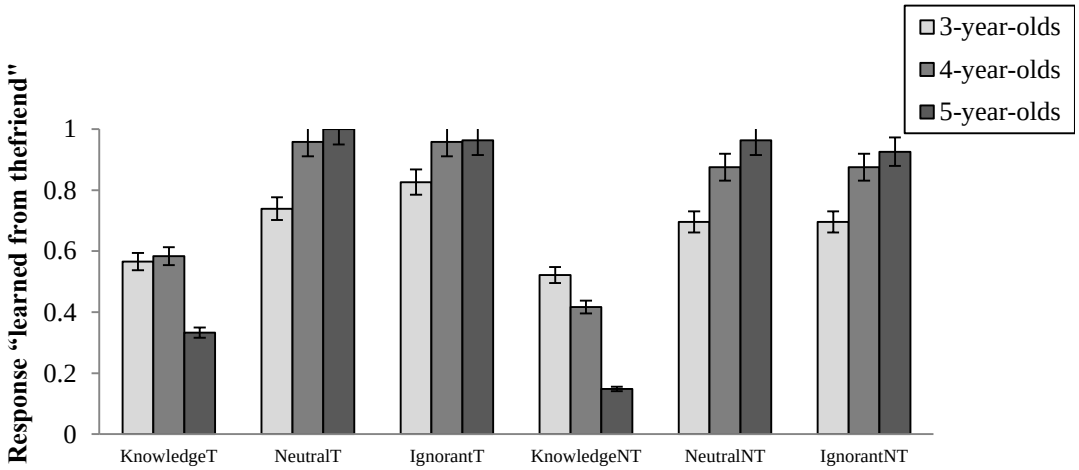

Figure 6. Mean percentage of "learned from the friend" responses by age for the six learning stories. (Note. KnowledgeT means knowledgeable child - teaching and NeutralNT means neutral child- no teaching)

Theory of mind. Children's understanding of appearance-reality, false belief and representational change was analyzed in a MANOVA with age group as an independent variable. The test showed that there was an age effect overall, Wilks' Lambda, F (6, 74) = 4.644, $p < .001$, $\eta_p^2 = .174$. In the appearance-reality distinction, an age effect was revealed, F (2, 74) = 14.489, $p < .001$, $\eta_p^2 = .302$, indicating that 5-year-olds (mean = 1.67, SD = .48) were better than both 4-year-olds (mean = 1.04, SD = .88) and 3-year-olds (for 3-year-olds, mean = .56, SD = .76). There was no age effect in false belief understanding, $p = .114$, showing 5-year-olds with mean score of 1.70 (SD= .61), 4-year-

olds with mean 1.61 (SD= .58) and 3-year-olds with mean 1.3 (SD= .80). Representational change understanding revealed an age effect, F (2, 74) = 4.799, $p < .05$, $\eta_p^2 = .125$, showing 5-year-olds (mean = 1.67, SD = .55) were not different from 4-year-olds (mean = 1.43, SD = .79), but were better than 3-year-olds (mean = 1.05, SD = .69).

Relations among responses in learning stories and theory of mind. Table 4 presents the relations among children's responses in learning stories and theory of mind. Multiple correlations among responses in learning stories were found. Children's responses for learning stories in which the child character's knowledge state was identical (e.g., knowledgeable character–teaching and knowledgeable character–no teaching) tended to be related. Also, children's prediction of intention to learn and judgment of occurrence of learning in neutral character stories tended to relate to those in ignorant character stories. Some aspects of theory of mind were related to children's prediction of intention to learn, and judgment of whether learning really occurred. Children with better theory of mind predicted an already knowledgeable character will not try to learn, whereas an ignorant character will try to learn in teaching stories. Also, children with better theory of mind were more likely to judge that learning did not occur when a character was already knowledgeable, but learning occurred when a character was neutral or ignorant initially. Some relations between children's prediction of intention to learn /judgment of occurrence of learning in ignorant character stories and theory of mind still remained significant even after age controlled.

Table 4. Correlations among measurement (Note. KnowledgeT means knowledgeable child character – teaching, and KnowledgeNT means knowledgeable child character- no

teaching. Coefficients in parenthesis are age partialled correlation, Responses of "will try to learn" and "learned knowledge from the friend" were coded as 1 across all stories, Theory of mind refers to combined score of appearance-reality, false belief, and representation change.)

	Variable	1	2	3	4	5	6	7	8	9	10
Learning intention question	1. Knowledge T	-	.155 (.152)	-.036 (.012)	.523** (.478**)	-.020 (.063)	.026 (.100)	-.309** (-.223)	.014 (.069)	-.212 (-.147)	-.284* (-.195)
	2. Neutral T		-	.296* (.321**)	.114 (.099)	.326** (.350**)	.246* (.266*)	.061 (.068)	.178 (.181)	.038 (.038)	.100 (.113)
	3. Ignorant T			-	-.088 (-.083)	.117 (.077)	.443** (.340**)	.107 (-.050)	.370** (.330**)	.316** (.248*)	.339** (.238*)
	4. Knowledge NT				-	.183 (.257*)	.109 (.148)	-.115 (-.052)	-.113 (-.086)	-.192 (-.158)	-.201 (-.155)
	5. Neutral NT					-	.300** (.277*)	.212 (.144)	.150 (.116)	.132 (.082)	.203 (.135)
	6. Ignorant NT						-	.008 (-.203)	.022 (-.053)	.155 (.058)	.055 (-.134)
	7.Appearancereality							-	.242* (.152)	.360** (.272*)	.790** (.731**)
	8.False belief								-	.177 (.081)	.629** (.572**)
	9.Representationchange									-	.711** (.665**)
	10. Theory of mind										-
Judgment of occurrence of learning question	1.Knowledge T	-	.222* (.273*)	.190 (.182)	.530** (.499**)	.255* (.307*)	.135 (.157)	-.242* (-.163)	-.124 (-.084)	-.063 (.001)	-.232 (-.153)
	2.Neutral T		-	.411** (.288*)	.141 (.214)	.384** (.234*)	.359** (.219)	.176 (.004)	-.027 (-.107)	.204 (.111)	.173 (.009)
	3. Ignorant T			-	.115 (.120)	.433* (.342**)	.541** (.477**)	.176 (.129)	.216 (.195)	.129 (.093)	.219 (.180)
	4. Knowledge NT				-	.308** (.407**)	.170 (.231*)	-.319** (-.226)	.056 (.118)	-.101 (-.022)	-.194 (-.079)
	5. Neutral NT					-	.538** (.450**)	.302* (.170)	.195 (.137)	.193 (.103)	.287* (.156)
	6. Ignorant NT						-	.177 (.040)	.261* (.215)	.352** (.291*)	.342** (.245*)
	7. Appearance reality							-	-	-	-
	8. False belief								-	-	-
	9.Representationchange									-	-
	10. Theory of mind									-	-

5. Discussion

In Study 3, a developmental change was found in children's understanding of learning based on a learner's knowledge state. Only 5-year-olds, but not younger children, reliably predicted an ignorant person will try to learn but a knowledgeable person will not. Similarly, when children were asked whether learning occurred in the given stories, 4- and 5-year-olds, not 3-year-olds, considered a child character's initial knowledge state to judge whether there was a change in the learner's knowledge. The children's prediction of learning intention and judgment of learning were related with their theory of mind development as well.

Results from Study1 indicated that during early childhood children come to understand a person's knowledge state determines his intention to learn. The interaction between character knowledge and age group showed that only 5-year-olds, but not younger children understand if a person is already knowledgeable, he does not need to learn it again, so he will not try to learn the same knowledge from the other person. Older children also understood if the person is ignorant, he will try to learn knowledge rather than keep doing another activity. A similar pattern was found in children's judgment of occurrence of learning as well. Only 4- and 5-year-olds, but not 3-year-olds, considered a character's initial knowledge state to determine whether learning occurred. The older children, but not younger ones, more frequently judged a character really learned knowledge from an informant when he was neutral or ignorant at the beginning than when he was knowledgeable.

A peer informant's teaching intention did not influence children's prediction of a learner's intention to learn. Instead, whether the informant revealed a teaching intention or not influenced children's judgment of whether a character really learned knowledge from him. Such results imply that when the informant explicitly teaches knowledge, so the source of knowledge is obvious, children more often recognize learning happened from the informant. One result we did not expect was that 4-year-olds' prediction of the intention to learn was higher when a peer informant did not have the intention to teach than when he tried to teach knowledge explicitly. However, this pattern was not found with either 3- or 5-year-olds, thus we may need to see if this pattern would be repeated in other contexts.

Moreover, the relations between children's responses in learning stories and theory of mind were found, and some of them remained even after age was controlled. It is plausible in that in order to predict a person's intention to learn and judge whether there was a change in knowledge, children need to use theory of mind to consider a learner's and an informant's mental state.

Study 4

1. Research Questions and Design

Study 3 showed that there is a developmental change in children's understanding of learning during early childhood. However, Study 3 still did not answer the question of whether children will show a similar pattern even when an informant is an adult teacher.

If children weigh the informant's authority rather than the necessity of learning, their response could differ depending on whether the informant is their peer or an adult teacher. Thus, it would be meaningful to see if children's understanding of learning is similar even when the informant is an adult teacher who may have more authority and knowledge than their peers. Study 4 examined the almost identical research questions from Study 3—how young children predict a person's intention to learn and whether he has learned knowledge when there is information of the person's knowledge state and an informant's teaching intention, but when the informant is the adult teacher.

In Study 4, a similar set of learning stories from Study 3 were told to young children and their prediction of the intention to learn and judgment of the occurrence of learning were asked after parts 1 and 2 respectively. A difference from Study 3 was that a peer informant was replaced with an adult teacher, and introduced as a teacher in the stories. In addition to the learning stories, the same theory of mind tasks from Study 3 were also presented.

2. Participants

Twenty-three 3-year-olds (10 boys and 13 girls, Mean age = 44.70 months, range = 43-47 months), twenty-four 4-year-olds (nine boys and 15 girls, Mean age = 54.25, range = 49-59 months) and twenty-four 5-year-olds (15 boys and 10 girls, Mean age = 67.48, range = 61-72 months) participated. Children were recruited from a kindergarten and a nursery school in an urban area in South Korea, and were generally from middle class families. All participants were proficient in Korean.

3. Procedures

Six learning stories were presented to children in an identical way from Study 3. The only difference from Study 3 was that the informant was introduced as an adult teacher.

4. Results

Scoring. Coding identical to Study 3 was used for children's responses in the prediction of intention to learn, judgment of occurrence of learning, and theory of mind questions.

Prediction of intention to learn. Figure 7 presents the mean percentage of children's responses of "will try to learn from the teacher" for each story. Children's responses were regressed onto main effects of age group, teacher intention, character knowledge, and all possible interactions, using GEE. Main effects of age group and character knowledge, and a two-way interaction between age group and character knowledge were found. The main effect of age group, χ^2 (2, 71) = 8.082, $p < .01$, indicated that overall, 5- compared to 3-year-olds more frequently predicted a character in the stories will try to learn from a teacher. The main effect of character knowledge, χ^2 (2, 71) = 28.116, $p < .001$ showed that children were more likely to predict a child character will try to learn knowledge in the ignorant character stories, followed by neutral character stories and knowledgeable stories.

The two-way interaction between age group and character knowledge, $\chi^2(4, 71) = 28.313$, $p < .001$, was analyzed by examining the character knowledge effect for each age group. The 3-year-olds did not reveal the character knowledge effect, whereas the older groups did. The 4-year-olds more frequently predicted a character will try to learn in neutral and ignorant character stories than in knowledgeable character stories, and 5-year-olds most frequently predicted a character will try to learn in ignorant character stories, followed by the neutral character and ignorant character stories in that order.

Each age group's prediction of the intention to learn was compared to chance as well. Three-year-olds' responses of "will try to learn from the teacher" were below chance in neutral character-teaching story and comparable to chance in all other stories. The 4-year-olds' predictions of learning intention were below chance in both knowledgeable character-teaching and -no teaching stories, and above chance in the ignorant character-teaching and -no teaching stories. The 5-year-old's predictions of learning intention were below chance in both knowledgeable character-teaching and -no teaching stories, but above the chance in neutral character-teaching, and ignorant character-teaching and -no teaching stories.

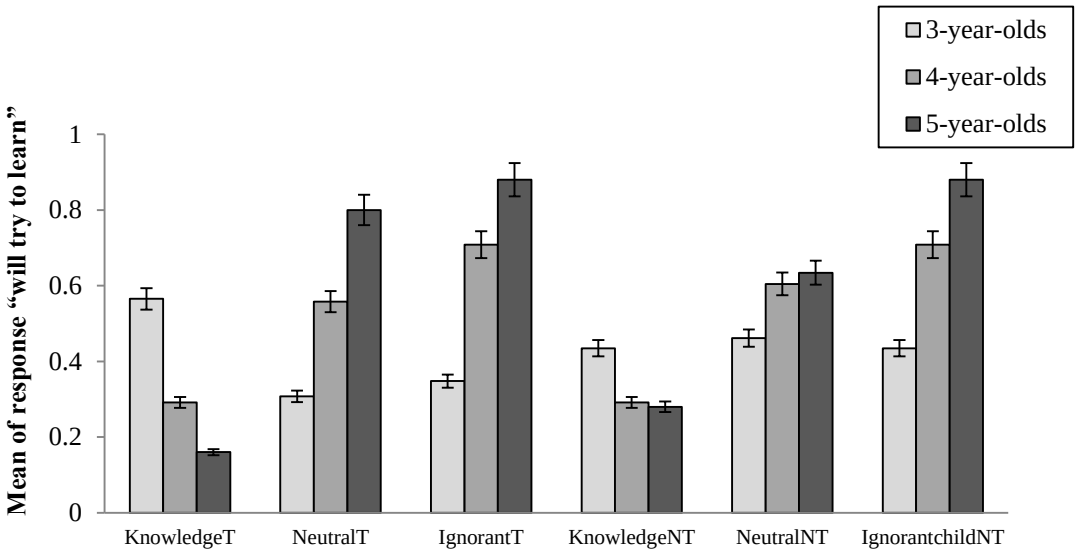

Figure 7. Mean percentage of "will try to learn" responses by age for the six learning stories. (Note. Knowledge T means knowledgeable character teaching and Knowledge NT means knowledgeable character no teaching)

Judgment of occurrence of learning. Figure 8 presents children's judgment of whether learning really occurred in each story. When children's responses were regressed onto main effect of age group, teacher intention and character knowledge, and all possible interactions, main effects of teacher intention and character knowledge, and the two-way interactions between age group and character knowledge and between teacher intention and character knowledge remained. The main effect of teacher intention, $\chi^2(1, 71) = 16.633$, $p < .001$, indicated that overall, children more frequently judged learning occurred in teaching than no teaching stories. Also, another main effect of character knowledge state, $\chi^2(2, 71) = 76.814$, $p < .001$, revealed that children more often judged

that learning occurred in neutral and ignorant character stories than in knowledgeable character stories. These main effects were consistent with Study 3.

The two-way interaction between character knowledge and age, $\chi^2(4, 71) = 13.202$, $p < .05$, was decomposed by examining the age group effect for each stories that differed in character knowledge. An age effect was only found in knowledgeable character stories. The 3-year-olds more frequently judged the character learned knowledge from the teacher than the 4- and 5-year-olds. This difference means that 3-year-olds, compared to the older groups, less often considered the learner's initial knowledge state to judge whether learning occurred. Another interaction between teacher intention and character knowledge, $\chi^2 (2, 71) = 8.301$, $p < .05$, indicated that in neutral and ignorant character stories, children more often judged learning occurred in teaching stories than no teaching stories. No difference was found between teaching and no teaching in the knowledgeable character stories.

Children's judgment of whether learning occurred was also compared to chance. The 3-year-olds' judgments of learning were above chance in both neutral character-teaching and -no teaching and ignorant character-teaching and -no teaching stories. However, their responses did not differ from chance in the knowledgeable character stories. The 4-year-olds' judgments of learning were below chance in knowledgeable character-teaching and -no teaching stories, but above chance in all other stories. The 5-year-olds' judgments of learning were above chance in neutral character-teaching and -no teaching stories and ignorant character-teaching and -no teaching stories. Their

judgments of learning were comparable to chance in knowledgeable character-teaching story, but below the chance in knowledgeable character-no teaching story.

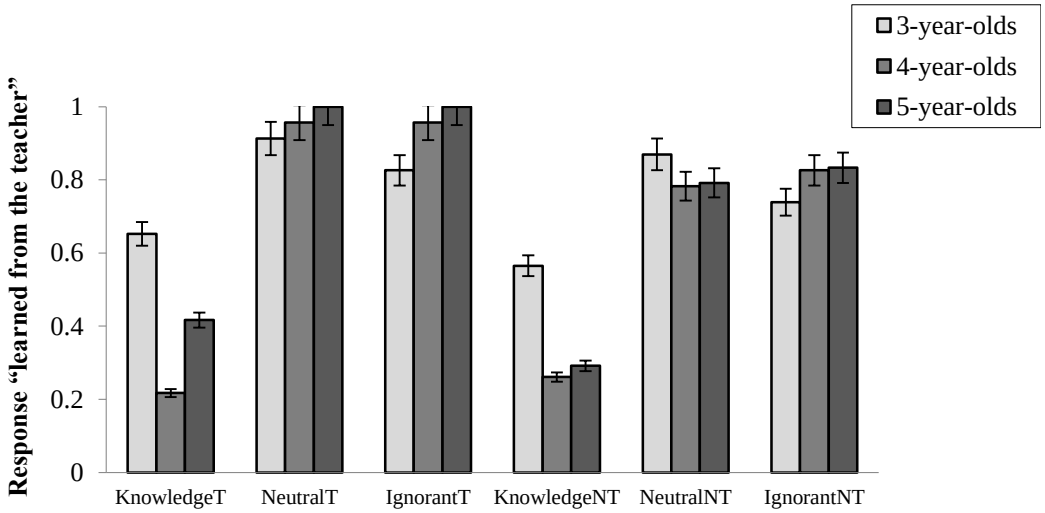

Figure 8. Mean percentage of "learned from the teacher" responses by age for the six learning stories. (Note. KnowledgeT means knowledgeable child character- teaching and knowledge NT means knowledgeable child character- no teaching)

Theory of mind. Children's responses for the appearance-reality distinction, false belief, and representational change were analyzed in a MANOVA with age group as an independent variable as was done in Study 3. The analysis showed an age effect, Wilks' Lambda, F (6, 71) = 6.898, $p < .001$, $\eta_p^2 = .244$. In the appearance-reality distinction, 5-year-olds (mean = 1.52, SD = .65) were not different from 4-year-olds (mean = 1.13, SD = .85), but were better than 3-year-olds (mean = .65, SD = .81), F(2, 71) = 7.042, $p < .01$, $\eta_p^2 = .176$. False belief understanding also showed an age effect, F(2, 71) = 11.712, $p < .001$, $\eta_p^2 = .262$, revealing that 5-year-olds (mean = 1.84, SD = .37) and 4-year-olds (mean = 1.75, SD = .44) were better than 3-year-olds (mean = 1.1, SD = .79).

Similarly, an age effect was shown in children's understanding of representational change as well, $F(2, 71) = 9.657$, $p < .001$, $\eta_p^2 = .226$, showing both 5-year-olds (mean = 1.72, SD = .46) and 4-year-olds (mean = 1.54, SD = .66) were better than 3-year- olds (mean = .95, SD = .89).

Relations among responses in learning stories and theory of mind. Multiple correlations were found among children's responses in the learning stories. (See Table 5) Children's responses in the learning stories in which the child character's knowledge state was identical (e.g., knowledgeable child–teaching and knowledgeable child–no teaching) tended to be related to each other like in Study 4. Children's responses in neutral child stories tended to relate to those in ignorant child stories rather than to the knowledgeable child stories. In addition, similar to Study 3, children's prediction of learning intention and judgment of whether learning occurred were related with some aspects of theory of mind. Most of relations between theory of mind and children's responses in learning stories, however, disappeared once age was controlled.

Table 5. Correlations among measurement (Note. Knowledge T means knowledgeable child character– teaching, and Knowledge NT means knowledgeable child character- no teaching. Coefficients in parenthesis are age-partialled correlations, Responses of "will try to learn" and "learned knowledge from the teacher" were coded as 1 across all stories, Theory of mind refers to combined score of appearance-reality, false belief, and representational change.)

	Variable	1	2	3	4	5	6	7	8	9	10
Learning intention question	1. Knowledge T	-	-.030 (.092)	-.227 (-.080)	.375** (.386**)	.099 (.142)	-.021 (.144)	-.079 (.044)	-.213 (-.118)	-.255* (-.149)	.255 (-.077)
	2. Neutral T		-	.328** (.203)	-.149 (-.071)	.189* (.143)	.361** (.214)	.092 (-.127)	.023 (-.023)	.140 (.079)	.143 (-.036)
	3. Ignorant T			-	-.103 (-.096)	.111 (.114)	.376** (.214)	.251* (-.127)	.206 (-.023)	.278* (.079)	.302* (-.036)
	4. Knowledge NT				-	.099 (.118)	.105 (.200)	-.038 (.009)	-.049 (-.009)	-.091 (-.048)	-.101 (-.046)
	5. Neutral NT					-	.107 (.115)	-.105 (-.216)	.002 (.032)	-.056 (-.056)	-.085 (-.139)
	6. Ignorant NT						-	.098 (-.085)	.290* (.156)	.201 (.019)	.220 (-.025)
	7.Appearancereality							-	.233* (.157)	.367** (.254**)	.792** (.743**)
	8.False belief								-	.213* (.143)	.624** (.603**)
	9.Representationchange										.728** (.676**)
	10. Theory of mind									-	-
Judgment of occurrence of learning question	1. Knowledge T	-	-..102 (-.020)	.051 (.106)	.451** (.460**)	-.043 (-.023)	-.012 (.025)	-.097 (-.046)	-.194 (-.191)	.047 (.114)	-.134 (-.088)
	2.Neutral T		-	.489** (.289*)	.017 (-.013)	.319** (.176)	.423** (.349**)	-.102 (-.291*)	.001 (-.024)	.053 (-.101)	-.023 (-.226)
	3. Ignorant T			-	.130 (.124)	.250* (.261*)	.487** (.512**)	-.033 (-.094)	.022 (-.041)	.041 (-.031)	.003 (-.094)
	4. Knowledge NT				-	.140 (.081)	.236* (.233)	-.091 (-.025)	-.298* (-.217)	-.086 (-.009)	-.198 (-.104)
	5. Neutral NT					-	.499** (.477**)	.124 (.158)	.030 (.032)	.016 (.031)	.080 (.112)
	6. Ignorant NT						-	-.066 (-.123)	.024 (-.004)	.052 (.003)	-.009 (-.081)
	7. Appearance reality							-	-	-	-
	8. False belief								-	-	-
	9.Representationchange									-	-
	10. Theory of mind									-	-

5. Discussion

Study 4 examined how children predict a character's intention to learn and judge the occurrence learning based on the character's knowledge state and a teacher's intention. Consistent with Study 3, only older children reliably considered whether a child character is knowledgeable or not to predict his intention to learn and to judge whether learning actually occurred. Also, children's prediction of learning intention and judgment of learning were related to their theory of mind.

Study 4 confirmed the findings from Study 3 that during early childhood children gain the understanding that a learner's knowledge state influences his intention to learn. Interestingly, in Study 4 in which the informants in the learning stories were adult teachers, there was an overall increase with age in children's predictions of the intention to learn from a teacher. This pattern was different from Study 3 in which the informants were character's peers and there was no age difference in the predictions to learn. The new pattern might indicate that with age children's interest in learning from adult informants may increase, as Study 1 in Part 1 indicated. In addition, like in Study 3, only older children, but not 3-year-olds, considered a character's knowledge state to predict his intention to learn. Given that informants in the learning stories in Study 4 were adult teachers, older children seem to weigh the learner's knowledge state rather than the informant's authority to judge the learner's intention to learn.

In regards to the children's judgment of the occurrence of learning, the overall pattern showed that children more frequently judged there was learning when a character was initially neutral or ignorant compared to when he was knowledgeable. However, it

was only the 4- and 5-year-olds who could reliably understand there was no learning if the character was already knowledgeable from the beginning. Furthermore, children more frequently judged there was learning in the teaching than no teaching stories, and this tendency was apparent in the neutral and ignorant character stories in which there was no evidence that the character was already knowledgeable.

Whether a teacher reveals a teaching intention did not influence children's overall prediction of the intention to learn, which was similar to Study 3. However, their predictions of learning intention in the neutral character–teaching story showed that with age children may react differently to a teacher's initiation of teaching. A clear age difference in the neutral character-teaching story showed that older children more frequently predict a character will try to learn rather than continuing to do his ongoing activity when a teacher initiates teaching. The 5-year-olds' prediction of learning intention was above chance, when 3-year-olds' response was below chance. This clear contrast based on children's age was not found in the neutral character–no teaching story. While there was no overall difference in children's prediction of intention to learn between teaching and no teaching situations, the current results in the neutral stories imply there could be an age-related increase in interest in learning from adults' teaching when there is no other information, such as a learner's knowledge state, to consider.

Study 5

1. Research Questions and Design

Studies 3 and 4 showed that children gain a clear understanding that learning invovles a change in a learner's knowledge, and a person's intention to learn is dependent on his knowledge state in early childhood. However, it still remains a question of whether children use this knowledge-based reasoning to evaluate their own learning. For instance, even if children predict another will try to learn when he is ignorant, they themselves could judge they do not need to learn knowledge when they recognize their own ignornace. Thus, it is be important to see if the same knowledge-based reasoning is applied to judge their own as well as another's learning. The first goal of Study 5 was to see whether children judge not only another's but also their own learning based on the learner's knowledge. To be specific, whether children predict another's intention to learn and judge if that person has learned knowledge based on his knowledge as shown in Studies 3 and 4 was investigated again. In addition, whether this reasoning is applied to their judgmenets of the necessity and desire for their *own* learning, and the occurrence of their own learning was examined.

Second, whether children with better knowledge-based judgmenets of another's and their own learning actually learn more and have more positive learning-related behaviors was tested. For these questions, the study examined whether children learn better in an experimental learning situation if they are better able to judge another's leraning intention and occurrence of learning based on his knowledge, or if they are better able to judge their necessity, desire, and occurrence of their own learning based on

their own knoweldge state. In addition, whether those children show more positive learning-related behaviors in typical learning situations in their school as rated by their teachers was measured.

In order to assess children's judgment of another's learning, all children were presented with the four learning stories that were used in Studies 3 and 4, and asked to predict the character's intention to learn and judge whether knowledge was acquired. Unlike Studies 3 and 4 that contrasted teaching versus no teaching stories, Study 5 only included teaching but not the no teaching stories to focus on children's understanding of learning based on a learner's knowledge state. Thus, the four stories only depicted situations in which informants tried to teach either an already knowledgeable or an ignorant character to focus on children's judgments on the basis of the character's knowledge state.

Also, in Study 5, both teacher and child version stories were presented to test directly the possible difference in children's responses depending on the informant's identity. Thus, four stories were designed based on crossing 2 (Informant identity) X 2 (Child's knowledge state) to result in: an adult teacher instructing a knowledgeable character, an adult teacher instructing an ignorant character, a peer instructing a knowledgeable character, and a peer instructing an ignorant character. Similar to Studies 3 and 4, after Part 1 of the stories, children were asked a prediction question of another's intention to learn. Following that, Part 2 was presented along with a question asking children to judge occurrence of another's learning.

Children also played a box game that was designed as a learning situation, and their judgment of their own learning and how much they learned from the game were measured. To be specific, in the game, all children were presented with both familiar knowledge items (two familiar factual and two familiar behavioral items), and novel knowledge items (two novel factual and two novel behavioral items), and their judgment of whether they needed and wanted to learn the knowledge items, and whether they really learned them from the game were asked. The contrast between factual and behavioral knowledge was included to test previous findings that young children start to have behavioral understanding about learning first (Esbensen et al., 1997; Montgomery, 1992; Perner, 1991; Pramling, 1988). In addition, how many novel knowledge items the children learned from the game was also recorded.

In addition, the children's teachers were asked to complete the Preschool Learning Behavior Scale (PLBS; McDermott, Green, Francis, & Stott, 2000) to measure the children's general learning-related behaviors in school. Lastly, the children's standard verbal ability was assessed using the Differential Ability Scales- Second Edition (DAS-II; Elliott, 2007).

2. Participants

Twenty-seven 3-year-olds (14 boys and 13 girls, Mean age = 43.44 months, range = 40-47 months), twenty-six 4-year-olds (9 boys and 17 girls, Mean age = 53.04 months, range = 48-58 months), twenty-one 5-year-olds (9 boys and 12 girls, Mean age = 64.67 months, range = 60-71 months), and eleven 6-year-olds (8 boys and 3 girls, Mean age= 75.91, range = 72 -81 months) participated. Children were recruited in local

preschools and a kindergarten in the Eastern United States. Approximately, 69.4% of children were white, 17.6% were Asian American, and 12.9% were African American, and most were from middle class families. All children were proficient in English.

3. Procedures

In all procedures, children met a female researcher individually in quiet places in their schools. The order of measurements was counterbalanced, and the sequence of all tasks within a session was randomly decided.

Judgment of another's learning. Four learning stories (an adult teacher instructing a knowledgeable character, an adult teacher instructing an ignorant character, a peer instructing a knowledgeable character, and a peer instructing an ignorant character) were presented in an identical way from Studies 3 and 4. After Part 1, each child was asked a prediction of another's intention to learn, and after Part 2, a judgment of occurrence of another's learning was asked.

Judgment of own learning and actual learning. The researcher introduced the box game by saying "We are going to play a box game. In this box, there are some cards. You and I are going to take turns to shake it and take out a card, and then, we are going to talk about the card." After the instructions, the researcher took her turn first, and took out one of cards from the box.

In the box, there were eight cards, and four of them presented familiar knowledge items and the other four presented novel knowledge items that children may not have heard or seen before. Also, four out of eight items were factual knowledge (e.g.,

what to call a chair) whereas the other half were behavioral knowledge (e.g., how to clap). This contrast between factual and behavioral knowledge was included to test previous findings that young children start to have a behavioral understanding about learning first (Esbensen et al., 1997; Montgomery, 1992; Perner, 1991; Pramling, 1988). Thus, the items employed in the box game were: two familiar factual knowledge items, two novel factual knowledge items, two familiar behavioral knowledge items, and two novel behavioral knowledge items.

Factual knowledge cards presented a photo of an object (e.g., a chair, a squeezer) with the question "What is it?" on each card. A chair and a cup were used as familiar knowledge items, and a squeezer and a pourer were used as novel knowledge items. Behavioral knowledge cards were presented with a sentence and no photo, asking if they knew how to do a certain action (e.g., "how to clap", "how to Juna"). "How to clap" and "How to close eyes" were used as familiar behavioral knowledge, and "How to Juna" and "How to Swob" were used as novel behavioral knowledge items. Most children were not able to read the sentence on the cards, so the researcher read it for them, saying, "How to clap. Do you know how to clap?"

Whenever either the researcher or the child took a card out, the ***knowledge recognition question*** was asked first -- whether children recognize their own knowledge state about item on the card (i.e., "Do you know what it is or you don't know what it is?"). A small number of children (mostly 3-year-olds) answered they did not know familiar items. For them, the researcher gave clues (e.g., "we use it whenever we drink something," "we need to do that whenever we sleep"), and asked them to identify or demonstrate the

knowledge items. After these prompts, all of the children could name or demonstrate the familiar items. Once the children demonstrated their knowledge, the researcher asked whether they knew the familiar items again, and their second responses were entered in the data set.

There were also a few children who claimed they knew the novel items. For them, the researcher asked them to name the object or show how to do the action. Once the children talked or showed something (in fact, no child could identify what the novel item was correctly) claiming they knew it, the researcher said the item was different from what the child said or showed. Next, the researcher again asked the children whether they knew the novel item, and children's second answer was entered in the data set. Most of them answered about their knowledge state correctly at the second question. These processes were needed because a main purpose of the box game was to deliberately present familiar and novel knowledge, and examine how children judge their own learning depending on their knowledge state.

After the knowledge questions, a set of questions to measure how children judge their own learning in the box game was asked These questions included the ***judgment of necessity of learning*** -- whether they judged they needed to learn the knowledge (e.g., "Do you need to learn what it is or you don't need to learn what it is?") and the ***judgment of desire for learning*** -- whether they wanted to learn the knowledge (e.g., "Do you want to learn what it is or you don't want to learn what it is?). The order of the necessity of learning and the desire for learning questions was randomly decided.

After those questions, the researcher gave the answer to the question on each card regardless of whether the information was already familiar or novel. For the factual knowledge, the researcher stated the name of objects on the cards two times, “This is a chair. We call it a chair.” (For a novel factual knowledge item, “This is a Damu. We call it a Damu.”) For the behavioral knowledge items, the researcher demonstrated how to do the specific action while explaining that the action she is showing is the target item. For instance, for the item of “How to close eyes,” the researcher closed her eyes and said, “This is how to close eyes. This is how to close eyes.” Novel behavioral items presented to children were ones that children may not have seen and heard before. “Juna” was an action in which the researcher put her one hand on her head, and put another hand under her chin. Another behavioral item was “Swob,” and it was an action in which the researcher made a fist with one hand and put another hand under an elbow of her arm.

After presenting either familiar or novel knowledge, the researcher asked the ***judgment of occurrence of own learning*** question**,** “Did you learn it is Damu today from me, or did you already know that yesterday?” or “Did you learn how to do Juna like this today from me (showing the action again), or did you already know how to do it yesterday?” The order of alternatives in all questions was randomly decided.

Lastly, after finishing all cards, the researcher measured how much novel knowledge children learned from the game using recall and recognition tests. Tests for factual and behavior items had a similar procedure but were given separately. The researcher presented six relevant photos at the same time for factual and behavioral item tests respectively. There were two photos of target novel objects or actions that children

saw in the game (i.e., Damu, Kami/ a person doing Juna and Swob), two photos of distracting novel objects or actions that children did not see in the game, and two photos of familiar objects/actions used in the game (i.e., a chair, a cup/ a person closing her eyes, a person clapping). For the recall test, the researcher pointed to each photo, and asked the children to name each object or action by asking, "What is it?" or "What is she doing now?"

The recall test was followed by the recognition test for factual and behavioral items respectively. In the recognition tests, the researcher asked children to point to a photo the researcher named by asking, "Where is Damu?" or "Which picture is showing how to Juna?" Children were asked questions for all items including the familiar ones, but only children's answers to target (novel) items were entered in the data set. In fact, all children were correct in answering for familiar items.

Preschool learning behavior scale (PLBS). Teachers were asked to rate children's learning-related behaviors in their classrooms using the Preschool Learning Behavior Scale (PLBS; McDermott, Leigh, & Perry, 2002). This questionnaire assessed three distinctive subscales of competence motivation, attention/persistence, and attitude toward learning. The competence motivation scale assessed children's interest or approach to learning activities (e.g., "Is reluctant to tackle a new activity," "Shows little determination to complete an activity," "Says task is too hard without making much effort to attempt it"). The attention/persistence subscale measured children's skill in focusing and maintaining attention (e.g., "Acts without taking sufficient time to look at the problem or work out a solution," "Tries hard, but concentration soon fades and

performance deteriorates"). The attitude dimension assessed children's tendency to cooperate, accept help, and express hostility when they are frustrated (e.g., "Shows little desire to please you," "Doesn't achieve anything constructive when in a mopey or sulky mood"). The results from the national PLBS standardization showed that this instrument is reliable and valid, and preschoolers' learning behavior was positively associated with social skills and prosocial behaviors, whereas poor learning behavior was related to problem behaviors in school (McDermott et al., 2002).

Language ability. Children's standard verbal ability, including verbal comprehension and ability to name objects, was assessed through the Differential Ability Scale (DAS, Elliott, 1990).

4. Results

Scoring

Judgment of another's learning. In Study 5, a coding strategy that was different from Studies 3 and 4 was used to measure children's total scores of correct knowledge-based reasoning. Thus, in the knowledgeable character stories, answers of "will not try to learn" and "did not learn from the teacher (friend)" were coded as 1 and the opposite responses were coded as 0. For judgments of the occurrence of other's learning, in the ignorant character stories answers of "learned from the teacher (friend)" were coded as 1 and the opposite responses received 0. Consequently, total scores for prediction of other's intention to learn and judgment of the occurrence of other's learning ranged from 0 to 4 respectively.

Knowledge recognition and judgment of own learning. In the box game, for familiar items, statements of "I know it," "I don't need to learn," "I don't want to learn" and "I already knew it yesterday" were coded as 1, whereas the opposite answers received 0. For novel items, the answers of "I don't know it," "I need to learn," "I want to learn," and "I learned it today" were coded as 1 respectively, and opposite answers received 0. This coding strategy was used to see whether children can recognize their own knowledge state correctly, whether they judge the necessity of and desire for learning based on their own knowledge state, and whether they determine the occurrence of learning depending on the presence of a change in knowledge. As such, the total scores for knowledge recognition, necessity of learning, desire for learning, and occurrence of own learning questions were 0 to 4 for familiar and novel items respectively.

Children's actual learning from the box game. Children received a score of 1 when they correctly named a novel object or action in the recall test, and when they pointed to the right photo of a novel object or action that the researcher asked for in the recognition test. Children's learning was totaled across behavioral and factual novel knowledge items, thus their scores ranged from 0-8.

4-1. Judgment of another's learning

McNeil tests did not show any systematic differences in children's responses between the Teacher versus Peer Informant stories for any of the age groups, thus children's responses were aggregated across the different informant stories. This finding suggests that children's prediction of the intention to learn and judgment of the

occurrence of learning were not influenced by whether the informant was an adult teacher or a peer in learning stories.

Prediction of other's intention to learn. Children's predictions of another's intention to learn were analyzed in a 4 (Age) X 2 (Child knowledge) repeated measures ANOVA. (See Figure 9) An age effect occurred, F (3, 85) = 8.187, $p < .01$, $\eta_p^2 = .193$, showing that 4-, 5-, and 6-year-olds were better than 3-year-olds, and 6-year-olds were also better than 4-year-olds in terms of the prediction of the intention to learn based on a learner's knowledge state.

When children's responses were compared with chance, 3-year-olds did not differ from chance level for both the knowledgeable and ignorant character stories. The 4-year-olds were above the chance in the knowledgeable character stories, but comparable to chance in the ignorant character stories. Five- and 6-year-olds were above chance in both types of stories.

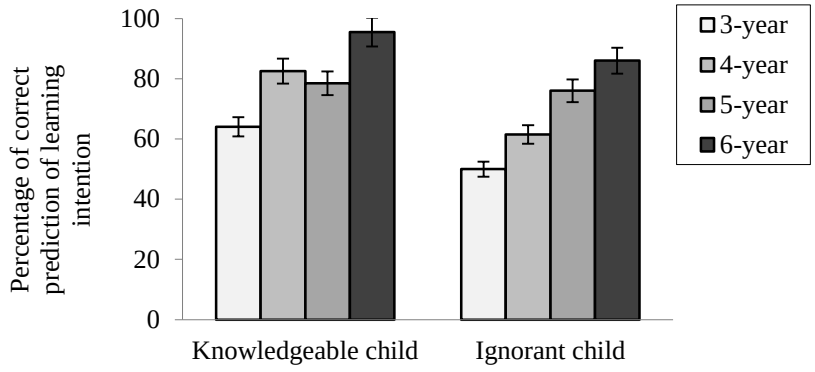

Figure 9. Percentages of correct prediction of other's intention to learn

Judgment of occurrence of other's learning. Children's judgments of the occurrence of another's learning were analyzed in a 4 (Age) X 2 (Child knowledge) repeated measures ANOVA. (See Figure 10) An age effect was found, F (3, 85) = 11.730, $p < .001$, $\eta_p^2 = .303$, showing that 4-, 5-, and 6-year-olds scored better than 3-year-olds, and 6-year-olds were also better than 4-year-olds in judgment of the occurrence of learning based on a change in a learner's knowledge state. Also, there was a character knowledge effect, F (1, 85) = 20.762, $p < .001$, $\eta_p^2 = .204$, indicating that children were better at judging that an initially ignorant character had learned knowledge from an informant than judging that a character who was already knowledgeable did not learn from the informant.

When children's responses were compared to chance, the 3- and 4-year-olds' judgments of the occurrence of learning were comparable to chance in the knowledgeable character stories, but above chance in ignorant character ones. The 5- and 6-year-olds' judgments were above chance in the knowledgeable character stories. Their judgments of the occurrence of learning in the ignorant character stories could not be analyzed statistically because both age groups had perfect scores.

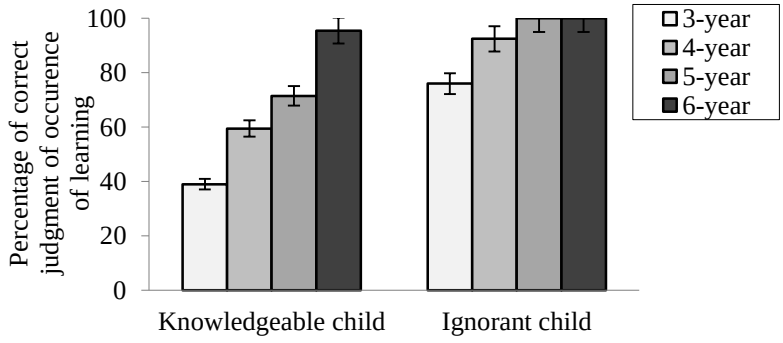

Figure 10. Percentages of correct judgment of occurrence of other's learning

4-2. Knowledge recognition, judgment of own learning and actual learning from the box game

Knowledge recognition. Children's correct recognition of their own knowledge state depending on whether the item was familiar or novel was analyzed in a 4 (Age) X 2 (Knowledge novelty) X 2 (Knowledge type) repeated measures ANOVA. (See Figure 11) An age effect was found, F (3, 85) = 3.281, $p < .05$, $\eta_p^2 = .108$, indicating that 4-, 5-, and 6-year olds' recognition of their own knowledge state was better than 3-year-olds. An interaction between age and knowledge novelty was also found, F (3, 85) = 3.209, $p < .05$, $\eta_p^2 = .106$. When the age effect was examined for the familiar and novel knowledge items separately, the age effect was found only for familiar knowledge, F (3, 85) = 3.815, $p < .05$, $\eta_p^2 = .124$, showing that 4-, 5-, and 6-year-olds' recognition that they already knew the familiar items was higher than the 3-year-olds. However, we should note that even when children said they did not know familiar knowledge items initially, once they were given a chance to think again whether they knew it, all of the participants could name or demonstrate the familiar knowledge items, and most of them correctly identified that they were knowledgeable about the familiar items at the second question.

When all age groups' recognition of their own knowledge state was compared to chance, 3- and 4-year-olds' recognition was above chance for all items. The 5-year-olds' recognition for novel behavior items was above the chance and the 5- and 6-year-olds' recognition of all other knowledge items could not be compared to chance statistically because their recognition was 100% correct. These results indicate even 3-year-olds have

a very good understanding of whether they know something or not when the items are clearly familiar or novel.

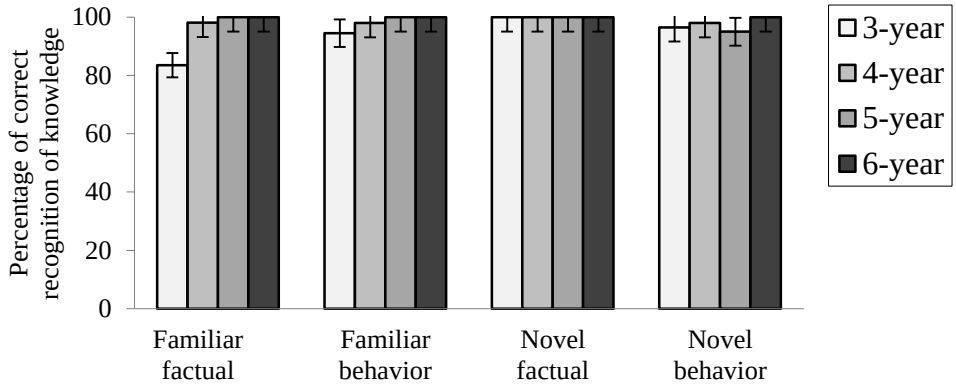

Figure 11. Percentages of correct recognition of knowledge

Knowledge-based attitudes to own learning. McNeil tests did not show any difference between judgments of the necessity of learning and desire for learning. Most children answered both questions identically, regardless of which question was asked first. This consistency indicates that children at these ages may not differentiate the necessity of and desire for learning. Thus, children's responses to those two questions were aggregated under the name of ***Knowledge-based attitudes to own learning***. (See Figure 12.) When the children's scores were analyzed in a 4 (Age) X 2 (Knowledge novelty) X 2 (Knowledge type) repeated measures ANOVA, there was an age effect, F (3, 85) = 17.73, $p < .001$, $\eta_p^2 = .396$, showing that 4-, 5-, and 6-year-olds had better knowledge-based attitudes to their own learning than 3-year-olds, and 6-year-olds also were better than 4-year-olds. This result indicates that older, compared to younger children were better able to judge whether they needed and wanted to learn something based on whether they already knew it or not. Older children were more likely to judge they did not need and

want to learn knowledge if they already knew it, whereas they needed and wanted to learn the knowledge if it was novel to them.

Children's knowledge-based attitudes to own learning were compared to chance for each age group. The 3-year-olds' knowledge-based attitudes to their own learning did not differ from chance in all four types of task, but the 4-, 5-, and 6-year-olds were above chance in all types.

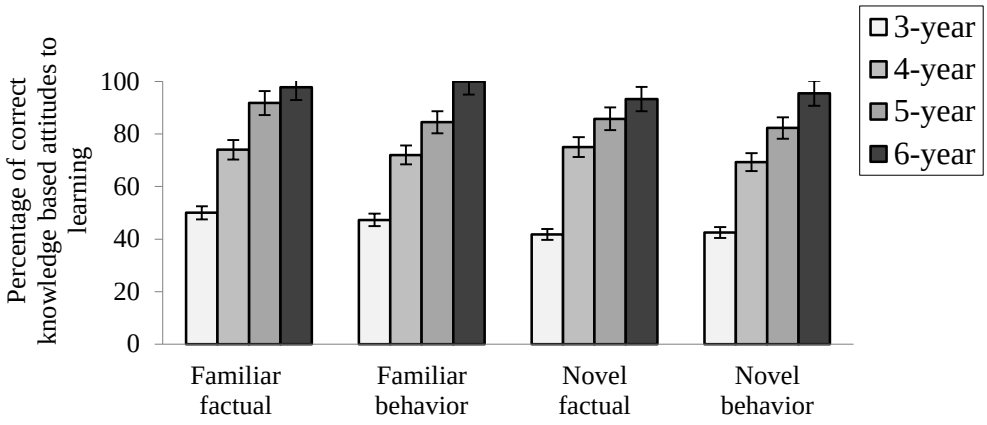

Figure 12. Percentages of correct knowledge based attitudes to own learning (High percentage means the age group is good at judging whether they need/want to learn something or not based on their own knowledge state)

Judgment of occurrence of own learning. Children's correct judgments of whether they have learned the knowledge today or already knew it yesterday was analyzed in a 4 (Age) X 2 (Knowledge novelty) X 2 (Knowledge type) repeated measures ANOVA. (See Figure 13.) An age effect was found, F (3, 85) = 26.057, $p < .001$, η_p^2 = .494, indicating that 5- and 6-year-olds judged whether they have learned knowledge today or not the best, followed by 4- and 3-year-olds in that sequence.

When children's correct judgments of the occurrence of own learning were compared to chance, 3-year-olds' judgments were not different from chance for all the task types, but older groups were better than chance for all types of task.

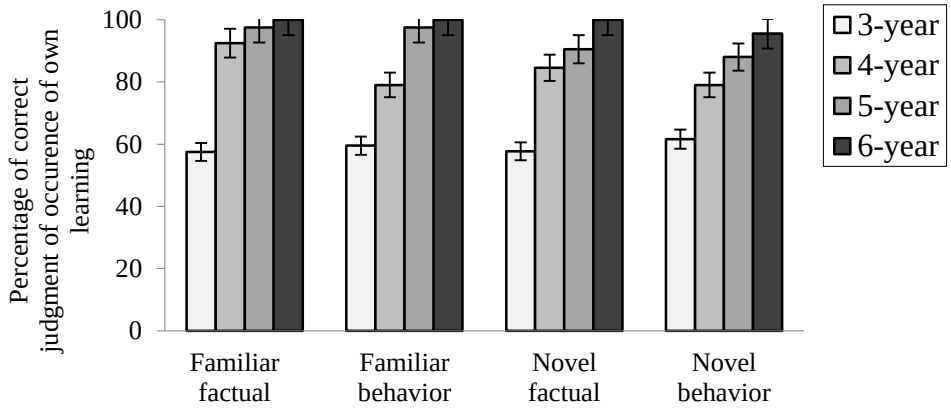

Figure 13. Percentages of correct judgment of occurrence of own learning

Children's learning from the box game. Children's learning of novel knowledge items from the box game was analyzed in a one-way ANOVA with age as an independent variable. An age effect was found, F (3, 85) = 5.950, $p < .01$, $\eta_p^2 = .182$, showing that 5- and 6-year-olds received the highest scores, followed by the 4- and 3-year-olds in that order. The mean scores for 3-, 4-, 5-, and 6-year-olds were 1.63 (SD=1.28), 2.60 (1.78), 2.60 (1.35), and 3.73 (1.56) out of 8.

4-3. Relation between judgments of other's and own learning

Whether children's judgment of another's learning in hypothetical learning situations is related to their judgment of their own learning in the box game was examined. Because our interest was to see the relation between children's judgment of another's learning and judgment of own learning, to simplify the analysis, we totaled responses across the

knowledgeable and ignorant character stories. For the same reason, and also because there was no specific difference in children's correct responses depending on the knowledge type and knowledge novelty, children's knowledge-based attitude to own learning and judgment of the occurrence of own learning were also collapsed across factual and behavioral knowledge and across familiar and novel knowledge.

Table 6. Correlations among children's judgment of other's and their own learning. (Coefficients in parentheses are age and standard verbal ability score controlled.)

	1. Total prediction of other's intention to learn	2. Total judgment of occurrence of other's learning	3. Total knowledge based attitudes to own learning	4. Total judgment of occurrence of own learning
1	-	.313**	.473**	.459**
		(.163)	(.320**)	(.279*)
2		-	.552**	.684**
			(.366**)	(.495**)
3			-	.765**
				(.610**)
4				-

Table 6 presents the correlations among children's total correct predictions of other's intention to learn, total correct judgments of the occurrence of other's learning in the learning stories, total knowledge-based attitude to own learning and total correct judgments of the occurrence of own learning in the box game. Correlations among the variables were also examined while controlling for age and standard verbal ability score to see the unique relations between children's judgment of other's and own learning. There were strong correlations between children's judgment of other's learning and judgment of own learning, and these relations were maintained even after age and verbal

ability were controlled. Thus, children seem to use knowledge-based reasoning consistently when they judge another's and their own learning.

4-4. Relation between judgment of other's and their own learning and actual learning from the box game.

The box game learning scores were examined to determine whether children with better knowledge-based judgments of other's and own learning also learned better in the actual learning situation of the box game. Regression analyses were conducted to test if total prediction of other's intention to learn, total judgment of the occurrence of other's learning, total knowledge-based attitude to own learning, and total judgment of the occurrence of own learning respectively have unique contributions to the actual learning score from the box game. Age, but not standard verbal ability, was included as a covariate to be controlled because standard verbal ability was not correlated with learning score (p = .280).

In the regression analysis for the total prediction of other's intention to learn with children's learning from the box game, age was entered in the first step, and it retained a relation, R = .390, R^2= .152, $F(1, 85) = 14.736$, $p < .001$. In the second step, the total prediction of the intention to learn was entered, and it improved the model, ΔR^2= .073, $F(2, 85) = 11.768$, $p < .001$. Thus, the regression analysis showed that the children's understanding that an individual's knowledge state influences his intention to learn was uniquely related with how much the children learned in the actual learning situation even with age controlled.

Moreover, whether children's knowledge-based attitudes to own learning were related with their actual learning from the box game was also examined using a similar analysis. When age was entered at the first step, it retained a relation, $R = .385$, $R^2 = .148$, $F(1, 85) = 14.736$, $p < .001$. The total knowledge-based attitude to own learning was entered as a second step, and it improved the model, $\Delta R^2 = .042$, $F(2, 85) = 9.792$, $p < .001$. Thus, children's knowledge-based attitude to own learning also had a unique contribution to children's actual learning with age controlled.

Meanwhile, although identical regression analyses were conducted, the total judgment of the occurrence of another's learning in the learning stories and the total judgment of the occurrence of own learning in the box game did not make significant contributions to learning from the box game.

In sum, the prediction of another's intention to learn and knowledge-based attitude to own learning each had unique contributions to children's learning score in the box game. In other words, children who better predicted whether a person will try to learn or not based on the person's knowledge state, and who better judged whether they needed and wanted to learn based on their own knowledge state, learned more in an actual learning situation.

4-5. Relation between judgment of other's and their own learning and PLBS

The PLBS subscales as rated by teachers showed good internal validity (Cronbach's α =.79–.89) in the study, thus were employed as indicators of children's general learning-related behaviors in their schools. In order to examine whether children

with better knowledge-based judgments of other's and their own learning showed more positive PLBS scores, canonical correlations followed by multiple regression analyses were conducted. Canonical analysis was adopted because it allows the examination of relations between two multivariate data sets simultaneously (Weiss, 1972), so it was appropriate to investigate the overall relations between the three subscales (competence motivation, persistence/attention, attitude) of the PLBS and judgment of another's learning which includes prediction of other's intention to learn and judgment of occurrence of another's learning, and the relations between subscales of PLBS and judgment of own learning which includes knowledge-based attitudes to own learning and judgment of occurrence of own learning. Only age, but not standard verbal ability, was included as a covariate because standard verbal ability was not related with any PLBS subscale or total PLBS.

The canonical analysis between the PLBS subscales and the judgment of other's learning set indicated an overall significant relation between these two multidimensional constructs (Wilk's $\Lambda = .75$, F [9, 85] = 2.58, $p <. 01$). The loadings for the one significant canonical correlation (canonical $R = .48$, $p < .01$) are displayed in Table 7. The highest positive loadings in the PLBS set were shown for competence motivation, followed by persistence/attention, and attitude in that order. Age in the judgment of other's learning set showed the highest negative loading, and it was followed by a positive loading for total prediction of other's intention to learn and judgment of occurrence of other's learning. Standardized variance of the PLBS explained by judgment of other's learning set was 15.66%, and standardized variance of the judgment of other's learning set that was explained by PLBS was 4.24%.

Table 7. Canonical Structure of PLBS with judgment of other's learning.

Variable	Canonical functions
PLBS	
Competence Motivation	.9212
Persistence/Attention	.9430
Attitude	.5091
Judgment of other's learning	
Total prediction of intention to learn	.2937
Total judgment of occurrence of learning	.1223
Age	-.6189

Table 8. Squared semi-partial correlations of competence motivation, persistence/attention and attitude explained by each variable in each variable in judgment of other's learning controlling other variables.

	Competence motivation	Persistence/ attention	Attitude
Total prediction of intention to learn	.0575 (p<.05)	.0509 (p<.05)	.0056 (p=.48)
Total judgment of occurrence of learning	.0530 (p<.05)	.0485 (p<.05)	.0301 (p=.11)
Age	.1758 (p<.0001)	.1940 (p<.0001)	.0611 (p<.05)

The canonical correlation analysis was followed by multiple regression analyses predicting PLBS scores from total prediction of other's intention to learn, total judgment of occurrence of another's learning and age. As Table 8 shows, age was always a significant predictor of all subscales of the PLBS, and total prediction of another's intention to learn and total judgment of the occurrence of another's learning were significant predictors of competence motivation and persistence/attention subscale while controlling for an age effect.

Similar analyses of the canonical correlation and subsequent multiple regression analyses were done to see the relations between judgment of own learning set and PLBS set. Again, age was included in the set of judgments of own learning as a covariate to be controlled. The canonical analysis indicated an overall significant relation between these two sets of variables (Wilk's $\Lambda = .70$, F [9, 85] = 3.12, $p < .01$) with one significant canonical correlation (canonical $R =. 53$, $p < .01$) that is displayed in Table 9. The significant pair of canonical variates revealed the highest positive loadings for the PLBS persistence/attention, and it was followed by competence motivation, and then attitude. Age in the judgment of own learning set again showed a high negative loading, and it was followed by a positive loading for total knowledge-based attitude to own learning, and total judgment of the occurrence of own learning. Standardized variance of the PLBS explained by judgment of own learning set was 21.41%, and standardized variance of judgment of own learning set that was explained by PLBS was 4.49%.

Univariate multiple regression analyses predicting the ratings on the PLBS from judgment of own learning were also conducted. As Table 10 displays, age and total

judgment of occurrence of own learning were always predictors to all subscales of PLBS.

Table 9. Canonical structure of PLBS with judgment of own learning.

Variable	Canonical functions
PLBS	
Competence Motivation	.8880
Persistence/Attention	.9838
Attitude	.7358
Judgment of own learning	
Total knowledge based attitude to own learning	.2311
Total judgment of occurrence of own learning	.2079
Age	-.5366

Table 10. Squared semi-partial correlations of competence motivation, persistence/attention and attitude explained by each variable in each variable in judgment of own learning controlling all other variables.

	Competence motivation	Persistence/ attention	Attitude
Total knowledge based attitude to own learning	.0134 (p=.25)	.0271 (=.09)	.0085 (p=.37)
Total judgment of occurrence of own learning	.0441 (p<.05)	.0410 (p<.05)	.0457 (p<.05)
Age	.2096 (p<.0001)	.2535 (p<.0001)	.1307 (p<.001)

In sum, children with better knowledge-based judgment of another's and their own learning were rated by their teachers to have more positive learning-related behaviors independently of age.

5. Discussion

Study 5 examined the development of young children's knowledge-based reasoning to judge another's and their own learning, and whether this development contributes to their actual learning and general learning-related behaviors. In both the judgment of another's and their own learning a consistent age-related change was found. With age, children come to predict and judge a person's intention to learn and occurrence of learning based on his knowledge state and its change. Also, they themselves become able to judge whether to learn depending on whether they are already knowledgeable or not and whether they have learned something based on a change in their knowledge. This knowledge-based reasoning of other's and their own learning was positively related with how much they learn in a learning situation and with having positive learning-related behaviors as rated by teachers even with age controlled.

During early childhood, young children come to understand a person will try to learn something if he is ignorant, but not if he is already knowledgeable. This understanding did not differ depending on whether the informant was an adult teacher or a peer. Thus, older preschoolers, especially 5- and 6-year-olds, judge a person's intention to learn based on his knowledge state rather than the informant's authority or relation with him. Similarly, the older preschoolers also understood that judging whether learning occurs depends on whether there is a change in the learner's knowledge. Five- and 6-

year-olds considered whether a person was knowledgeable at the beginning to judge if he has learned something. In comparison, younger children had difficulty judging another's learning based on a change in his knowledge.

An important new finding of Study 5 is that children clearly rely on knowledge-based reasoning when they judge their own learning, just as they did in hypothetical learning stories. Only the older children, and not the 3-year-olds, predicted another's intention to learn and judged the occurrence of learning based on the character's knowledge state in the stories. The children older than 3 years judged they needed and wanted to learn when the given knowledge item was novel, whereas they do not if they are already familiar with the items. It is notable that even 3-year-olds could correctly recognize their own ignorance and knowledge about given items in the box game, but only older children used such knowledge-based reasoning to determine whether to learn in the box game. Older children also judged whether they have learned something on the basis of whether there was a change in their own knowledge.

There were also strong correlations among children' judgment of another's learning and judgment of own learning as well, and those relations were maintained even with age and standard verbal ability controlled. Thus, taken together, coherent reasoning based on a learner's knowledge may underlie when children judge another's and their own learning. The pattern shows that in early childhood children gain the idea that individuals, including themselves, need to decide whether to learn based on knowledge states, and judge whether there was learning based on the presence of a change in knowledge.

Moreover, another important finding was that young children's knowledge-based judgments of other's and their own learning made unique contributions to their actual learning. Children's total prediction of another's intention to learn and knowledge-based attitudes to their own learning were related with their learning from the box game even after controlling for age. This finding means that children who better predicted an ignorant person, but not a knowledgeable one, will try to learn and who judged that they needed and wanted to learn something when they are ignorant about it, but not when they are knowledgeable, learned better in an actual learning situation regardless of age.

In a similar vein, children with better knowledge-based judgments of other's and their own learning were reported to have more positive learning-related behaviors by their teachers regardless of age. Specifically, children who better predicted a character's intention to learn based on his knowledge or who better judged whether the character really has learned knowledge based on the presence of knowledge change were rated as having better competence/motivation and attention/persistence regardless of age. Also, children who better judged whether they really learned or not in the box game were reported to show positive learning-related behaviors in all aspects of competence/motivation, attention/persistence and attitude towards learning with age controlled. Thus, taken together, children's understanding and judgment of learning based on a learner's knowledge state may have important implications for their actual learning and behaviors.

CHAPTER 5

GENERAL DISCUSSION

Prediction of Learning and Actual Learning Based on an Informant's Knowledge State and Teaching Intention

Part 1 examined how children construe social situations with others as prospective learning contexts when there is information about the informant's knowledge state and his teaching intention, and whether this understanding is applied to their own learning. How children judge the value of learning from other and predict the success of learning was examined in Study 1, and how they themselves learn in a similar situation was investigated in Study 2.

Specifically, Study 1 examined how young children aged from 3 to 5 years predict a person's intention to learn and learning outcome when they know an informant's knowledge state (knowledgeable, neutral, ignorant) and teaching intention (tries to teach, does not have intention to teach). Young children most frequently predicted a person will try to learn when the informant is knowledgeable, and that was followed by when an informant is neutral and when the informant is ignorant. This pattern indicated that older preschoolers consider an informant's knowledge state to judge the value of learning from the person. At the same time, the results showed that older children more frequently predicted a person will try to learn from the informant. Thus, it indicated that with age overall children's interest in learning from an adult teacher may increase.

In terms of predicting the outcome of learning, there was a knowledge effect, indicating children most frequently predicted successful learning would occur when the informant was knowledgeable or neutral than when the informant was ignorant. However, an interaction between informant's knowledge and age showed that older children, rather than younger ones, more frequently predicted successful learning would occur in stories of knowledgeable and neutral informants. This result indicated that unless there is clear evidence of an informant's ignorance, older children have a higher expectation of learning from a teacher.

Taken together, young children's prediction of intention to learn and learning outcome varies depending on whether the informant has enough knowledge or not, and unless there is evidence that the informant is ignorant, older children showed higher expectation of learning from others.

The Study 1's findings were extended to children's own learning in Study 2, indicating that children's knowledge-based reasoning to predict another's learning might also be applied to their own learning. That is, children who heard information from informants whom they perceived as knowledgeable, actually learned more novel animal names from them compared to children in the ignorant informant conditions, even though they were given identical information in the same way. This agreement may indicate that as children construe a social context with a knowledgeable informant as a promising learning context for a character in Study 1, they also may perceive their own learning situation with knowledgeable informants as a better learning context, thus learned better in the situation.

This finding indicated that preschoolers' judgments of which social situations can contribute to learning develops with age. Previous research has shown that during early childhood children come to be aware of their own learning and the different means of knowledge acquisition (Astington & Pelletier, 1996; Bartsch et al., 2003; Esbensen et al., 1997; Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Taylor et al., 1994). They also begin to consider diverse mental states to judge whether another has learned knowledge (Sobel et al., 2007; Sobel, 2015). Crucially, preschoolers come to understand judgment of whether learning occurred requires a change in knowledge (Wang, 2010).

Children's emerging understanding of learning based on a change in mental sates, especially a change in knowledge, may allow them to evaluate which social situations are capable of increasing knowledge. As Study 1 showed, older preschoolers predicted that a learner will try to learn knowledge and will learn successfully as long as there was not evidence for the teacher's ignorance. Also, only 5-year-olds could reliably predict that a character cannot learn successfully from an ignorant teacher. Thus, with age, children come to think that a social situation with an adult will be a promising learning context unless there is clear evidence for the informant's ignorance. However, when they know the informant is ignorant, they think the situation cannot increase a learner's knowledge.

These findings of children's judgments of social situations as prospective learning contexts broaden previous findings on children's selective trust based on informants' knowledge or previous accuracy (Birch et al., 2008; Clément, Koenig, & Harris, 2004; Ganea et al., 2011; Jaswal & Neely, 2006; Sabbagh & Baldwin, 2001; Sabbagh & Shafman, 2009; Sabbagh et al., 2003). Much research has shown that young

children become able to compare the relative trustworthiness of different informants by 3 years, and they seek and endorse the information from more accurate speakers. By asking children's explicit prediction of a learner's intention to learn and the learning outcome from the social situation, Study 1 showed that in early childhood children become better able to determine what is a more promising learning context and what the consequent learning outcome will be based on an informant's s knowledge states.

The findings in Study 2 confirmed that preschoolers' judgments of social situations based on an informant's knowledge state are applied to their own learning as well. When children were just exposed to information given by either a knowledgeable or ignorant informant, their actual learning was influenced by their perception of the informants' knowledge state. In fact, prior evidence has shown that children still accept information from previously inaccurate or ignorant speakers (Krogh-Jesperson & Echols, 2012; Vanderbilt et al., 2014), even though they accept more information from a knowledgeable informant (Koenig & Woodward, 2010; Sabbagh & Baldwin, 2001; Sabbagh & Shafman, 2009; Sabbagh et al., 2003). In Study 2, although the children in the ignorant informant conditions seemed to try to respond to the recall and recognition tests based on the information they were told from ignorant speakers—just as children in knowledgeable informants' conditions did—their mistrust (or lack of trust) of the informants may have led them to learn or accept less of the given information.

Findings from Study 1 also suggest possible individual differences in learning from others. Children who gave positive predictions for the learning intention and learning outcome questions in the neutral teacher stories in which there was no

information about the teacher's knowledge state revealed similar patterns in the knowledgeable and ignorant teacher conditions, and these relations remained even when age was controlled. While these results suggest there could be individual differences in preferences or expectations about learning from others, much remains to be investigated to understand what may cause these individual differences, and how they could affect learning.

Meanwhile, in both Studies 1 and 2, an effect for hearing the informant's instructional intention was not found. Despite the possible implications of a recent theoretical framework as well as empirical evidence that children weigh a speaker's intention to convey information (Landrum, Mills, & Johnston, 2013; Landrum, Eaves, & Shafto, 2015; Lane, Wellman, & Gelman, 2013; Mascaro & Sperber, 2009; Shafto, Eaves, Navarro, & Perfors, 2012; Jeong & Frye, 2018) and the development of understanding of intentionality of teaching during early childhood (Ziv et al., 2008, 2016), the current research did not detect an effect of revealing the informant's teaching intention. There might be several possible reasons why the current study did not find a teaching intention effect.

One possibility may be that children more heavily weigh informants' knowledge than their teaching intention. In other words, in both Studies 1 and 2, to evaluate the social situations as learning contexts the children could have focused more on whether the informant was knowledgeable. In fact, if children appreciate that learning involves a change in knowledge (Wang, 2010), the more critical part in social learning with an informant could be whether the informant has adequate knowledge so that the interaction

can increase the learner's knowledge. In comparison, the presence of the informant's intention to teach could be subordinate because it may be less directly associated with increases in knowledge. If so, then children's prediction of learning that they made as a third party and for their own learning could have been more influenced by the knowledge aspect of the informant.

Alternatively, children, especially at this age, could be more confident in their judgments about knowledge states than their judgments about another's teaching intention. Study 2 showed that there were more variations in children's perception of the intention of the game in comparison to perceptions of the informants' knowledge state. Older preschoolers were more accurate in recognizing the teaching intention of the game. In the teaching conditions, even though all children were told the informants in the video would teach new animal names, some younger children still perceived the informants presented the game to play. This difference suggests that young children could be more confident in their perception of an informant's knowledge state than the presence of her teaching intention.

Nevertheless, it may be noteworthy that in Study 1, when no information was given about the teacher's knowledge state, the age groups varied in their prediction of the character's learning intention. In the neutral teaching condition, the older children, and especially the 5-year-olds, more often answered the character will try to learn from the teacher. The 5-year-olds' predictions of learning intention were above chance, while the 3-year-olds' were below chance. This pattern implies that most of 5-year-olds accepted the possibility of learning initiated by the teacher, whereas most of 3-year-olds thought

they would continue their ongoing activity in the same situation. A similar age difference was not found in the neutral teacher-no teaching story in which the teacher did not reveal a teaching intention. These results suggest that with age children may react and participate differently when a learning opportunity is explicitly suggested by another.

It is a unique feature of Studies 1 and 2 that they assessed the effect of informants' knowledge state and teaching intention together. More tests are needed to see whether revealing the teaching intention makes a difference in children's perception of the social situation and their actual engagement in learning. These questions are especially worth investigating, given their implications for education, and the broad findings that show that children perceive what parents and teachers expect, and try to behave in accordance with those expectations (Alexander, Entwisle, & Bedinger, 1994; Brophy & Good, 1970; Darley & Fazio, 1980; Hoover-dempsey & Sandler, 1997; McKown & Weinstein, 2008; Weinstein & Middlestadt, 1979).

While Studies 1 and 2 separately investigated children's prediction of other's learning and whether these judgments related to their own actual learning, future research should test how children's prediction of their own learning is related with their own learning based on an informant's knowledge state and teaching intention. In addition, investigation of individual and developmental variations in children's preference and perception of social situations that potentially lead to learning, and how they may affect children's learning strategy, motivation to learn, and actual learning should be explored more extensively. Such research might offer highly useful information not only for

understanding the nature of children's learning, but also for determining more effective ways for educating diverse learners.

Understanding of Learning Based on a Learner's Knowledge State and an Informant's Teaching Intention

While Part 1 focused on how children consider an informant's mental state to understand the social situation as a learning context and learn from it, Part 2, especially Studies 3 and 4 broadened the framework to include the learner's side of the interaction. Studies 3 and 4 investigated when young children think a person will try to learn and when learning occurs based on the person's knowledge state and an informant's teaching intention. Across Studies 3 and 4, only older preschoolers, and especially 5-year-olds, could reliably predict a learner's intention to learn based on the learner's knowledge state. Similarly, only 4- and 5-year-olds understood that a change in knowledge was necessary to judge whether a character had learned.

These age-related changes in the prediction of an intention to learn and judgments of the occurrence of learning are consistent with previous findings on the development of young children's understanding of knowledge acquisition and the different means of learning in early childhood (Bartsch et el., 2003; Esbensen et al., 1997; O'Neill & Gopnik, 1991; Sobel, 2015; Sobel et al., 2007; Taylor et al., 1994; Wang, 2010). Even though children may start before their third birthday to be aware of an individual's ignorance or knowledge based on their perceptual access to information (Harris et al., 2017; Knudsen & Liszkowski, 2012; Liszkowski et al., 2006; Liszkowski et

al., 2008; O'Neill, 1996), their appreciation of changes in knowledge and therefore their understanding of learning may develop later in the preschool period.

The improvement in children's understanding of learning was related to their theory of mind. In both Studies 3 and 4, children with better theory of mind were better able to predict that a person's intention to learn is dependent on his knowledge state and also that learning involves a change in knowledge state. Some of these relations remained even after age was controlled, especially when the informant was a peer. Such relations are consistent with previous findings on the relations between mental state understanding and children's understanding of teaching (Bensalah et al., 2012; Olson & Bruner, 1996; Ziv & Frye, 2004; Ziv et al., 2008; 2016). Just as previous findings have indicated that children's theory of mind is related to their understanding of when and why teaching occurs, the current results showed that in order to understand the nature of learning, children need to be able to appreciate changes in people's underlying mental states.

Meanwhile, the informant's teaching intention influenced children's judgments of whether learning actually occurred in both Studies 3 and 4. When a peer or an adult teacher revealed the intention to teach, and then explicitly taught something, more of the children judged that the character learned knowledge from the informant than when the knowledge was incidentally presented by an informant. In fact, this pattern was similar to Taylor et al. (1994)'s original findings. They found that when information was explicitly taught with statement of "I will teach it to you" children were better able to recognize they had learned something new than when the information was implicitly presented.

Thus, when knowledge is explicitly conveyed by an informant, children more frequently judge there would be learning from the informant.

Understanding of Learning as a Change in Knowledge and Its Relation with Children's Learning

Study 5 broadened the findings from Studies 3 and 4, and looked at what implications the development of children's understanding of learning has for their own learning. Study 5 showed that there is an age-related change in the prediction of another's intention to learn and judgments of the occurrence of learning based on a learner's knowledge state, which confirmed the findings of Studies 3 and 4. Given that similar developmental changes were found in Studies 3 and 4 that involved Korean children and in Study 5 that involved American children, it is thought that children from middle class families in both societies may come to have knowledge-based understanding of learning at similar ages. Nevertheless, it would be meaningful to see if this development of understanding of learning based on knowledge appears at a similar life stage in more diverse contexts, and whether schooling or educational experiences influences the development.

An important new finding of Study 5 is that children use the same knowledge-based reasoning to judge their own learning as they did in hypothetical learning stories about other learners. Older preschoolers predicted another's intention to learn and judged the occurrence of learning based on the other's knowledge in the hypothetical stories across Studies 3, 4 and 5. Similarly, 4- year-olds and older children judged whether they need and want to learn knowledge depending on whether the given knowledge item is

novel or an already familiar one. Although even 3-year-olds correctly recognized their own knowledge status—whether they are ignorant or knowledgeable about something in the box game in Study 5, only older children used knowledge-based reasoning to determine whether to learn.

Older children also judged whether they learned something depending on whether there was a change in their own knowledge. While some previous works found that children better recognize learning when the learned knowledge is behavioral rather than when it is factual (Esbensen et al., 1997; Perner, 1991), results from Study 5 did not show such a difference in the judgment of learning based on the kind of knowledge. Thus, taken together, a coherent reasoning based on a learner's knowledge may underlie when children judge another's and their own learning. Strong correlations between children's judgments of another's learning and their own learning also support this conclusion.

Also, the correlations between children's judgment of another's learning and their judgment of own learning indicated that children who judged another's learning on the basis of his knowledge were likely to judge their own learning using the same reasoning regardless of age. That is, although there is an age-related change in understanding of learning based on a learner's knowledge state, even in a same age group, some children may use knowledge-based reasoning more than other children. Thus, it would be meaningful to examine which factors can increase children's knowledge-based reasoning (e.g., school experience, parenting attitudes etc.).

Moreover, children's knowledge-based reasoning about learning made unique contributions to children's actual learning. Children's prediction of another's intention to

learn based on his knowledge state and their knowledge-based attitudes to their own learning were related with their actual learning in the box game, and these relations were maintained even after controlling for age. This result indicates that children who better predicted whether a person will try to learn or not depending on his knowledge state, or ones who better judged whether to learn knowledge depending on their own knowledge state, learned better in the an actual learning situation regardless of age.

In a similar vein, children with better knowledge-based understanding of others' and their own learning were reported to have more positive learning-related behaviors by their teachers. Specifically, children who better predicted a character's intention to learn based on his knowledge or who better judged whether the character really has learned based on the presence of a knowledge change were rated as the ones with better competence/motivation and attention/persistence regardless of age. Also, children who better judged whether they really learned knowledge or not in the box game were reported to show positive learning-related behaviors in all aspects of competence/motivation, attention/persistence and attitude with age controlled.

Thus, children's understanding and judgment of learning based on the learner's knowledge state had important relations with their actual learning and behaviors. Previous research on an individual's knowledge monitoring and its relation to academic achievement has found that learners with better recognition of their own knowledge or ability are likely to learn better and have better academic performances overall (Isaacson & Fujita, 2006; Tobias & Everson, 2000, 2002). As those authors have claimed, this relation is plausible because people who can evaluate their own knowledge and ability

can correctly allocate their cognitive resources and effort to tasks or problems based on whether they are already knowledgeable or not about the problem or task.

However, the effective allocation of resources is only possible when the learner identify knowledge that they don't know yet as one that they need to learn or solve. If children are unaware that they need to solve or learn a task that they do not know well, they may just try to focus on a problem that they already understand or are already confident about it. Once this basic understanding is present, it becomes possible to consider how resources can be better applied to accomplish learning. The current findings show that in early childhood children gain the basic reasoning that individuals need and want to learn things they do not know yet and they do not need to try to learn knowledge that they already know. Moreover, young children's learning and learning related-behaviors benefitted from having this understanding.

Children with this understanding may have learned better in the box game because they could differentiate the items they needed to pay more attention to from the items they could safely ignore, and thus adjust their cognitive efforts to learn more effectively. Similarly, children who understood that learning involves a change in knowledge might have been more likely to be aware of their own learning in school, and also be likely to recognize that the school activities could increase their knowledge and skills about something. Consequently, they could have more interest in activities for learning, and maintain their attention and efforts for them appropriately. Although the current study cannot address causal relations between children's understanding of learning and their actual learning, given previous research on the link between learners'

knowledge recognition and their academic achievement (Isaacson & Fujita, 2006; Tobias & Everson, 2000, 2002), children's emerging knowledge-based reasoning about learning could play an important role in children's learning and behaviors to control their learning.

The development of knowledge-based reasoning on learning shown in the current study could have important implications for understanding and supporting young children's learning. In contrast to traditional developmental perspectives that view young children as lacking the capacity to understand and monitor their own cognitive processes (Flavell, 1978, Flavell & Wellman, 1977; Inhelder & Piaget, 1958), the current study showed that by 4 or 5 years, children can make reasonable decisions about when or what to learn based on their current knowledge state. This result indicates that young children start to have naïve but important metacognitive abilities to monitor and decide their learning in early childhood.

Children's emerging understanding of learning based on knowledge states should become a part of the metacognitive knowledge that is needed for self-regulated learning. In self-regulated learning learners monitor and control diverse aspects of their learning, including their knowledge, ability, strengths and weaknesses. They set up their own goals, adjust their strategies depending the goal, and reflect on the outcome of their learning (Pintrich, Wolters, & Baxter, 2000; Pintrich & Zusho, 2002; Zimmerman, 1990, 2002; Zimmerman & Schunk, 2011). Children's growing metacognitive understanding that a person's knowledge state influences the necessity of and motivation for learning, and that learning depends on a change in knowledge, may allow them to decide effectively what

to learn and what they need to pay the most attention to, and better evaluate their own learning.

As a first step to examine the connection between young children's understanding of learning and their own learning, Study 5 examined the relations that children's knowledge-based reasoning has with their actual learning and with teacher-rated learning behavior in school. In order to have a more detailed picture of the relation, it will be necessary to test whether children's understanding of learning plays a role in the diverse stages of learning including goal setting, monitoring, controlling, and reflection. Metacognitive research has shown that children's learning is enhanced when they have personal insight into their own thinking and learning (Pintrich, 2002; Paris & Winograd, 1990). Thus, further research is needed to understand how young children consider various aspects that can influence learning, such as a learner's and an informant's mental state, effort and ability, and usefulness of knowledge and task characteristics. How they understand these diverse factors that can affect learning, and whether that understanding influences their expectation of learning and actual learning are interesting questions that should be explored more. Finding ways to support young children's growth as self-aware, decisive and active learners might be fruitful in further investigations of children's development of the understanding of learning and its influence on their learning.

APPENDIX

Study 1

Knowledgeable teacher's teaching

He is Minsu, and she is his teacher. The teacher knows how to make a house well. Look how she makes a house nicely. Minsu is drawing a picture now. At that time, the teacher comes and says "Minsu, do you want to know how to make a house? I want to teach you how to make it."

Control question: Does the teacher know how to make a house well? (This question to check children's understanding of teacher's knowledge state was asked in all stories except for neutral teacher stories.)

Learning intention question: Will Minsu try to learn how to make a house from the teacher, or will he try to continue to draw the picture?

Learning outcome question: If the teacher teaches how to make a house, can Minsu learn successfully how to make a house from the teacher, or cannot he learn it successfully?

Neutral teacher's teaching

She is Jiho and she is her teacher. Jiho is now reading a story book. At that time, the teacher comes and says "Jiho, do you want to know how to make an airplane? I want to teach you how to make an airplane."

Ignorant teacher's teaching

She is Jiwon and she is her teacher. The teacher does not know how to make a boat well. Look how she makes a boat. Jiwon is reading a picture book now. At that time, the teacher comes and says “Jiwon, do you want to know how to make a boat? I want to teach you how to make it.”

Knowledgeable teacher’s no teaching

He is Jihan and she is his teacher. The teacher knows how to make a house well. Look how she makes a house nicely. Jihan is drawing a picture now. While drawing the picture, he happens to see the teacher is making a house now. However, the teacher does not know Jihan is seeing her, and she is just making a house now.

Control question: Does the teacher know how to make a house well?

Does she know Jihan is seeing her or doesn’t she know he is seeing her? (This question to check if children understand the teacher could not have intention to teach was asked in all no teaching stories.)

Learning intention question: Will Jihan try to learn how to make a house from the teacher, or will he try to continue to draw the picture?

Learning outcome question: If Jihan watches how the teacher makes a house, can he learn successfully how to make a house from the teacher, or cannot he learn it successfully?

Neutral teacher’s no teaching

She is Jua and she is her teacher. Jua is now reading a story book. While reading the story book, she just happens to see the teacher is making an airplane. However, the teacher does not know Jua is seeing her, and she is just making an airplane now.

Ignorant teacher's no teaching

He is Yoonho and she is his teacher. The teacher does not know how to make a boat well. Look how she makes a boat. Yoonho is reading a picture book now. While reading the picture book, he just happens to see the teacher is making a boat. However, the teacher does not know Yoonho is seeing her, and she is just making the boat now.

Study 4

(In Study 3, an informant in the story was a peer informant, and the design of each story was identical across Studies 3, 4, and 5)

Teaching a knowledgeable child

Part 1:

She is Jihye and she is her teacher. Jihye knows how to make a house with paper well. Look, how she made it nicely. One day Jihye is reading a story book. At that time, her teacher comes and says "Do you want to know how to make a house with paper? I want to teach you how to make it."

Control question: Does Jihye know how to make a house well?

Prediction of intention to learn question: Will Jihye try to learn how to make a house or continue to read the book?

Part 2: The part 2 is identical across teaching stories.

Then let's see what is going on. The teacher shows Jihye how to make a house like this. Now Jihye just made a new house with paper. Look! She made the same house as she made by herself before.

Judgment of occurrence of learning question: Did Jihye really learn how to make the house from the teacher or she did not learn it from her?

Teaching a neutral child

Part 1:

He is Juhyung and she is his teacher. One day Juhyung is drawing a picture. At that time, his teacher comes and says "Do you want to know how to make a box? I want to teach you how to make it."

Teaching an ignorant child

Part 1:

He is Minyoung and she is his teacher. Minyoung does not know how to make a boat well. Look, how he made it. One day Minyoung is drawing a picture. At that time, his teacher comes and says "Do you want to know how to make a boat with paper? I want to teach you how to make it."

No teaching of a knowledgeable child

Part 1:

He is Minho and she is his teacher. Minho knows how to make a house with paper well. Look, how he made it nicely. One day Minho is reading a story book. At that time, he just happens to see the teacher is making a house with paper. However, his teacher does not know that Minho happened to see she is making a house.

Control question: Does Minho know how to make a house well?

Does teacher know Minho sees she is making a house?

Prediction of intention to learn question: Will Minho try to learn how to make a house or continue to read the book?

Part 2: The part 2 is identical across no teaching stories.

Then let's see what is going on. The teacher is making the house, and Minho sees the teacher making the house. Now, Minho just made a new house with paper. Look! He made the same house as he made by himself before.

Judgment of occurrence of learning question: Did Minho really learn how to make a house from the teacher or he did not learn it from her?

No teaching of a neutral child

Part 1:

She is Sujin and she is her teacher. One day, Sujin is drawing a picture. At that time, she just happens to see the teacher is making a box. However, her teacher does not know that Sujin happened to see she is making a box.

No teaching of an ignorant child

Part 1:

She is Jiyoon and she is her teacher. Jiyoon does not know how to make an airplane well. Look how she made it. One day, Jiyoon is drawing a picture. At that time, she just happens to see the teacher is making an airplane with paper. However, her teacher does not know that Jiyoon happened to see she is making an airplane.

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