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# I. Introduction and theoretical background

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It is a fundamental human quality to form intentions, to act intentionally and to ascribe intentions to other people. We readily interpret others' behavior as being intentional and infer their intentions through observation of their actions and reasoning about their minds. Being able to understand other people's intentions is a core element of social cognition and allows for appropriate interactions with others, whereas impaired understanding of intentions is associated with problems in the social domain, as has been reported for Autism spectrum disorder (Boria et al., 2009; Cattaneo et al., 2007; Vivanti et al., 2011). In typically developing children, there is a gradual development from an action-based understanding to a more abstract understanding of intentions as mental states. Even very young children (at about 1 year of age) seem to be able to grasp intentions in the sense of the goals that actions are directed at (Tomasello, Carpenter, Call, Behne, & Moll, 2005). However, an understanding of intentions on a mental-representational level develops long after that and is not completed before about 5 years of age (Feinfield, Lee, Flavell, Green, & Flavell, 1999; Schult, 2002).

The factors underlying the shift from a very basic notion of intentions as inherent in actions to a more sophisticated conception of intentions as mental states are still poorly understood. It is probable that increasing cognitive and linguistic abilities as well as increasing experience with social situations, are contributing to the development of a full understanding of intentions. Especially language abilities are of great importance for grasping mental states and have repeatedly been associated with the development of a theory of mind (ToM) (J. de Villiers & de Villiers, 2014; Farrant, Maybery, & Fletcher, 2012; Farrar & Maag, 2002; Bertram F Malle, 2002; Milligan, Astington, & Dack, 2007). Whereas several studies have shown high correlations of language abilities and ToM abilities, it is still debated if language development subserves ToM development, if it is the other way around or if there is a bi-directional relationship (de Villiers, 2007).

Regarding intention understanding, it is plausible that as language abilities increase, a more fine-grained understanding of intentions, clearly distinguishable from other mental states like desires and beliefs, evolves. Apart from being able to understand and distinguish mental state verbs like *think*, *decide* or *want* and understanding verbs that imply the pursuit of a goal like *try*, development of syntactic abilities seems to be utterly important. Complex syntactical structures, like sentences with embedded complements, are used to express the content of minds and to contrast them with reality (J. de Villiers & de Villiers, 2014). As there are so many findings relating false belief understanding to language development, the question arises whether understanding of intentions is also related to language ability, especially to syntactic ability.

What I suggest is that intentions can be understood on an action-based level without understanding complex syntax, as has been shown for very young and even preverbal children (Aldridge, Stone, Sweeney, & Bower, 2000; Meltzoff, 1995), but that understanding of intentions as mental states is related to syntactic development. In the first part of the thesis, the theoretical background of this claim will be explained in detail. In the second part, the study investigating development of intention understanding and its relation to receptive syntactic abilities in children aged between 3 and 6 years will be presented, and results and will be discussed.

# 1. What is an intention?

In order to comprehend how the understanding of intentions emerges gradually in a child's development and why linguistic abilities may play a crucial role in the understanding of intentions, it is necessary to define precisely what an intention is. What do we mean by saying that someone has an intention? Drawing on specific literature from both philosophy and psychology, this chapter will provide a definition of intentions, describe how intentions are related to actions and introduce a subdivision of intentions in *prior intentions* and *intentions in actions*, which is of great importance for the present study. The influential approach of a folk concept of intentional action will be presented briefly. Finally, intentions as representational mental states and their connections to beliefs and desires as well as major differences between these concepts will be discussed.

## 1.1. Intentions and intentionality

Attempts to define the concepts of intention and intentionality have a long tradition within the philosophy of mind (see Aristotle, 1892/330 B. C.; Heider, 1958; Hume, 1978/1740, for some outstanding examples). First of all, it is important to clarify how the concept of "intention" is related to the concept of "intentionality". In one of his groundbreaking works, the philosopher John R. Searle (1983) defined intentionality as the capacity of the mind to be *about* something, to represent objects and states of affairs in the world. Accordingly, intentionality is the directedness or *aboutness* that is shared by different kinds of mental states, including desires, fears, hopes, beliefs and intentions. All intentional mental states are *about* objects or states of affairs in the world, in other words; they have a propositional content. In Searle's view, having an intention is just one intentional mental state among others, with the special condition that the propositional content concerns an action. Therefore, we adopt the definition that an intention is a mental representational state that is about an action. All intentional mental states have conditions of satisfaction. While e.g. a belief can be true or false, an intention can be fulfilled or unfulfilled (cf. Searle, 1983). This is what links intentions to intentional actions, that are directed at fulfilling an intention.

## 1.2. Intentions and actions

As has already been stated, intentions are always about actions. Conversely, there are no actions without intentions (cf. Searle, 1983). But the relationship between intentions and actions is not as straightforward as it might seem. Intentions both cause and represent actions, which Searle (1983) called the "causal self-reference of intentions". Thus, actions are the conditions of satisfaction of intentions. Only if the agent forms an intention and acts

on this intention, the intention is fulfilled. If my intention is to water my plants and I take a watering pot and water them, my intention is fulfilled, the conditions of satisfaction are met. On the contrary, if I put a watering pot next to my plants and then later accidentally run over it ("unintentional behavior") and thereby water them, my intention is *not* fulfilled. In order for an intention to be fulfilled, the intended outcome has to come about "in the right way" (Searle, 1983, p. 82), namely by the intended means. Intentions already specify the "how" of an action. They also specify the "who" of an action: It has to be the agent herself/himself that produces the intended outcome. If it just happens to start raining and the rain waters my plants, my intention is *not* fulfilled either.

The relationship between intentions and actions can also be explained with regard to goals. Generally speaking, agents that form intentions and perform intentional actions hold three important characteristics (cf. Tomasello et al., 2005): 1) They have a goal toward which to act. 2) They are able to change the environment. 3) They are able to perceive the environment so as to know when the state of the environment matches the goal. With regard to these characteristics, an intention is "a plan of action the organism chooses and commits itself to in pursuit of a goal" (Tomasello et al., 2005, p. 676). However, the intentional action that is performed in order to reach the goal may produce a result that does or does not match the goal. An intentional action can either be a failed attempt to meet the goal, a successful attempt to meet the goal or can bring about an unintended result (cf. Tomasello et al., 2005).

### **1.3. Distinguishing *prior intentions* and *intentions in actions***

An intention is a mental state, a mental decision to perform a certain action (= *prior intention*), but an intention is also manifest on a behavioral level, as the intentional component of an action (= *intention in action*). This distinction between *prior intention* and *intention in action* drawn by Searle (1983) also refers to the observability of intentions: A *prior intention* is not observable per se, as it is the mental representation of a future action. This intention might not be reflected in behavior. For example, someone can form the intention to go to the gym, but then be kept from doing it by an extra work load that has to be done instead. A *prior intention* refers to what one thinks he/she will do, even though it might not happen or to what one decides to do, even though he/she might fail to do so. In contrast, an *intention in action* can be inferred by observing behavior. It refers to the intentional component of an action, which is present in almost every human action. Usually, an action consists of an intentional component and a physical component, like opening a door involves an intention and a bodily movement that is caused by the intention. If someone is asked what he/she is doing, the answer usually refers to the intentional component, which is related to the goal of the action, like "I'm opening the door" and not to the physical component, like "I'm causing my hand to turn to the left/right". Behavior that is lacking an

*intention in action* is called “unintentional behavior”, e.g. dropping something on the floor, breaking a glass accidentally etc. Actions which have an intentional component, but do not result in the intended outcome, are still intentional actions. In that case, when asked about what one was doing, one would still refer to the intentional component, like “I was trying to open the door” (cf. Searle, 1983).

#### **1.4. A folk concept of intentional action**

Some authors have chosen an empirical approach to define “intentionality”, namely to ask people what distinguishes intentional from unintentional behavior (Knobe, 2003, 2006; Malle & Knobe, 1997). Note that the term “intentionality” here solely refers to the intentionality of an action, and is not equivalent to what Searle called the “intentionality” of mental states. The distinction between unintentional and intentional behavior is of great importance for making social judgements, like blaming someone for an intentional action or excusing the same behavior when unintentional (Lagnado & Channon, 2008; Malle, 2006). It has been claimed that when people distinguish between intentional and unintentional behavior, they rely on a shared “folk concept of intentionality” (Malle & Knobe, 1997, p. 102), which actually is a folk concept of intentional *action*. It has indeed been reported that people show a very high agreement in their judgments of whether a certain behavior is intentional or not, indicating that they use a common folk concept of intentional action (Malle & Knobe, 1997). As they wanted to build a model of intentional action based on empirical data, Malle & Knobe (1997) asked people directly (p. 106): “When you say that somebody performed an action *intentionally*, what does this mean? Please explain.” Thereby they identified the following five components of intentionality: 1) a desire for an outcome, 2) beliefs about an action leading to that outcome, 3) an intention to perform the action, 4) skill to perform the action and 5) awareness of fulfilling the intention while performing the action. This finding clearly indicates that people refer to mental states when judging the intentionality of an action. Relevant mental states, apart from the intention per se, seem to be desire and belief. The relationship between desire and intention is indeed a close one, but desire and intention are conceptually clearly separable. Beliefs play a crucial role because intentions are based on beliefs about actions and their consequences.

#### **1.5. Intentions as representational mental states**

Despite their close connection to actions, it is important to acknowledge that above all, intentions are mental states. Intentions can never be directly observed, but *intentions in actions* can be inferred through observation of behavior. By observing behavior, we can also reason about which prior mental state, which *prior intention*, may have caused the action.

To understand *prior intentions* (purely mental intentions), it is necessary to distinguish intentions from other mental states like beliefs or desires.

### **1.5.1. Intentions and beliefs**

The difference between beliefs and intentions mainly relates to what has been called “direction of fit” (Searle, 1983). A belief has a “mind-to-world” direction of fit, as the belief in my mind should match the real world (and not the other way around). In contrast, an intention has a “world-to-mind” direction of fit, as the real world should match the intention in my mind (and not the other way around). Let’s consider an example: If I have a belief about the world, like that the train station is in the north of the city, but in reality, the train station is in the south of the city, I’m having a false belief and it can’t be said that the world is wrong. If I have an intention for an action, like to go to the train station, but in reality, this action is not carried out (because I’m mistakenly walking in the opposite direction), it can’t be said that my intention was false, but rather that something in the real world has gone wrong. An intention can never be true or false, like a belief can be true (matching reality) or false (not matching reality), but can be fulfilled (reality matches my intention) or unfulfilled (reality doesn’t match my intention). In this example, my unfulfilled intention was due to a false belief about the world, but intentions can also be unfulfilled due to other reasons.

### **1.5.2. Intentions and desires**

At first sight, intentions and desires seem to be very closely related. They are both conative attitudes that motivate an agent to take a certain action (Malle & Knobe, 2001). They share the “world-to-mind” direction of fit (Searle, 1983), meaning that the world has to change in accordance to the mind. Also, when observing behavior, the visible outcomes of desires and intentions often overlap, because agents are likely to engage in intentional actions in order to satisfy certain desires. It is often the case that either both intention and desire are frustrated or that both intention and desire are satisfied (Chiavarino, Apperly, & Humphreys, 2010). Still, there are several important differences between intentions and desires: The content of desires are goal states and how this goal states are achieved is not of importance. The content of intentions are goal-directed actions, and for the intention to be fulfilled, these actions have to be carried out in the intended way (cf. Baird & Astington, 2005). Another difference between intentions and desires concerns the commitment to act. One can have a desire for an outcome, but still intend to do something that will not result in the desired outcome or even do nothing about it at all. In contrast, having an intention means having a plan for action (cf. Schult, 2002). While one can desire an impossible outcome (e.g. to be on holiday for Christmas and to be at home at the same time), one can never intend to do anything one knows to be impossible. Put differently, I can desire all kinds of outcomes, but “I can only intend what my intention can cause” (Searle, 1983, p. 105).

## 2. Understanding intentions

It is commonly assumed that we understand others' intentions in an effortless and automatic manner. A quick understanding of the actions and intentions of others is crucial when living in a social environment (Van Overwalle & Baetens, 2009). Indeed, there is even an intentionality bias, meaning that we interpret most behavior as being intentional, even when it is not (Kelemen & Rosset, 2009; Rosset, 2008). But what are the underlying mechanisms and which brain structures are relevant for the processing of intentions? This chapter will describe different levels of intention understanding that are based on the mirroring and mentalizing system of the brain, and discuss under which circumstances these systems are activated.

### 2.1. Understanding *intentions in actions* and *prior intentions*

Referring to the distinction between *intentions in actions* and *prior intentions*, it is clear that intentions can be understood at different levels of complexity, from an action-based level to a more abstract mental representational level (Grafton & Hamilton, 2007). An understanding of *intentions in actions* includes distinguishing intentional actions from unintentional behavior and identifying the intentional component of an action. This relies heavily on an understanding of actions as being goal-directed and the ability to infer goals from observed behavior. Recognizing action goals of others is regarded as a basic form of intention understanding that appears early in childhood (see section 3.2.) and is seen as a first indicator of a simple mentalistic understanding of actions as being motivated by unseen intentions (Gopnik, Slaughter, & Meltzoff, 1994). An understanding of *prior intentions* means understanding intentions as representational mental states. A representational model of mind is seen as a successor of a more basic and simple mentalism (Gopnik et al., 1994). Understanding *prior intentions* entails capturing the properties of the mental state of an intention (in contrast to properties of other mental states like desires). It has been shown that the development of an understanding of intentions as mental states is not completed until about 5 years of age (e.g. Feinfield et al., 1999; Schult, 2002).

### 2.2. Understanding intentions based on actions: mirroring and mentalizing

It has been argued that the ability to understand other people's intentions through observation of their actions forms the basis of all higher-level understanding of others' minds (Blakemore & Decety, 2001). Actions "involve the organism in direct causal relations with the environment on which its survival depends" (Searle, 1983, p. 105), and are thus an

extremely relevant category for humans. Some authors have suggested that based on observation of behavior, intentions can be processed at three distinct levels: 1) a mirroring level, at which action goals are inferred on the basis of action observation, 2) a representational level, at which a psychological representation of the mental states underlying those actions is built, and 3) a conceptual level, at which people are able to reason about the semantic and logical properties of mental states (Chiavarino, Apperly, & Humphreys, 2012). The mirroring level is believed to be embedded in the „mirroring system“ of the brain (premotor cortex and anterior intraparietal sulcus), whereas the representational level and the conceptual level are seen as parts of the „mentalizing system“ of the brain (temporoparietal junction, medial prefrontal cortex, and precuneus) (see Van Overwalle & Baetens, 2009, for a review) Chiavarino et al. (2012) argue that the mirroring system and the mentalizing system constitute two independent routes to understanding behavior and intentions (see Figure 1), with the mirroring system allowing for an understanding of the intentional component of actions and the mentalizing system allowing for a more abstract understanding of intentions as mental states.

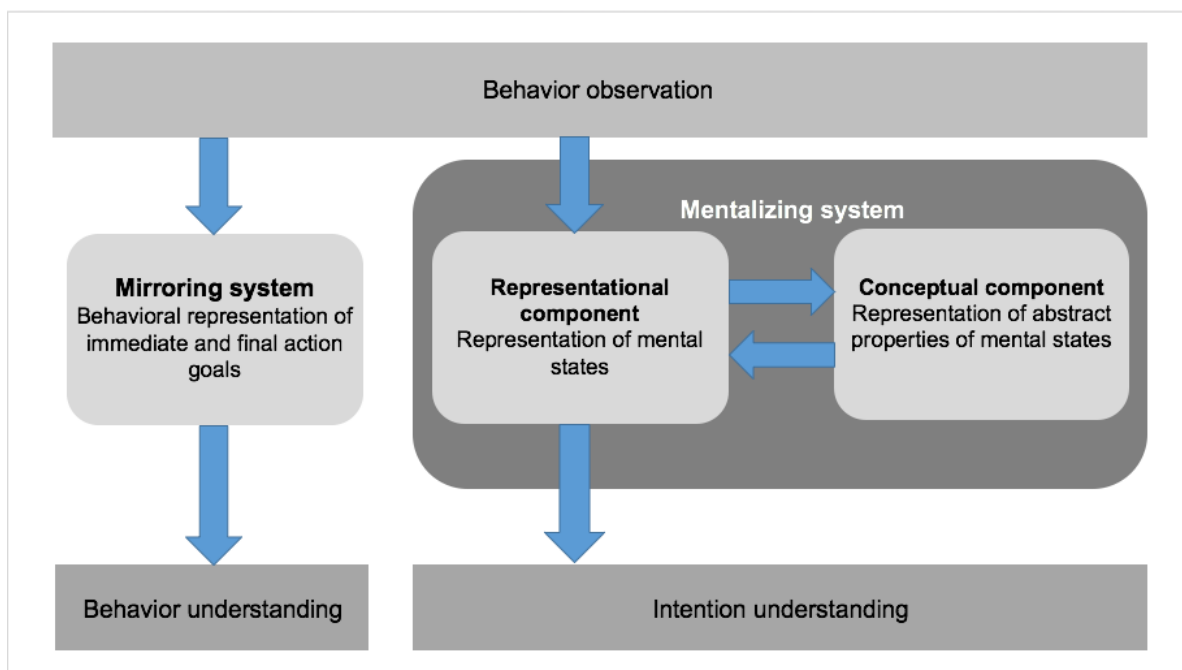


Figure 1. Processes that lead from observing behavior to an understanding of behavior and intentions. (adapted from Chiavarino et al., 2012).

It is still debated if the mirroring system and the mentalizing system operate independently (e.g. Jacob & Jeannerod, 2005; Saxe, 2006) or if the mirroring system supports the mentalizing system in certain ways (Agnew, Bhakoo, & Puri, 2007; Etzel, Gazzola, & Keysers, 2008; Uddin, Iacoboni, Lange, & Keenan, 2007). It is possible that the mirroring system supplies the mentalizing system with rapid and intuitive input about action goals and that this input serves as a basis for inferring higher-level intentions (Van Overwalle, 2009). Alternatively, the mentalizing system may have goal-detecting properties

of its own. Research applying fMRI indicates that the mentalizing function could have evolved from a lower-level basic function that is also involved in orienting attention and recruits the same TPJ area as mentalizing (Decety & Lamm, 2007). The TPJ may play a crucial role for identifying goals of behavior within the mentalizing system (Van Overwalle, 2009).

### **2.2.1. The mirroring system**

The mirroring system operates in response to observed movements of body parts and seems to code the immediate action goal as well as its physical execution and its final outcome (Rizzolatti & Sinigaglia, 2010). Most importantly, the observation of another person carrying out an action activates of one's own motor system as if one were about to perform the same action. Via this "embodied simulation" it is possible to gain a basic understanding of immediate and final action goals as well as of how the action is performed (Gallese, 2007). Activation of "mirror neurons" is mostly found in the premotor cortex (PMC) and the anterior intraparietal sulcus (aIPS) (Ciaramidaro, Becchio, Colle, Bara, & Walter, 2014; Gallese, Eagle, & Migone, 2007). There is strong evidence for the existence of a mirroring system in humans as well as in other species like monkeys and its functional role is quite well-known (see Rizzolatti, 2005; Rizzolatti & Craighero, 2004; Rizzolatti, Fogassi, & Gallese, 2001).

It has been stated that the mirroring system codes immediate and final action goals, and is therefore important for the understanding of intentions. However, there has been some doubt if the mirroring system does indeed code final action goals in the sense of underlying intentions. When e.g. someone grasps a pen, the immediate action goal is to get a hold of the pen, whereas the final action goal may be to write something on a piece of paper. The final goal is present in the agent's mind and this so-called "action intention" is set before the beginning of the movements. When we observe an action like grasping a pen, mirror neurons for grasping will be activated in our brains. Via this direct matching, however, we will only know *what* the action is (a grasp), but not *why* the action happened. There could be different underlying action intentions (Gallese et al., 2007). Some authors have therefore concluded that the mirroring system is not sufficient for determining intentions of others, especially in the case of social and communicative intentions (Csibra, 2005; Jacob & Jeannerod, 2005).

### **2.2.2. The mentalizing system**

Mentalizing, also often referred to as theory of mind (ToM), comprises the capacity to attribute mental states to other people and constitutes a central aspect of social cognition (Green et al., 2008; Harrington, Siegert, & McClure, 2005). The mentalizing system can be activated by many cues in the environment as long as they come from an agent (C. D. Frith & Frith, 2006). Mostly, the agents we are interested in are our conspecifics. Information we

use to infer other humans' emotional states can come from their faces, from their voices, and from whole-body movements (Adolphs, 2002). Mental states like desires and intentions can be read from eye gaze direction and body movements (Langton, Watt, & Bruce, 2000). Mentalizing processes are linked with brain activity in the prefrontal cortex (PFC), the temporoparietal junction (TPJ), and possibly the precuneus (PC) (Van Overwalle & Baetens, 2009). Research has shown activation of the mentalizing system in tasks where participants attributed mental states to non-biological "agents" in the form of two-dimensional shapes (Castelli, Happé, Frith, & Frith, 2000) or made inferences about goals and beliefs of characters in stories or cartoons (Walter et al., 2004; Young & Saxe, 2009). Thus, storytelling seems to provide a means to activate the mentalizing system. This notion is also supported by the finding that the mentalizing system is activated by advanced ToM tasks like the Strange Stories Task (Happé, 1994; White, Hill, Happé, & Frith, 2009). In general, the mentalizing system is activated in tasks that use verbally presented material about goals, desires etc., whereas the mirroring system is active when moving body parts are observed (cf. Van Overwalle & Baetens, 2009). Interestingly, the mentalizing system is also activated during action observation when subjects are explicitly instructed to identify the intentions of the agents they observe (Centelles, Assaiante, Nazarian, Anton, & Schmitz, 2011; de Lange, Spronk, Willems, Toni, & Bekkering, 2008; Grèzes, Frith, & Passingham, 2004).

### **2.2.3. When do we mirror and when do we mentalize?**

It is not quite clear yet under which circumstances mirroring of behavior is a sufficient mechanism to infer action goals and in which situations mentalizing is necessary in order to understand underlying goals or intentions of actions. Brass, Schmitt, Spengler, and Gergely (2007) found an activation of the mentalizing system in tasks in which movements were observed, while simultaneous reflection on the intention of the actor (or the *why* of the action) was required due to constraints of the situation. The activity of the mentalizing system was modulated by constraints like plausibility of the action, whereas the activity of the mirroring system was not modulated in that way (Brass et al., 2007). In a nutshell, the authors found that the mentalizing system was activated when an action could not be understood on the basis of perceptual information alone. In line with that, Spunt, Satpute, and Lieberman (2010) found that the mentalizing system was activated in tasks in which participants were asked *why* actors performed certain actions, thus requiring a high-level understanding of actions. Generally, it seems that via mirroring of actions one can understand the *what* component of an action, that is the *intention in action* (which equals the answer to the question 'what are you doing?'). Via mentalizing, one can understand the *why* component of an action, that is the *prior intention* (which equals the answer to the question 'why are you doing what you are doing?') (cf. van Overwalle & Baetens, 2009).

With regard to development, it is plausible that the mirroring system supports an early understanding of intentions which is based on observable actions, whereas the mentalizing system supports a later developing and higher-level understanding of intentions as representational mental states, and fosters the ability to reason about conceptual properties of intentions in contrast to e. g. desires.

### 3. Development of intention understanding

Understanding of intentions, both of *intentions in actions* and of *prior intentions*, is an extremely important step in children's development. As it constitutes a fundamental part of ToM, this chapter will cover ToM and its development, as well as the role of domain-specific and domain-general capacities for ToM. The emergence of intention understanding based on actions in early childhood and further development of intention understanding based on a representational model of the mind, will be discussed in more detail.

#### 3.1. ToM: Understanding others' minds

ToM refers to the human ability to understand that other people have minds and that those minds contain beliefs, knowledge, desires, intentions and emotions that may be different from one's own (J. de Villiers & de Villiers, 2014). Having a ToM helps us to explain and predict others' behavior and we reason about others' minds constantly without conscious reflection (Miller, 2006). It has been called a "theory" of mind because it shares certain features with scientific theories (cf. Gopnik & Meltzoff, 1997; Gopnik & Wellman, 1992): It postulates unobservables (mental states in this case), predicts them from observables (e.g. behavior, facial expressions, linguistic expressions) and uses them to explain other observables (e.g. behavior). Even though it has been debated whether our understanding of others' mental states indeed relies on what can be called a "theory" (Goldman, 2012), the term is still common in the literature and will therefore be used here as an equivalent to "mentalizing" (C. D. Frith & Frith, 2006; U. Frith & Frith, 2003) or "mindreading" (Gallese & Goldman, 1998; Goldman, 2009).

##### 3.1.1. Theories of ToM development

The ability to "read others' minds" is not present from birth on, but develops gradually during childhood. According to the Piagetian view, children at the beginning of ToM development are cognitively egocentric, thus lack the notion that there are different conceptual, perceptual and affective perspectives (Piaget, 1985). Even though children start to appreciate the existence of different perspectives in their first years of life, a certain egocentric bias persists even into adulthood (Apperly, Warren, Andrews, Grant, & Todd, 2011; Keysar, Lin, & Barr, 2003).

There are several competing theories that try to explain how ToM develops in childhood. An influential approach is *theory theory*, which postulates that although ToM shares some features with an actual scientific theory, it is rather an everyday framework in the sense of a folk psychology (Gopnik & Meltzoff, 1997; Gopnik & Wellman, 1994; Josef Perner, 1991). This folk psychological theory undergoes fundamental changes over the

course of development. Specifically, Bartsch & Wellman (1995) presented evidence for three developmental steps. The first step is the acquisition of a desire psychology, which is mentalistic, but still nonrepresentational. Children at the age of two already understand that people are connected to objects in the sense of wanting them, fearing them etc., but do not yet understand that people represent objects or states of affairs in their minds as being a certain way. Around the age of three, children begin to appreciate the role of beliefs, which can be true or false, and start to talk about beliefs, thoughts and desires, but still rather refer to desires than to beliefs when explaining behavior (desire-belief psychology). As a last step in the development of a representational ToM, at about four years of age, children begin to understand in which ways beliefs, apart from desires, are connected to behavior (belief-desire psychology). Supporters of *theory theory* stress the importance of experience which helps children to revise and improve their ToM and fosters a shift from a nonrepresentational to a representational conception of minds (Gopnik & Wellman, 1992; Henry M Wellman, Cross, & Watson, 2001).

Other researchers that adhere to the *modularity of mind* hypothesis (see Fodor, 1983) believe that ToM is acquired by means of innate modules (Leslie, 1994; Leslie, Friedman, & German, 2004; Scholl & Leslie, 1999). According to Leslie (1994), an important advocate of *modularity theory*, three early maturing, domain-specific and modular mechanisms subserve ToM development. The Theory of Body Mechanisms (ToBY) emerges early in the first year of life and allows infants to recognize that agents are able to move on their own. The first Theory of Mind Mechanism (ToMM<sub>1</sub>), developing later in the first year of life, permits them to construe agents as perceivers of the environment that actively pursue goals. The second Theory of Mind Mechanism (ToMM<sub>2</sub>) begins to develop during the second year of life and enables children to represent agents as holding propositional attitudes. Propositional attitudes are mental states that have propositional content, like *wanting that*, *believing that*, *intending that* etc., which are not directly observable, but nevertheless direct the actions of an agent (Bowler & Thommen, 2000). Also building on a modular account of the mind, Baron-Cohen (1995) proposed that ToM development relies on unfolding of cognitive modules that are sensitive to detection of intentions (intentionality detector; ID), eye direction (Eye Direction Detector; EED) and shared attention (Shared Attention Mechanism; SAM). Development of these cognitive modules leads to a full knowledge of mental state concepts (Theory of Mind Mechanism, TOMM). Baron-Cohen (1995) rejected the claim of informational encapsulation of modules that was originally proposed by Fodor (1983) and claimed that the modules interact. However, the development of these cognitive modules is due to neurological maturation and their nature is not determined by experience. This is a major difference to *theory theory*, in which experience plays a crucial role. Within the framework of *modularity theory*, it is also often stated that people within the autistic spectrum lack certain modules, like SAM and

TOMM (Baron-Cohen, 1995); this being the reason for their difficulty with ToM tasks (Baron-Cohen, 2000; U. Frith, 2001; Lombardo, Chakrabarti, Bullmore, Consortium, & Baron-Cohen, 2011; White et al., 2009).

*Simulation theory* is a main competitor of *theory theory*, as it proposes that we do not come to understand others through the use of a folk theory, but rather simulate others' mental states in our own mental apparatus (Cruz & Gordon, 2002). Accordingly, children begin to understand others' mental states by using the awareness of their own mental states and by simulating what they themselves would think/believe/desire etc. in someone else's place (Gallese & Goldman, 1998; P L Harris, 1992). *Simulation theory* posits the use of an off-line simulation, in which one takes one's own decision-making system off-line and feeds it with "pretend" inputs of beliefs, desires etc. of the person that one wishes to simulate (Cruz & Gordon, 2002). Over the course of development, children's simulations become more and more accurate and experience crucially contributes to this improvement. Evidence that supports simulation theory comes from research dealing with mirroring processes, which showed that observation of actions leads to some degree to a simulation of the same action in the observer (Cattaneo & Rizzolatti, 2009; Rizzolatti, 2005; Rizzolatti & Craighero, 2004). Some authors argued that the mirroring of motor intentions could serve as a basis for mindreading, thus for what we call a "theory of mind" (Agnew et al., 2007; Gallese & Goldman, 1998; Gallese, Keysers, & Rizzolatti, 2004). Mirror-based mindreading is referred to as low-level mindreading, because it is essentially stimulus-driven, whereas high-level mindreading involves memory-driven, reconstructive processes. Importantly, *simulation theory* claims that both low-level and high-level mindreading rely on simulating certain states in oneself, being it simple motor intentions or representational mental states (Goldman & Shanton, 2016).

### **3.1.2. Does ToM rely on domain-specific or domain-general capacities?**

For the purpose of this thesis, the question if ToM is based on domain-specific or domain-general capacities, is of great importance. Originally, the idea that ToM is a domain-specific module (TOMM), was based on the finding that people within the autism spectrum (e.g. Asperger syndrome) showed a very specific impairment in the domain of ToM, while abilities in other cognitive domains remained relatively intact. However, in the influential paper "Does the autistic child have a theory of mind?", Baron-Cohen, Leslie, and Frith (1985) claimed that ToM is "one of the manifestations of a basic metarepresentational capacity (p. 37). Metarepresentation refers to the ability to represent the relation between representation and referent (Stone & Gerrans, 2006). Several other authors have suggested that metarepresentation is a domain-general capacity that includes, but is not restricted to metarepresentation of mental states (Corballis, 2003; Josef Perner, 1991; Stone & Gerrans,

2006; Suddendorf & Whiten, 2001). Others have, based on findings from autism, advanced the idea that ToM relies on a domain-specific capacity for the metarepresentation of mental states, which is independent from other forms of metarepresentation (TOMM; Leslie, 1994; Leslie et al., 2004; Leslie & Thaiss, 1992).

Despite this great conceptual difference, there is some agreement between all theories of ToM development. First, ToM depends on the development of some lower-level precursors. These basic cognitive mechanisms represent information about the social world of the infant/toddler and enable interactions with others. Precursors include face processing, emotion processing, gaze monitoring, detection of animacy, identification of intentions and goals, and joint attention (Baron-Cohen, 1995b; Charman et al., 2000; Csibra, Szilvia, Orsolya, & György, 2003; Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Saxe, Carey, & Kanwisher, 2004; Henry M Wellman et al., 2004). These capacities are believed to be domain-specific, as they are specific to social stimuli. All these abilities allow the normally-developed toddler to deal with the social surroundings on the basis of perceptual information. Also, it appears that toddlers have a domain-general capacity for secondary representations (the ability represent and compare two different representations), but still lack the ability to metarepresent beliefs (Suddendorf & Whiten, 2001). Around the age of 4 years, a typically-developed child has acquired a set of higher-level domain-general cognitive mechanisms serving metacognitive functions. These include advanced executive functions (like working memory, inhibition and flexible control of attention), secondary representation, recursion (use of embedded representations), and metarepresentation (de Villiers & Pyers, 2002; Josef Perner, 1991; Smith, Apperly, & White, 2003; Suddendorf & Whiten, 2001). This is also the age at which children master classic ToM tasks like false belief tasks (Henry M Wellman et al., 2001), which are linguistically demanding and require inhibition. If these demands are lowered, younger children indeed show some ability to pass these tasks (see Mitchell, 1997, for a review).

In contrast to the traditional dichotomy between a domain-general or domain-specific account, according to a more recent theoretical account, ToM abilities depend on the interaction of domain-specific low-level precursors and domain-general high-level mechanisms (Stone & Gerrans, 2006). So, ToM deficits may result from defective low-level input systems, like joint attention or emotion recognition, or from problems with high-level domain-general capacities like execute functions, language, metarepresentation etc., instead of resulting from a defective ToM module. This is supported by evidence showing that individuals impaired in ToM also show deficits in e.g. recognizing facial expressions or judging mental states from eye gaze or expression in the eye region (Gregory et al., 2002; Hornak, Rolls, & Wades, 1996; Snowden et al., 2003). Stone & Gerrans (2006) argue that ToM ability is not best explained in terms of a domain-specific cognitive module, but results

from the interaction of domain-specific mechanisms specialized for social stimuli with the domain-general ability of metarepresentation.

## **3.2. The emergence of intention understanding**

Usually, intention understanding is seen as one of the earliest steps in ToM development, preceding understanding of desires and beliefs (Meltzoff, 1995). This view is based on findings that already at a very young age, children are able to differentiate to some degree between intentional and unintentional behavior (Behne, Carpenter, Call, & Tomasello, 2005) and understand actions as being goal-directed (Cannon & Woodward, 2012; Sommerville & Woodward, 2005). This action-based and pre-verbal understanding of intentions is regarded as fundamental for developing a fully representational ToM.

### **3.2.1. Precursors of intention understanding in infants**

One of the first steps in the understanding of intentions is the distinction between agents and non-agents. At about 7 months of age, infants already understand that humans, in contrast to inanimate blocks, can cause each other to move even in the absence of direct physical contact (Woodward, Phillips, & Spelke, 1993). It has also been shown that one-year-old infants follow the gaze of objects that are considered agentive, but do not display gaze following for non-agentive objects (Johnson, Slaughter, & Carey, 1998). Moreover, infants ascribe goals to agents, but not to inanimate objects. Infants as young as 6 months assume that a human arm is goal-directed when it reaches for something, but do not expect the same for an inanimate rod (Woodward, 1998). Using a habituation paradigm, Woodward (1998) also showed that 6- and 9-year-olds paid more attention to an agent's goal relative to the executed movements, indicating a distinct sensitivity to intention-relevant features of an action. When observing a continuous flow of human behavior, 10- to 11-month-olds subdivide their perceptual experience into sequences that coincide with the initiation and completion of intentions (Baldwin, Baird, Saylor, & Clark, 2001). At about 1 year of age, infants can distinguish goal-directed behavior from behavior that is not goal-directed (Tomasello et al., 2005).

The question remains if these findings really reflect a genuine understanding of intentions. Povinelli (2001) highlighted the "possibility that the early detection of the structural regularities of behavior are not, strictly speaking, the early manifestation of the uniquely human system for reasoning about intentions" (pp. 240-241). In this view, the identification of goals as the end-states of actions is not directly related to an understanding of intentions, but rather reflects a low-level system for detecting structure in behavior (Baird & Baldwin, 2001). Thus, it is still unclear if children have a concept of intention in their first year of life.

### **3.2.2. Intention understanding in toddlers: Imitation of intentional actions**

There is strong evidence that toddlers have some understanding of the intentions of others. At the age of 18 months, children already demonstrate considerable abilities in the social domain, suggesting that they possess the necessary skills for perceiving others' intentions (Baird & Astington, 2005). Since it is not possible to use verbal paradigms when working with children at this young age, many studies of toddlers' understanding of intentions use imitation paradigms.

According to Tomasello (1996), imitation consists of the reproduction of *intentional* actions of others, including both the end result / goal and the behavior by means of which that goal is accomplished (the goal and the "how" of the action). At about 13 months of age, imitative learning is beginning to occur (Carpenter, Nagell, & Tomasello, 1998). Instead of mimicking every action in the environment, for imitative learning it is necessary to distinguish intentional and unintentional actions and to focus on imitation of intentional actions. Carpenter, Akhtar, and Tomasello (1998) found that children between 14 and 18 months imitated intentional actions to a greater extent than accidental actions. In this study, children observed several sequences of two actions, in which either both actions were marked as intentional (with the verbal clue "there!"), or in which one was marked as intentional ("there!") and the other was marked as unintentional ("woops!"). Note that the use of these verbal clues does not presuppose real linguistic knowledge (syntax, semantics etc.), but only relies on an extremely basic understanding of stereotypic utterances that are also marked by intonation. Following the sequence, an end result was observed (e.g. lights turned on). When children were asked to bring about the same result, they more often imitated *only* the intentional action, compared to imitating only the accidental action and compared to imitating both the intentional and the accidental action. These findings clearly indicate that even very young children have some understanding of *intentions in actions*, and can differentiate actions motivated by intentions from accidental, unintentional actions. Childrens' performance on the imitation task was not correlated with language ability, assessed by the MacArthur Communicative Development Inventory (Reznick & Goldsmith, 1989).

In a similar way, young children's understanding of intentions can be investigated using behavioral re-enactment procedures which include failed intentional actions (Aldridge et al., 2000; Meltzoff, 1995). Meltzoff (1995) investigated whether children imitated what others actually did or what they intended to do. Eighteen-month-olds were randomly assigned to four different groups. One experimental group observed an adult demonstrating an intentional action with an object; and tried, but failed to bring about the intended result (*demonstration intended* group). The other experimental group observed an adult successfully carrying out an intentional action (*demonstration target* group). One control group did not observe an action and was just given the objects, another control group

observed an adult handling the objects in a meaningless way. Comparisons between groups showed that the toddlers who observed a failed attempt, imitated the intended actions of adults as often as the toddlers who saw successful performance of the action. The *demonstration intended* group and the *demonstration target* group produced the intended action significantly more often than the control groups. These results indicate that very young children (at the age of 1;6) are able to understand the underlying goals and intentions of actions, even when the intended outcome is not achieved. Studies of the understanding of failed intentional actions are important because they require the understanding that others may have intentions that do not match with real outcomes. Similar to studies of understanding of false beliefs, they involve deviations from the true state of affairs ("the real world"). Meltzoff (1995) also compared a *human demonstration* condition to an *inanimate demonstration* condition and found that children were 6 times as likely to produce the intended action in the *human demonstration* condition as in the *inanimate demonstration* condition. Again, this suggests that children only ascribe underlying intentions to biological agents and not to inanimate devices. Overall, Meltzoff's studies showed that toddlers do not rely on pure physical movements or motions when imitating others, but understand others' behavior in the sense of intentionally motivated actions and thus imitate the underlying action goal (even when not observable). The behavioral re-enactment procedures have also been used to investigate intention understanding in children with diagnoses of autism spectrum disorder, yielding the interesting result that even preverbal autistic children (between about two and four years old) were highly likely to re-enact unsuccessful intentional actions (Aldridge et al., 2000). These findings are contradictory to the widely reported ToM deficits in autism spectrum disorder (see Baron-Cohen, 2000, for a review).

### **3.3. Young children's understanding of intentions as mental states**

Starting from about 3 years of age, children can be tested for their intention understanding in more explicit verbal ways because of their already quite developed language abilities (Baird & Astington, 2005). Already between 2 and 3 years of age, children begin to use intention terms to explain and excuse actions (*mean to*, *try to*, *on purpose*) (Bretherton, 1991). Because language provides a format for the metarepresentation of intentions (see section 4.1. for further elaboration), in verbal procedures children can be directly asked for their understanding of intentions as mental states (*prior intentions*).

#### **3.3.1. Intention and action**

One of the earliest attempts to assess young children's understanding of *prior intentions* was a series of studies by Astington (1991, 1993). In her studies, she showed 3-year-olds, 4-year-olds and 5-year-olds pictures of children who were either preparing for an

activity or engaging in an activity. The children were asked about the actions ("Which boy is swinging?") and the intentions ("Which girl is gonna paint?"). Terms used for the intentions were *gonna*, *thinks she'll/he'll*, *wants to* and *would like to*. Three-year-olds, unlike 5-year-olds, generally confused *prior intentions* with actions. This might also be due to language abilities, as 3-year-olds do not have a concept of future tense as stable as 5-year-olds do, which the author critically remarked herself. Another limitation of the study was that children did not have to differentiate between desires and intentions (note the use of terms like *wants to* and *would like to*) in order to answer the questions correctly. In conclusion, it can be stated that 3-year-olds do not distinguish between the intention to act (*prior intention*) and the action itself (*intention in action*). Baird & Moses (2001) also investigated children's understanding of the relation between intentions and actions by asking 4- and 5-year-olds about the intentions of two characters performing the same action. Children heard stories in which different underlying intentions of actions were clearly stated, e.g. running to be healthy or running to be home fast, nevertheless 4-year-olds tended to attribute the same intention to both characters. In contrast, 5-year-olds correctly assigned different intentions to the characters. So, it seems that children have difficulties to distinguish intentions from actions until about 5 years of age.

### **3.3.2. Intentional action**

Even though it has been found in a number of studies that even infants and toddlers understand the difference between intentional and unintentional behavior (Call & Tomasello, 1998; Carpenter, Akhtar, et al., 1998; Olineck & Poulin-Dubois, 2005), this might be due to a matching strategy, comparing the desire or goal to the outcome (Astington, 2001b). When no explicit information about desires or goals is given, 3-year-olds still struggle with this distinction. In a study by Astington & Lee (1991), 3-, 4- and 5-year-old children were presented pairs of stories, in one of which a character intentionally produced an outcome and in the other a character accidentally produced the same outcome, e.g. fed birds on purpose or accidentally dropped bread crumbs on the floor that birds subsequently ate. No additional information about the desirability of the outcome was provided. Children were then asked who of the two characters *meant to* achieve the outcome. While 3-year-olds performed at chance level, 5-year-olds showed above-chance performance. This is not in line with the finding that children at a much younger age seem to be able to differentiate between intentional and unintentional behavior in imitation paradigms. This implies that in the imitation paradigms, children were seeing the failed intentions more as failed attempts to meet a certain desire. Importantly, these results also indicate that 3-year-olds fail to take into account the means by which a goal was achieved when judging if an action was intentional or not.

### 3.3.3. Intention and desire

Some authors claim that 3-year-olds concept of intention is completely undifferentiated from the concept of desire and that the ability to distinguish desires and intentions is only mastered at about 5 years of age (Astington, 2001a), regardless of whether desires and intentions are considered from a first-person or a third-person perspective (Phillips, Baron-Cohen, & Rutter, 1998). There are only a few studies in which desires and intentions were clearly disentangled. In a study by Schult (2002) a discord between intentions and desires was established by presenting stories in which the character carried out an intentional action, but did not achieve the desired result, or achieved the desired result, but not by means of an intentional action (mismatch conditions). In another set of stories, both intention and desire were fulfilled or neither intention nor desire were fulfilled (match conditions). Participants were aged 4, 5 and 7 years and there was an adult control group. The results showed that 4-year-olds and 5-year-olds could not make consistent accurate judgements of whether the protagonist fulfilled his/her intention ("Did X do what he/she planned to do?") when the intention was fulfilled, but the desire was not satisfied. The author argues that the errors in this condition might be due to defining intentions as means to an end, instead of seeing intentions as motives for actions. If intentions are seen as means to an end, and the end state was not what was desired, children drew the conclusion that the intention didn't work and the character did not do what he/she had planned to do. When the intention was unfulfilled, but the desire was satisfied, 4-year-olds were also less accurate than older age groups in detecting that the intention was not fulfilled. A possible explanation for this result could be that the younger children focused their attention on the happy outcome of the satisfied desire and failed to understand that the question required a comparison of the initial plan (*a prior intention*) and the event in the story. This was also apparent in justifications by the children that referred to the desired outcome ("she got what she wanted"), following the logic that if the desired outcome was achieved, the planned action must have worked, where in fact, the protagonist failed to complete the planned action and his/her desire was satisfied by other means. Whereas 4-year-olds had difficulties with both mismatch conditions and 5-year-olds had problems with the intention-fulfilled/desire-unsatisfied condition, 7-year-olds showed an accurate conception of intentions that matched that of the adult control group.

In another experiment, Schult (2002) used a paradigm consisting of a target-hitting game, in which the intended action and the desired outcome were also independent. By applying a less verbally challenging method, this study was aimed at investigating intention understanding in even younger children. Participating children, which were 3, 4 and 5 years old, were invited to play a game, in which they tossed bean bags into three colored buckets. Some buckets contained pictures that should be hit in order to win the game, but children had no knowledge which buckets contained the pictures. By telling the children that hitting

the buckets with the pictures meant that they would win the game, it was assumed that childrens' desire was to hit the pictures (which was confirmed by asking children what they wanted). Before children tossed the bag, the experimenter asked them which colored bucket they would try to hit (*prior intention*). After the bean bag went into one of the buckets, the experimenter showed the child if it contained a picture or not. Then the experimenter asked the children which color they had tried to hit (referring to *prior intention* and *intention in action*). When children hit their intended target, no age differences were found in reporting their intention. In contrast, when they did not hit the intended target, 3-year-olds made significantly more mistakes in reporting their intention than 4- and 5-year olds. This difference was more pronounced when the intention was unfulfilled, but the desire was satisfied (the bucket contained a picture). In this condition, 3-year-olds scored below chance levels. This particular condition was also the most difficult one for 4- and 5-year-olds, but overall they scored near ceiling for all conditions. The results indicate that 3-year-old children use a simple desire-outcome matching strategy when judging intentions, especially in the case of satisfied desires. A potential reason why 4-year-olds and 5-year-olds scored near ceiling in the game paradigm, but showed poorer performance in the story paradigm might be that the game paradigm required less verbal ability than the story paradigm (cf. Schult, 2002).

In a study by Feinfield and colleagues (1999), desires and intentions referred to different goals in the first place. The authors used stories about characters who desired to go to location A, but intended to go to a place they disliked (location B) because of his/her mother's wish. In the end, the protagonists unintentionally ended up at location A, which was their initial desire. The intention neither matched the desire nor could be inferred by the outcome. Participating children, which were 3 and 4 years old, were asked questions about the intention, one related to the *intention in action* ("Where did X try to go?") and one related to the *prior intention* ("Where did X decide to go? Where did X think he was going to go?") and about the desire ("Where did X want to go?"). There was a difference in performance on the two questions related to the intention (Try question and Think question) between 3-year-olds and 4-year-olds, indicating that 3-year-olds had more problems identifying an intention that neither corresponded to the desire nor to the outcome of the story. Three-year olds scored below chance, whereas 4-year-olds scored significantly better than chance on these two question types. Both groups scored better than chance on the Like question related to the desire.

In a second study, Feinfield and colleagues (1999) used a different story paradigm. 3-year-olds and 4-year olds were told stories, in which characters tried to get an object, but found another (more desirable) object instead. The character in the story was instructed by his mother to get object X (e.g. a bowl of peas), but when looking for it, found object Y (e.g. a chocolate cake) instead. The children were then asked what the character tried to get (Try

question) and what he/she thought he/she was going to get (Think question). There was no explicit information about the character's initial desire, but the children were also asked what they thought the character liked better (Like question). To assess if children could differentiate intention and outcome, they were also asked if the character found what he/she was looking for (Outcome question). The authors reported that 4-year-olds performed significantly better than 3-year-olds on the Like question, the Outcome question and the Think question. Performance of 3-year-olds was at chance level for the Think question, whereas 4-year-olds scored above chance. These findings again indicate that 3-year-olds do not have a consistent concept of *prior intentions*. Feinfield and colleagues (1999) then wanted to test if young children's knowledge of this concept was underestimated as a result of task characteristics. Especially, the use of the verb "think" might have contributed to the poor performance of 3-year-olds, because it refers to a belief about an action that later proved to be false and it is well known that 3-year-olds have difficulties with false beliefs (see Wellman et al., 2001, for a review). Accordingly, understanding of *prior intentions* was assessed in a different way in the third study. Instead of "think", the verb "decide" was used to put the focus more on the mental plan instead of the belief. It was also made clear that the characters' intentions were entirely their own and not their mother's. Otherwise, the tasks resembled the ones of the second study. Participating children, which were all 3 years old, performed equally well on *prior intention* tasks as on *intention in action* tasks in this study, suggesting that the use of an intention term ("decide") instead of a belief term ("think") made *prior intentions* as accessible as *intentions in actions*. Younger 3-year-olds and older 3-year-olds were also compared regarding task performance, which showed that while the older group performed above chance on all questions asked, the younger group performed above chance only for the Outcome question and the Like question, but not for the question related to the *prior intention* and the *intention in action*. The authors concluded that most children probably begin to acquire the concept of *prior intention* and *intention in action* as differentiated from desire and outcome somewhere between the ages of 3;6 and 4;0 years.

In conclusion, it can be stated that while a basic understanding of intentions that is based on observable actions is definitely present in 3-year-olds, a more complex understanding of intentions as unobservable mental states continues to develop long after that age and even 5-year-olds are still struggling with some aspects of intention understanding.

## 4. The relation of language and intention understanding

It has been established that over the first few years of life, there is a shift from an implicit understanding of intentions from observed behavior (*intentions in actions*) to a more explicit and verbally tangible understanding of intentions as mental states (*prior intentions*). Some authors proposed that language is instrumental in the development of new understanding and therefore helps children to develop and refine their concept of intentions (Astington, 1999; Baird & Astington, 2005). Others propose that recognizing others' intentions helps children to acquire language (Tomasello, 1995). In any case, it has been established that language development is related to ToM development (see Milligan et al., 2007, for a review). In this chapter, the relation of language and metarepresentation, of language development and ToM development and more specifically, of language development and development of intention understanding, will be discussed.

### 4.1. Language and metarepresentation

Language can be designated as the “most specific hallmark of what it means to be human” (Gallese et al., 2007, p. 138), and has likely evolved to provide humans with a powerful social cognitive tool to communicate and exchange knowledge (Tomasello et al., 2005). Humans can represent the meanings of words they use, e.g. they can represent the meaning of “hammer”, but what do they represent when they use or hear verbs like *remember*, *hope*, *want*, *intend*, *decide*, *think* etc.? These mental verbs are metarepresentational, because in order to understand them, one has to represent that someone is representing something. More precisely, one must represent the representational attitude that such verbs involve (remembering, hoping, etc.) and the propositional content of the representational state (what is remembered, hoped etc.). So, in order to understand the difference between the sentences “I hope that you have washed your hands” and “I remember that you have washed your hands” one must be aware of the two different mental states underlying these expressions (cf. Antonietti, Liverta-Sempio, Marchetti, & Astington, 2006). This implies a link between mastery of mental language and metarepresentational ability (Olson, 1994).

There are two different views on the nature of this link, which are part of the older and larger debate about the relationship of language and thought. According to the Piagetian view (Piaget, 1945; Piaget & Inhelder, 1966), language depends on thought. According to the Vygotskian view (Vygotsky, 1934), thought is dependent on language. When we adopt the Piagetian perspective, it means that the level of understanding an individual has of the mind is expressed in his/her language use. Proponents of this view include Fodor (1975), who argued that concepts develop before the corresponding terms and that it would be

conceptually incoherent if it were otherwise. This is also the angle Bartsch & Wellman (1995) took in their studies when presenting as evidence for the understanding of the mind the spontaneously produced mental language of 2- to 5-year-old children. In contrast, in the Vygotskian perspective, language is a tool for the construction of thought, and e.g. Bruner (1990) argued that children acquire ToM by means of mastering the language. Authors in favor of this view argue that children may use a term without fully knowing what it encodes, and are therefore prompted to develop a concept or conceptual distinction which was not salient before (Gopnik & Meltzoff, 1993; Nelson, 1996).

#### **4.1.1. Mental verbs and their complements**

How can mental states be transparently encoded in language? To some extent, mental states are encoded in mental verbs. Comprehension of the verb is important because the verb tells us which kind of mental state is concerned (e.g. *hope* vs. *remember*). But each mental state has a propositional content (see section 1.1.), and this propositional content is contained in the complement following the verb. A complement is a word, phrase or clause that completes the meaning of a given expression (Crystal, 1997). While the expression *I think* is considered incomplete, *I think [it is raining]* is a full sentence (complement in square brackets). Mental verbs belong to the class of verbs that necessarily require complements. Some mental verbs can have simple complements like a noun phrase, e.g. *I want [an apple]* or syntactically more complex complements, e.g. *I want [to go to the cinema]* or *I want [my mother to come home]*.

Mental verbs can have “sentential complements” as their objects; they can embed a whole proposition (in a sentential form), like in “I think it is raining”. If a proposition is embedded under a mental verb, the truth value of the sentence can only be evaluated with regard to the mental verb. For instance, even though the sentence “Mary thinks that the earth is flat” contains a false piece of information (that the earth is flat), the sentence as a whole can still be true, if Mary does indeed *think* that the earth is flat. The propositional content of the complement may not correspond to the true state of affairs, but if it corresponds to the content of that particular mind, the sentence is true (cf. de Villiers & Pyers, 2002).

As the contents of mental states are not directly observable, the complements of mental verbs do not have a real-world counterpart. This becomes clear when you consider the sentences “Sally wants to play a game”, “Lisa hopes that Tom likes her”, “Lucas decided to go outside”, “My father intends to get married” etc., which contain mental verbs and complements that relate to desires, plans, hopes etc., but not to real-world phenomena. The truth value of the whole sentence depends on the state of mind, the truth value of the embedded proposition can be evaluated referring to reality, so e.g. the desire can be

satisfied or unsatisfied, the intention can be fulfilled or unfulfilled, the belief can be true or false etc.

#### **4.1.2. Acquisition of mental language**

Use of mental verbs such as *know*, *think*, *mean*, *forget* or *guess* emerges between 2;4 and 2;8 (Shatz, Wellman, & Silber, 1983). Although, taking into account the contexts in which these forms were used, it is clear that the terms did not function as expressions of mental states, but were used as routinized phrases (“I don’t know” or “Know what”). The earliest verbs used with a true mentalistic function are those related to desires. Bartsch and Wellman (1995) found that children soon after their second birthday start to use mental state verbs to express desires. Speculatively, this might be due to the fact that desires often have a real-world object as their content, so only require an understanding of how agents are connected to objects. Other mental verbs require a representational concept of the mind. A mental verb like “think” has no behavioral counterpart, it cannot be learned by observing what happens when the term is said. The meaning of mental verbs must be inferred by their role in the syntactic and semantic system of language (Gleitman, 1990). Belief terms like “think” are acquired later than desire terms like “want” (Bartsch & Wellman, 1995). Regarding the complements of mental verbs, research has shown that understanding of sentential complements is mastered at about 4 years of age (Farrant, Maybery, & Fletcher, 2012; de Villiers & Pyers, 2002).

#### **4.2. Language development and ToM development**

There are several good reasons to relate language development and ToM development. First, the content of minds is to a large part made explicit in the form of language. A child who has wants and feelings, has to learn to use language in order to express them. In the same manner, a child cannot directly observe the mental states of others, but can get to know about them through others’ talk. One might even say that “in typical development, ToM is so closely coupled with the development of communication and language, that we often do not recognize their interdependence” (Miller, 2006, p. 142). The acquisition of language provides a means for metarepresentation, namely to represent someone else’s representational mental state in one’s own mind, and this constitutes the hallmark of having a ToM.

Consistent with these theoretical considerations, a broad range of language measures have been found to correlate with ToM performance in children. These include receptive vocabulary (e.g. Happé, 1995), expressive narrative speech (e.g. Cutting & Dunn, 1999) or expressive and receptive syntax and semantics (e.g. Astington & Jenkins, 1999; Jenkins & Astington, 1996). When assessing the relation of language development and ToM

development, some confounding factors have to be considered, with age being the most important one. Children's age naturally correlates highly with their language ability, so it could be that age accounts for both language abilities and ToM development. However, correlations between language and ToM tasks remain significant when controlling for age (e.g. Cutting & Dunn, 1999; Ruffman, Slade, & Crowe, 2002). In a large meta-analysis of the relation of language abilities and performance on false belief tasks, which included 104 studies, an overall effect size (in a random effects model) of .43 was found (Milligan et al., 2007), which is a moderate to large effect in strength (Cohen, 1988). When only including the 32 studies where age was controlled for, the effect size decreased to .31, which is still a moderate effect. This leads to the conclusion that there is a relationship between language abilities and ToM that cannot be accounted for by age. Other confounding variables may be executive functions like working memory, although it has been shown that working memory does not mediate the relationship between ToM and language ability (Slade & Ruffman, 2005).

The reported correlations between measurements of language development and ToM development do of course not provide insights into the directionality of the effect. There is an on-going debate if there is a bidirectional relation of language and ToM (Miller, 2006; Slade & Ruffman, 2005), or if language development plays a causal role for the development of ToM (Astington, 2001a; J. de Villiers & de Villiers, 2014; de Villiers & Pyers, 2002; Kobayashi, 2010). Arguments for both positions will be put forward in the following sections. Another still debated question is which part of language; syntax, semantics or pragmatics, might be most related to ToM, with most authors arguing for a special role of syntactic abilities.

#### **4.2.1. Evidence for a causal role of language for ToM**

To establish a causal link between language and ToM, it has to be shown that language is a necessary precursor of ToM and that development in the linguistic domain entails a development in ToM. So, it is worth looking at longitudinal relationships between early language exposure and early language abilities and later ToM to support the claim of "linguistic determinism" (Kobayashi, 2010).

#### **Early language exposure and ToM**

It has been suggested that children's ToM development is related to their early exposure to talk about mental states. For instance, mothers' talk about mental states predicted children's later ToM performance (Ruffman et al., 2002), and engagement in family talk about feelings and causality at the age of 33 months correlated with ToM performance at the age of 40 months (Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991). There is also evidence that children with siblings show an advantage in ToM development compared

to children without siblings, which could presumably be due to more discourse about others' thoughts and feelings (Jenkins & Astington, 1996; McAlister & Peterson, 2007; Josef Perner, Ruffman, & Leekam, 1994). Further support for the importance of family talk for the development of ToM comes from research investigating deaf children. Woolfe, Want, and Siegal (2002) compared native signers to late signers (that learned sign language in school) in their performance on ToM tasks and found that early-signing children outperformed late-signing children. The authors reasoned that late-signing deaf children do not have as many opportunities for family discourse (because their parents are unable to use sign language) as deaf children of deaf parents (that use sign language to communicate with their children) and thus, have a disadvantage in learning about mental states through conversation. By contrast, deaf children who learn to sign in a home with native signers are comparable to normal children in their performance on theory-of-mind tasks (Peterson & Siegal, 2000). Taken together, it is clear that early language exposure plays a vital role for ToM development.

### **General language abilities and ToM**

Several studies have found associations of earlier language abilities with later ToM abilities. For instance, toddlers' language ability at the age of 2 years predicted their false belief understanding at the age of 4 years (Farrar & Maag, 2002; Watson, Painter, & Bornstein, 2001). Astington and Jenkins (1999) showed that performance on the TELD (Test of Early Language Development; Hresko, Reid, & Hammill, 1999) of 3-year-olds predicted their false belief performance 7 months later. Importantly, earlier false belief performance did not predict later performance on the TELD. Ruffman, Slade, Rowlandson, Rumsey, and Garnham (2003) revealed that general language ability including both syntax and semantics at the age of 3 years predicted ToM performance at 3;6, 4 and 5;6 years. Similarly, in a study by Slade and Ruffman (2005), both syntactic and semantic ability of children aged between 3 and 4 years predicted their false belief understanding 6 months later, whereas their earlier ToM did not predict their later overall performance on syntax and semantic tests.

### **Syntactic abilities and ToM**

Within the line of research that proposes a causal role of language abilities for ToM development, some researchers have explicitly stressed the importance of syntactic abilities, from basic syntax like word order (Astington & Jenkins, 1999) to more complex aspects of syntax like relative clauses (Smith et al., 2003) or object complements (J. de Villiers & de Villiers, 2014; de Villiers & Pyers, 2002; Hale & Tager-Flusberg, 2003).

Claims about relations of syntactic and ToM ability rely on the perceived similarity of structure underlying understanding of syntax and understanding of false beliefs. Whereas semantics involve understanding of words, syntax requires understanding of the relations

between words. Some argue that the syntactic ability to follow and keep track of complex relations between elements of sentences is just what helps children to pass false belief tasks (Astington & Jenkins, 1999). In classic false belief tasks, the child has to keep track of the location of the object and the presence or absence of a specific character. Even though it is doubtful if this truly parallels understanding of syntax, Astington and Jenkins (1999) showed that items of the TELD tapping syntax predicted false belief understanding 7 months later way better than TELD items tapping semantics. Importantly, whereas earlier syntactic abilities predicted later false belief performance (controlling for earlier false belief performance), earlier false belief performance did not predict later syntactic abilities (controlling for earlier language performance). Although Astington and Jenkins (1999) took these findings as evidence for a unique role of syntax in ToM development, others have questioned if the “syntactic” items of the TELD are really measuring *solely* syntactic ability and claimed that they rather measure a combination of syntactic and semantic knowledge (Ruffman et al., 2003). In contrast to Astington and Jenkins (1999), who examined rather simple syntax, Smith et al. (2003) found that more complex aspects of syntax, more precisely understanding of embedded relative clauses, e.g. “The girl kicked the man that jumped over the wall”, predicted false belief understanding, while understanding of similar sentences without embedded relative clauses did not.

**Sentential complement syntax.** Some authors have put a specific focus on only one type of embedding in sentences, namely embedded sentential complements (see also section 4.1.1). J. de Villiers and de Villiers (2000, 2009, 2014) argue that understanding of complement clauses is important for ToM development because the complement structure allows for a differentiation between the content of someone’s mind and reality. For example, in the sentence “Mary thought that there were smarties in the box”, the complement clause has the propositional content [there are smarties in the box]. Crucially, the propositional content only represents a mental state of a certain person, which can be contrasted with reality, as in “Mary thought that there were smarties in the box, but in fact there was a pen”. Even though the embedded complement clause contains a false proposition, the sentence as a whole can still be true. Only some verbs can take whole propositions as their complements; verbs of communication and mental state verbs. De Villiers and Pyers (2002) state that children younger than 4 years fail to understand sentential complement syntax both with verbs of communication and mental state verbs. They report that, e.g. when presenting a story of a mother buying apples, but saying that she bought oranges, children aged between 3 and 4 years do not answer the question “What did the mother say she bought?” correctly (they respond with “oranges” instead of “apples”). This is taken as evidence that children at this young age fail to incorporate the complement under the scope of the superordinate verb and interpret the question as “What did the mother buy?” Crucially, the authors argue that without understanding of this kind of syntactic construction, children

lack the ability to metarepresent others' false statements or false beliefs, leading to poor performance on false belief tasks.

**Memory for complements.** Aimed at testing exactly this kind of syntactic ability, de Villiers and Pyers (2002) designed a test called "memory for complements in described mistakes". In the test, children are presented sentences with either verbs of communication or mental state verbs, e.g. "He thought he found his ring, but it was really a bottle cap" and are then asked "What did he think?" In a longitudinal study, they found that performance on the memory for complements task uniquely contributed to later performance on false belief tasks, beyond the contribution of general language measures. These results have been replicated for typically developing children (Low, 2010), deaf children (P. A. de Villiers & de Villiers, 2012; Schick, de Villiers, de Villiers, & Hoffmeister, 2007) and children with specific language impairment (Farrant et al., 2012). To examine a potentially causal role of sentential complement syntax for ToM, some training studies have also been conducted. Hale and Tager-Flusberg (2003) found that children who were trained on using false complement constructions with the verb "say", later on performed better on false belief tasks compared to a control group. Apparently, the overt evidence of falsity in the statements led to a better understanding of falsity in beliefs. In a study with German-speaking children, Lohmann and Tomasello (2003) compared three different training conditions and a control condition. In the first training condition, the experimenter talked with the child about deceptive objects using no sentential complements. In the second training condition, children were trained on sentential complements, but the content did not refer to deceptive objects. In the third training condition, the experimenter used sentential complements with the verbs "think" and "say" in conversation about the deceptive objects. The control condition consisted of perceiving deceptive objects with no accompanying conversation. Whereas the control condition did not have an effect on subsequent performance on false belief tasks, comparisons of the training conditions revealed that the third condition (combination of deceptive objects and conversation with sentential complements) had the largest positive effect on false belief performance. The authors concluded that perspective-shifting discourse (about the deceptive objects) and sentential complement syntax each contribute independently to false belief understanding. As the results of these training studies converge with several correlational studies, there is indeed strong evidence for a causal role of syntactic ability, especially regarding sentential complements, for the development of false belief understanding.

**Critical views on the role of sentential complement syntax.** There are still some critical issues regarding the supposedly causal role of sentential complement syntax for the development of ToM. Instead of testing purely syntactic ability (and memory, for sure), it has been claimed that the memory for complement task is a test of false belief per se. Whereas de Villiers and Pyers (2002) argue that the memory for complement task requires only

understanding and memory of the embedded sentential complement, some earlier work suggests that even reconstruction of a mistaken proposition requires the child to have a theory of false beliefs (Josef Perner, 1991; Wimmer & Hartl, 1991). If this is true, the question remains why the memory for complement task is usually passed at an earlier age than classical false belief tasks like change of location tasks, with differing task demands (e.g. on working memory) as the most probable explanation. Some authors have also questioned if understanding of sentential complements does indeed contribute to ToM development over and above overall language development. Cheung and colleagues (2004) measured complement understanding in a slightly different way and found that their measure of memory for complements did not make a unique contribution to false-belief understanding beyond that of general language ability, neither in English-speaking nor in Cantonese-speaking children.

Regarding the role of syntax for ToM, there are also some conflicting results, which do not indicate a relation of syntactic ability and ToM in the case of aphasia (e.g. Varley & Siegal, 2000). Varley and Siegal (2000) report the case of an agrammatic patient, who showed intact ToM ability and reason that “grammar may play a vital role in configuring cognitive processes, but once these processes have been established, cognition can operate without grammar” (Varley & Siegal, 2000, p. 726). While these findings are extremely important in the light of the discussion about the interdependence of language and thought, they do not undermine the claim that language and ToM are related in development.

#### **4.2.2. Evidence for a bidirectional relation of language and ToM**

Some authors argue that ToM and language influence each other in development, meaning that the relationship between them is of a bidirectional nature (Miller, 2006; Slade & Ruffman, 2005). It is evident that ToM, which allows for an appropriate judgement of the mental states of an interlocutor, is important for successful communication, but in turn, language may also offer a way to learn about ToM. Language and ToM are also believed to share common precursors like joint attention (Charman et al., 2000; Tomasello, 1995). One of the earliest steps in ToM development, the appreciation of intentions in others, also plays a crucial role in language learning (see section 4.3.1.). An alternative to the view that ToM and language promote each other in development is that both are related to some underlying factor like development of executive functions (Carlson & Moses, 2001).

Evidence for a bidirectional relationship of language and ToM is rather sparse. In a longitudinal study by Slade and Ruffman (2005) investigating the developmental relationship between ToM and both syntax and semantics, language was generally found to be a more consistent predictor of false belief than vice versa. But the authors argue that this might be due to different sensitivity of language and ToM measures. Normally, language ability is assessed with a large number of items producing a wide range of scores, whereas ToM

ability is normally measured with few items producing less variability in the scores. Thus, ToM measures are less sensitive and this lower sensitivity may mask the true effects of earlier ToM on later language ability. To overcome this statistical problem, an equal number of items was used for both language and ToM measures in additional regression analyses. This new kind of sampling revealed that earlier ToM predicted later language and vice versa, thereby indicating a bidirectional relationship of language and ToM. It should also be noted that not only syntactic ability was connected to ToM, but that language abilities in the field of semantics and syntax were equally related to ToM. These findings are well in line with claims that changes in mental state understanding foster semantic development (Baldwin & Moses, 2001), e.g. Sabbagh and Baldwin (2001) found that a change in understanding knowledge states occurring between 3 and 4 years of age facilitates semantic development (learning of new words). In contrast to 3-year-olds, 4-year-olds take into account how likely a speaker is to be knowledgeable when presented with a new word and use this judgement for determining if they should learn a novel word pairing.

In conclusion, it is not quite clear yet in which ways language development and ToM development are interwoven. Although there have been some very strong claims, e.g. about the dependence of false belief understanding on syntactic ability, there are also findings in favor of the view that the relation is a bi-directional. Also, research concerning the relation of language abilities and ToM abilities *other* than false belief understanding still needs to be done.

### **4.3. Intention understanding and language development**

Most research in the area of language and ToM has dealt with relating language abilities with false belief understanding. The strong focus on the false belief task as the hallmark of ToM has led to criticism, because obviously, there is more to ToM than understanding false beliefs (Bloom & German, 2000).

Regarding the nature of the relationship of language and ToM, it has been suggested that in early stages of development, precursors of ToM foster language abilities, but later on, language abilities allow for an advancement and refinement of ToM (see Malle, 2002). In the case of intention understanding, this is indeed a very relevant claim. Early forms of intention understanding, like recognizing goal directed action (Gergely, Nádasdy, Csibra, & Biró, 1995; Sommerville & Woodward, 2005) or parsing the behavior stream into intention-relevant units (Baldwin et al., 2001) appear already at a pre-verbal stage in development. These basics skills do not demonstrate the ability to reason about the mind, but basic intention understanding is also regarded as facilitating word learning (see section 4.3.1.). As children's linguistic abilities increase in the further course of development, they acquire the ability to reason about intentions on an abstract level. Based on the growing body of

evidence relating syntactic ability to false belief understanding, it is probable that syntactic ability is connected to the ability to represent intentions as mental states and to distinguish intentions from related concepts like desires (see section 4.3.2.).

#### **4.3.1. Early intention understanding and early word learning**

When children acquire a certain language, a lot of the basic abilities that are also relevant for ToM development play an important role. These include gaze following, joint attention and the recognition of communicative intentions of others (Miller, 2006). Infants at a very young age realize that when they jointly attend to something with another person, the other person wants them to pay attention to a specific aspect of an object or event; and expresses this with words like *red*, *ball* or *fast* (Tomasello, 1995). However, the communicative intentions of others may be ambiguous, so that infants associate the word that was used with the object of their own focus instead of the actual object the speaker was labelling. To avoid this, at about 18 to 19 months of age, toddlers follow the direction of the speaker's gaze and use this to infer the correct referent of a novel word (Baldwin, 1991, 1993). So, normally developing toddlers actively seek and use cues about communicative intentions when they establish new word-object mappings (see Baldwin & Tomasello, 1998, for a review). In line with this view, autistic children, who have difficulties with joint attention and recognizing communicative intentions, show impairments in language learning (Carpenter & Tomasello, 2000).

#### **4.3.2. Language development and understanding intentions as mental states**

When sufficiently developed, language provides a format to represent an intention as a mental state. While other species also detect goals from observed behavior (see e.g. Call & Tomasello, 1998), only humans can reason on a higher level about intentions. Language allows us to reason about things which are not directly observable and thus serves as an excellent means to express and discern contents of the mind. Based on the current state of research on ToM development, it is explicitly stressed that *intentions in actions*, as long as they are equivalent to the desires or goals of an agent, can be inferred from behavior without language ability. What is argued here is that understanding of *prior intentions*, which are not overt in behavior, and which can be different from desires, is related to language ability.

As has already been stated, over the course of development there is a shift in intention understanding from an understanding based on the observable world to an understanding based on the unobservable mind (Baird & Astington, 2005). Development of language abilities crucially contributes to this shift, because increasing linguistic abilities help children to label mental states and to understand how mental states can be connected to

behavior or different from behavior. Even though 2- to 3-year-olds already use intention terms and can state that something was done accidentally or on purpose, the concept of intention of 3-year-olds is still ill-conceived (Baird & Astington, 2005). They can grasp the motivational state that precedes action, but conflate intentions and desires. The reported abilities of 5-year-olds to successfully distinguish desires from intentions (Schult, 2002; Feinfield et al., 1999) rely on the achievement of recognizing that action, desire and intention are distinct entities in the chain relating the internal to the external world, with intention mediating the relation of desire and outcome. In a mature conception, a desire would precede a *prior intention* (meaning that I can intend to act according to my desire or not), and then an intentional action would follow.

The development of metarepresentational ability likely underlies the achievement of a mature concept of intention (Perner, Stummer, & Lang, 1999). Three-year-olds, who do not make a distinction between intention and desire, probably don't think of someone's desires and intentions as mental representations of this person. It has been suggested that although 3-year-olds can represent hypothetical situations, they can still not *metarepresent*, meaning that they represent someone else representing the hypothetical situation. So, they conceive an intention by representing the goal state as a hypothetical situation, and associating a person with this hypothetical situation (Perner, 1991). According to Perner (1991), 3-year-olds only understand that there are goals people have and actions people can perform to reach these goals. Therefore, they can't distinguish desires and intentions, because in this conception both relate to the hypothetical situation of the goal state. Only when children start to represent an intention as a representational mental state of someone that consists of a plan for an action, which may or may not correspond to a real-world action, they can grasp this distinction.

The role of language for intention understanding is therefore grounded in the assumed relation of language and metarepresentation (which was already put forward in section 4.1.). Language can be used to represent a representational state of someone which is not in accordance with an actual situation. Children acquire the ability to metarepresent toward the end of the preschool years. Around the age of 6 years, they conceive intentions as representations that are different from actual events and actions (Baird & Astington, 2005). Based on the many findings of the relatedness of language ability and metarepresentation of beliefs (Farrant et al., 2012; Farrar & Maag, 2002; Milligan et al., 2007; Ruffman et al., 2003; Slade & Ruffman, 2005), it is assumed that language ability is also related to the metarepresentation of intentions. Because syntactic ability has been found to be important for representing beliefs that do not correspond to reality, it is believed that syntactic ability also plays an important role for representing intentions that do not correspond to real-world outcomes.

### 4.3.3. The language of intention

How are intentions usually expressed in language? There are several mental verbs (taking propositions as their complements) that are used to express *prior intentions*. These include *intend*, *decide* and *plan*. Referring to a *prior intention* to perform an action, one can also use the future forms *will* / *going to*. It should be pointed out that sometimes verbs like *want* can also be used to express *prior intentions*, in cases where desires and *prior intentions* overlap. E.g. when asking someone for his plans for the evening, he/she might say “I want to go to the cinema”, which can represent both a desire and a *prior intention* to fulfill this desire. *Intentions in actions*, though mostly observable in behavior, can also be marked linguistically. A common verb used to describe an *intention in action* is *try*. Even when the outcome does not match the goal, one can for instance say “I tried to find my key”, even though he/she did not find it. The *try* + *complement* construction always refers to an *intention in action*; it can only be used when some action has already been initiated.

Regarding syntactic construction, intentions are, like beliefs, expressed in sentences with mental verbs taking sentential complements. In contrast to belief verbs which take *tensed* sentential complements (meaning that they have an inflected verb), like in *I think [that she went home]*, verbs like *decide*, *intend*, *plan* take complements with uninflected verbs, like *I decided [to go home]*. Generally, tensed complements are more difficult for children to understand than untensed complements (J. de Villiers & de Villiers, 2014). Still, although intentions are encoded in a simpler syntactic form than beliefs, there are important similarities. Most importantly, both in the case of belief and *prior intention*, the complement can contain a proposition that does not conform to reality. In the sentence “Lucas intends to go swimming”, the complement has the propositional content of Lucas going swimming, that does not correspond with an event in reality (yet). A *prior intention* can never be present in real-life behavior at the time that it is present in someone's mind because it *precedes* behavior or is never transferred into actual behavior at all. An *intention in action* expressed in a complement, like in *I tried [to find my key]* can either correspond to reality or not, depending on if the intention is fulfilled or unfulfilled

## II. Study

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While action-based understanding of intentions has been studied widely in infants and toddlers, the development of a fully representational concept of intentions has not been investigated to the same extent. Also, factors that promote the shift from an action-based understanding to a representational understanding of intentions have not been clearly identified, although some authors have pointed out the possibly important role of language abilities (Astington, 2001a; Baird & Astington, 2005).

Based on the existing literature, two important research questions are addressed in the present study. First of all, it has been claimed that 3-year-old children's concept of intention is undifferentiated from that of desire and that children acquire an understanding of intentions as different from desires around the age of 4 years (Feinfield et al., 1999). It is also known that the ability to metarepresent mental states develops in late preschool years, thereby allowing a more refined concept of intentions, clearly separated from the outcomes of actions and from desires (Baird & Astington, 2005). Since evidence about this change in intention understanding is sparse and recent studies are lacking, I want to examine if there is indeed a shift in the understanding of intentions occurring somewhere around 4 years of age. The first research question therefore is: Is there a difference in intention understanding between young preschoolers (aged from 3 to about 4.5 years) and older preschoolers (aged above 4.5 to 6 years)? For the purpose of the first research question, an adopted version of the Intention/Desire Task by Feinfield and colleagues (1999) is applied. In the test, *prior intentions* and *intentions in actions* do not overlap with desires and cannot be inferred based on the outcomes of performed actions. It is hypothesized that the younger group of children will not be able to understand intentions, which do not conform to desires or outcomes, and that the older group will be able to do so. More specifically, it is hypothesized that 1) The younger group will not be able to understand *intentions in actions* that differ from desires and outcomes, whereas the older group will be able to do so, 2) The younger group will not be able to understand *prior intentions* that differ from desires and outcomes, and the older group will be able to do so. Regarding understanding of desires, no differences between age groups are expected, with both groups showing above-chance performance.

While it is expected that age will be a crucial factor for intention understanding, I also expect some interindividual differences that cannot be accounted for by age. While children's ToM generally emerges in orderly steps, individual children vary markedly in their rate of progress (Harris, Rosnay, & Pons, 2005). These individual differences could possibly be related to different levels of language competence. A large body of evidence indicates that ToM abilities are related to language development, especially in the domain of syntax.

Since false belief understanding has been found to correlate with syntactic abilities (de Villiers & Pyers, 2002; Ruffman et al., 2003; Slade & Ruffman, 2005) and expressions of beliefs and expressions of intentions share some syntactic features, syntactic abilities may also be relevant for intention understanding. The second research question therefore is: Is there a relation between intention understanding and syntactic abilities, which cannot be accounted for by age? For this purpose, the Test for Reception of Grammar (Fox, 2013) is administered. I hypothesize that scores of intention understanding and scores of syntactic abilities will be positively correlated, irrespective of possible confounding variables like age.

## 5. Method

### 5.1. Participants and design

Thirty-eight children participated in the study. The children were recruited via the staff of two different kindergartens in Vienna and one kindergarten in Linz, Upper Austria. Two children were excluded because of a severe delay in language development (scoring below the 10<sup>th</sup> percentile in the language test battery). The final sample thus consisted of 36 children (22 female) aged between 3;3 and 6;0 years ( $M = 4.61$ ,  $SD = 0.89$ ). For every child, parents signed an informed consent letter and provided demographical data including number of siblings, education of parents and income of parents. Also, it was determined if German was the native language of the child, if the child was multilingual or having another native language than German. Twenty-seven children were monolingual German speakers, eight were bi- or trilingual and one child was reported to have another native language. However, all participating children had sufficient German skills to understand the instructions and take part in the language assessment as well as the test for intention understanding. The majority of children had a rather high educational background, as indicated by their parents on an ordinal scale from 1 to 6. The categories of education were defined as follows: 1 = very low level of education (no school degree), 2 = low level of education (apprenticeship), 3 = low to medium level of education (craftsman's certificate), 4 = medium to high level of education (vocational school degree), 5 = high level of education (high school degree) and 6 = very high level of education (academic degree). For proportions of educational levels of mothers and fathers see Figure 2.

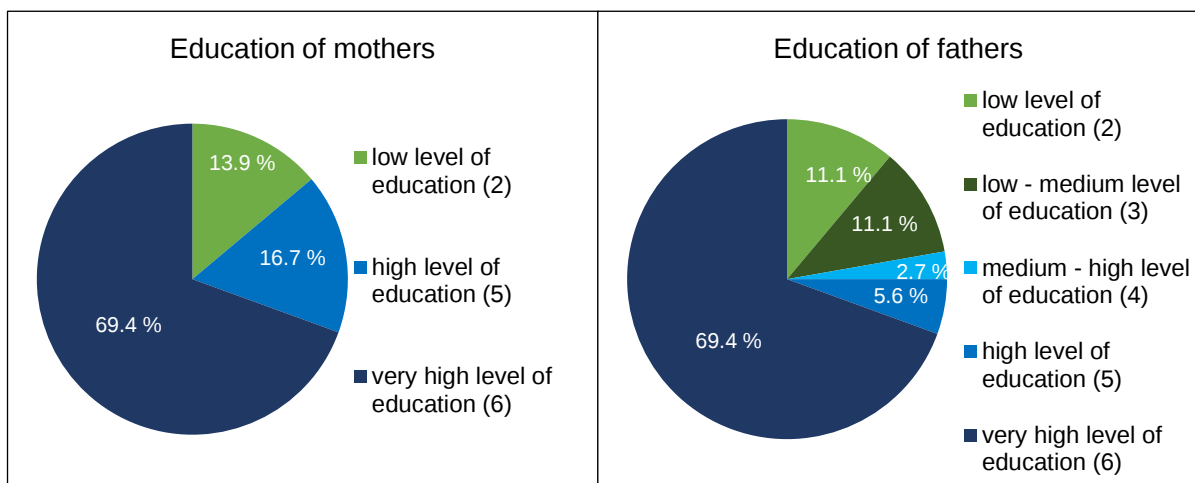


Figure 2. Proportions of educational levels among mothers and fathers of the sample.

All parents provided information about their educational level, but only 25 mothers and 22 fathers provided information about their income, again on an ordinal scale from 1 to

6. The categories of income were defined as follows: 1 = very low income (below 500 €), 2 = low income (501-1000 €), 3 = low to medium income (1001-1500 €), 4 = medium to high income (1501-2000 €), 5 = high income (2001-3000 €) and 6 = very high income (above 3000 €). Proportions of income levels are illustrated in Figure 3. Eleven children did not have any siblings at the time of testing, 24 had one sibling and one child had two siblings.

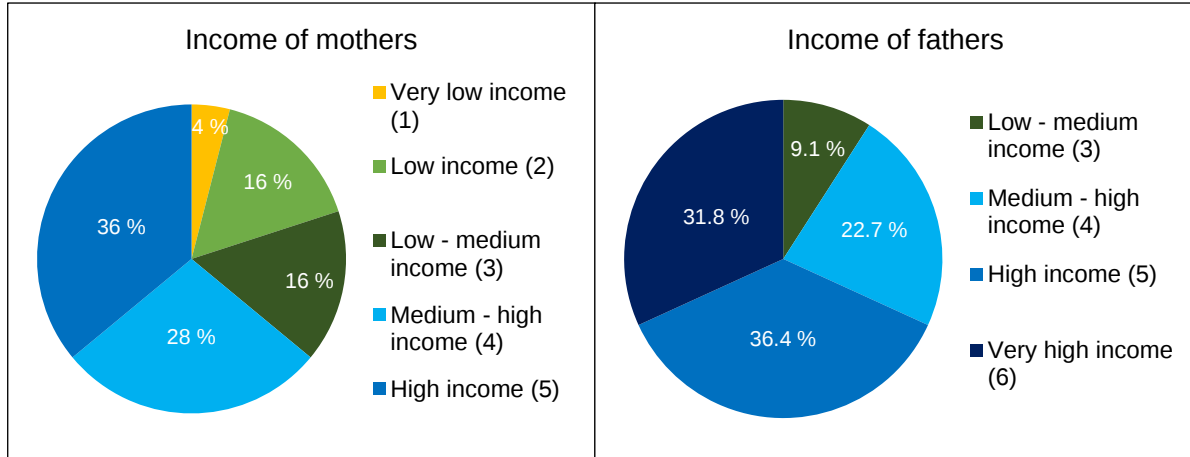


Figure 3. Proportions of income levels among mothers and fathers of the sample.

The study design consisted of 1) a 2 (older group vs. younger group) x 3 (Try question vs. Think question vs. Like question) mixed design, 2) a 2 (older group vs. younger group) x 3 (IDS1 vs. IDS2 vs. IDS3) mixed design and 3) a correlational design relating intention scores with language scores.

## 5.2. Procedure and materials

First, the examiner introduced herself to the child, explained the test procedure and asked for the child's consent to participate. Children were tested individually in a quiet room of the kindergarten and were seated at a table vis-à-vis of the examiner. Half of the children started with the Test for Reception of Grammar (German version, TROG-D, Fox, 2013), the other half started with the Intention/Desire Task (IDT, adapted from Feinfield et al., 1999). Depending on how many blocks of the TROG-D the child completed and on how fast responses were given, the test procedure lasted between 20 and 30 minutes.

### 5.2.1. Test for Reception of Grammar (German version)

Receptive syntactic abilities were assessed with the Test for Reception of Grammar in the German version (TROG-D, Fox, 2013). The TROG-D is a test of comprehension of syntactic structures that can be used for children between 3;0 and 10;11. The test material consists of 84 picture cards and a stimulus list. The procedure is as follows: The examiner reads a stimulus (a word or sentence) to the child, while the child is shown a picture card.

On each picture card, four different pictures are depicted and the child is asked to point to the picture that matches the stimulus it has heard. The diverting pictures are grammatically or lexically related to the correct picture. The TROG-D consists of 21 blocks, each consisting of four stimuli with the same structure (e.g. passive sentences). The blocks are arranged in hierarchical order from very simple to relatively complex syntactic structures. The test starts with very simple one-word items like *shoe* or *black*. The vocabulary tested in the first three blocks (consisting of four nouns, four verbs and four adjectives) is re-used throughout the test in more and more complex sentences. To give an example, in order to understand the sentences from the last block, like “The woman sees that the girl is pointing at herself”, the child must have acquired understanding of complement phrases and of binding principles of reflexive pronouns (see Figure 4 for an illustration). To pass a block, the child has to give correct answers to each of the four stimuli. If five blocks in a row are failed by the child, test administration is stopped. The number of blocks passed by the child is noted to give the raw score (between 0 and 21), which can then be transformed into a standardized score (depending on the child's age).

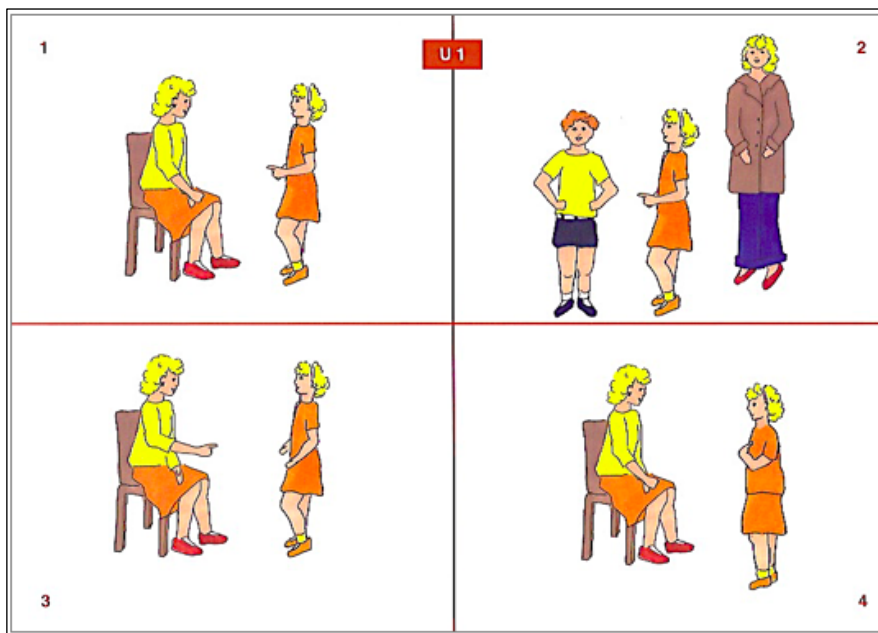


Figure 4. An example from the TROG-D. Picture card for the stimulus “The women sees that the girl is pointing at herself” (correct: picture 4).

### 5.2.2. Intention/Desire Task

To measure intention understanding, an adapted version of the Intention/Desire Task (IDT) used by Feinfield et al. (1999) was administered. The test material consists of four sets of six pictures depicting a story as well as an introductory picture of a girl with a thought bubble above her head. The material was designed and drawn by the author on the basis of the original material from Feinfield et al. (1999). First, the examiner shows the child the introductory picture and explains that the girl in the picture is thinking about what she is planning to do, to familiarize the child with the image of thought bubbles. Then, the test

procedure begins: For each of the four stories, the examiner places the first picture on the table in front of the child and then tells the story while adding the corresponding pictures until all six pictures are placed in front of the child (see Figure 5 for an illustration). Each story has the same structure: In the first picture, a child is depicted (in two stories a girl, in two a boy). This child likes to go to particular place (location A). This represents the protagonist's desire. In the second picture, the child is depicted together with her/his mother, who tells the child to go to a place it does not like (location B). In the third picture, the child is depicted with a thought bubble over her/his head, thinking about where to go and deciding to go to location B. This represents the protagonist's *prior intention*. In the fourth picture, you can see the child packing her/his things to go to location B. In the fifth picture, the child is in the bus on the way to location B. This represents the protagonist's *intention in action*. However, at the end of the story, the bus driver gets lost and the bus stops at location A. That way, both the desire and the outcome are different from the intention.

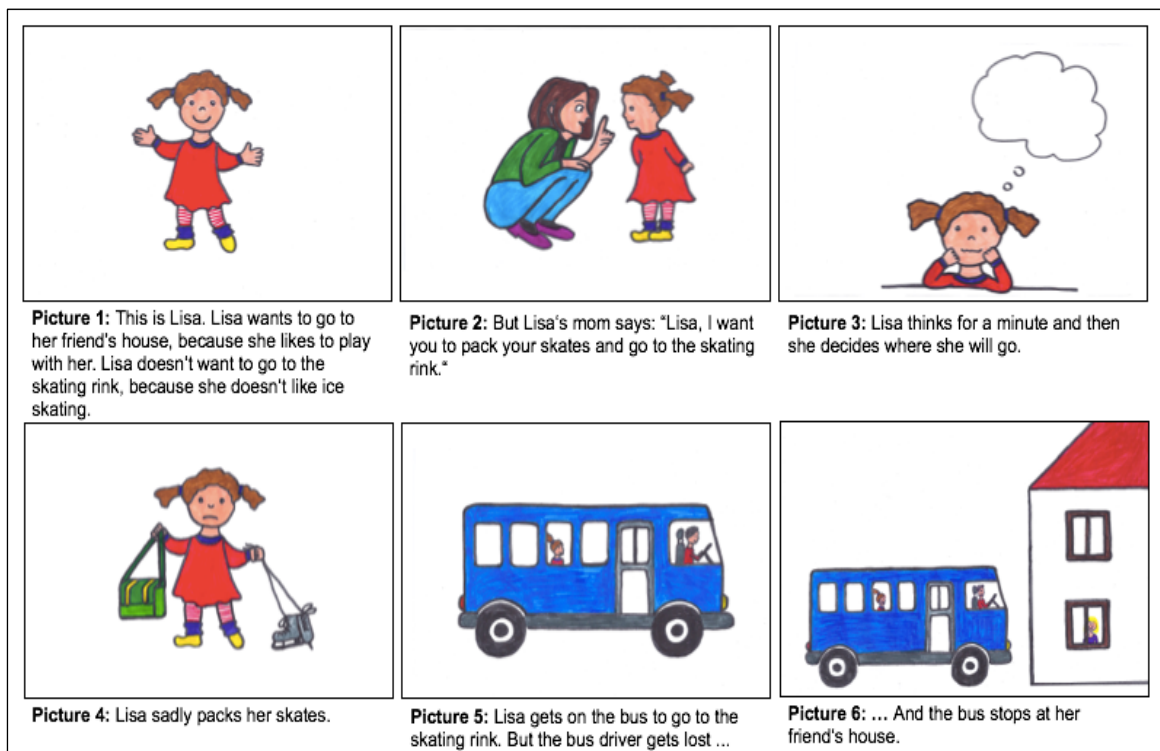


Figure 5. An example of a story of the IDT.

After placing picture 4 on the table, the examiner asks the child: "So, where did he/she decide to go? Where will he/she go?" in order to make sure that the child remembers what has happened so far. If the child answers correctly, the examiner repeats the answer and continues, if the child answers incorrectly, the examiner asks what the protagonist is packing and then asks again, where he/she decided to go. If the child still answers incorrectly, the examiner gives the correct answer and continues to tell the story. Likewise, if the child answers correctly the second time, the examiner repeats the answer and continues. After completion of the story, the participants are asked three questions. The

pictures are all left in front of the child while the child is asked the questions, in order to minimize memory demands of the task.

The first question, which is related to the *intention in action*, is: “Where did [name of the character] try to go? To [location A] or to [location B]?” (original German version e.g.: “*Wohin hat Lisa versucht, zu fahren? Zum Eislaufplatz oder zu ihrer Freundin?*”) and will be subsequently referred to as the Try question. The second question, which is related to the *prior intention*, is: “Do you remember where [name of the character] decided to go? Where did [name of the character] think that he/she was going to? [Location B] or [location A]?” (original German version e.g.: “*Kannst du dich erinnern, wofür Lisa sich entschieden hat? Wohin hat Lisa gedacht, dass sie fährt?*”) and will subsequently be denoted as the Think question. Finally, the third question, which concerns the desire, is: “Where did [name of the character] like to go? [Location A] or [location B]?” (original German version e.g.: “*Wohin wollte Lisa gerne fahren?*”) and will subsequently be referred to as the Like question. The order of the two response options is counterbalanced so that for each question type, in half of the cases the first option is the correct response and in the other half the second option is the correct response. Children score 1 point for each correct answer. That way, children can score 0 to 4 points for each question type.

### 5.3. Data preparation

To divide children into two groups based on their age, a median split was applied. The median was 4.58 years, resulting in 17 children in the younger group (aged between 3.25 and 4.42 years) and 19 children in the older group (aged between 4.58 and 6.00 years). To account for educational background of the children in the following analyses, the higher value out of the two specifications of education (education of mother/ education of father) was used as a rough ordinal indicator of educational background. Household income was estimated by adding up the mid-values of the category intervals that mothers and fathers used to indicate their income. Resulting estimates of household incomes were again divided into six ordinal categories. Regarding intention understanding, in addition to the scores for each question type, three intention/desire scores were computed for each child. The first intention/desire score (IDS1) consisted of the sum of correct Try questions, for which the accompanying Like question was answered correctly (meaning that correct Try questions in combination with incorrect Like questions were not considered). The second intention/desire score (IDS2) consisted of the sum of correct Think questions, for which the accompanying Like question was answered correctly. The third intention/desire score (IDS3) was built by summing up the cases, in which both the Try and the Think question were answered correctly, given a correct response on the Like question. An alpha level of .05 was used for all statistical tests.

## 6. Results

As a first step, a 2 (age group: younger vs. older) x 3 (question type: “try” vs. “think” vs. “like”) mixed analysis of variance (ANOVA) was performed, with age group as a between-subjects factor, question type as a within-subjects factor and number of correct responses as the dependent variable. The ANOVA yielded a significant main effect of age,  $F(1, 34) = 5.56$ ,  $p = .024$ , partial  $\eta^2 = .141$ , indicating that the older group ( $M = 3.14$ ,  $SD = 0.76$ ) performed better than the younger group ( $M = 2.43$ ,  $SD = 1.04$ ). The main effect of question type was also significant,  $F(2, 33) = 10.76$ ,  $p < .001$ , partial  $\eta^2 = .240$ . There was no significant interaction between age and question type,  $F(2, 33) = 1.77$ ,  $p = .179$ . The main effect of question type was further investigated using planned comparisons with Bonferroni correction, which indicated that there was a significant mean difference between the Try question ( $M = 2.78$ ,  $SD = 1.50$ ) and the Like question ( $M = 3.47$ ,  $SD = 1.03$ ),  $p = .025$ ,  $d = -0.55$ , and a significant mean difference between the Think question ( $M = 2.17$ ,  $SD = 1.52$ ) and the Like question,  $p < .001$ ,  $d = -1.02$ . The mean difference between the two questions related to the intention, the Try question and the Think question, was not statistically significant,  $p = .139$  (see Figure 6 for an illustration).

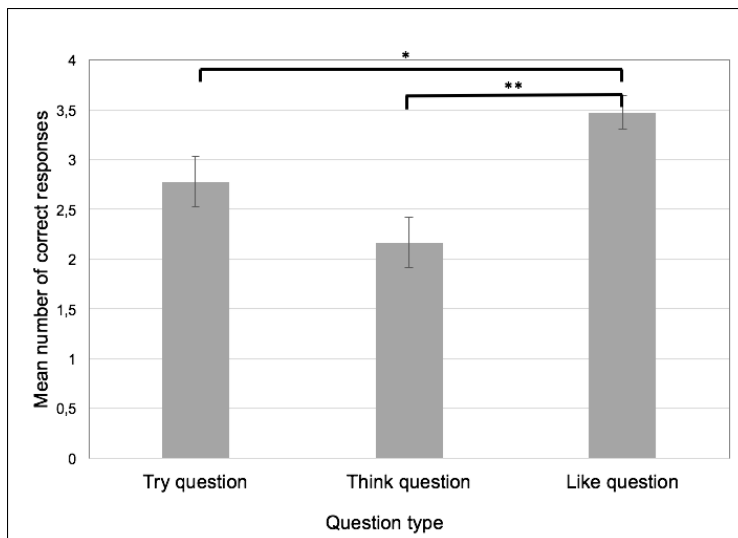


Figure 6. Differences between mean scores (error bars indicate standard errors) on the Try question, the Think question and the Like question. \*  $p < .05$ , \*\*  $p < .01$

Differences between the two age groups were further analyzed with between-group  $t$ -tests for each question type. These revealed a significant difference in performance on the Try question between the older group ( $M = 3.37$ ,  $SD = 1.26$ ) and the younger group ( $M = 2.12$ ,  $SD = 1.50$ ),  $t(34) = 2.72$ ,  $p = .010$ ,  $d = 0.91$ . For the performance on the Think question, there was no significant difference between the older group ( $M = 2.26$ ,  $SD = 1.84$ ) and the younger group ( $M = 2.06$ ,  $SD = 1.60$ ),  $t(34) = 0.40$ ,  $p = .694$ . Comparing performance on the Like question, there was a marginally significant difference between the older group ( $M = 3.79$ ,  $SD = 0.71$ ) and the younger group ( $M = 3.12$ ,  $SD = 1.22$ ),  $t(34) = 2.05$ ,  $p = .049$ ,  $d =$

0.69 (see Figure 7 for an illustration).

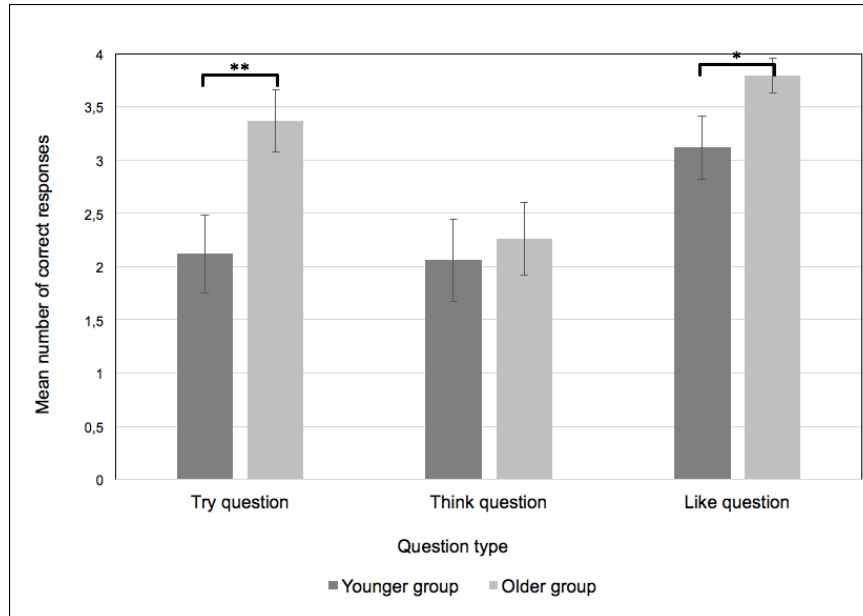


Figure 7. Differences between mean scores (error bars indicate standard errors) of the older group and the younger group on the Try question, the Think question and the Like question. \*  $p < .05$ , \*\*  $p < .01$

One-sample  $t$ -tests testing the observed values against the value expected by chance ( $= 2$ ) showed that the younger group's performance on the Try and the Think question did not differ significantly from chance,  $t(16) = 0.32$ ,  $p = .750$  and  $t(16) = 0.15$ ,  $p = .881$  respectively. Performance of the younger group on the Like question was significantly above chance level,  $t(16) = 3.78$ ,  $p = .002$ . For the older group, performance on the Try question was well above chance level,  $t(18) = 4.74$ ,  $p < .001$ , whereas performance on the Think question did not differ significantly from chance,  $t(18) = 0.77$ ,  $p = .450$ . Performance of the older group on the Like question was significantly above chance level,  $t(18) = 10.93$ ,  $p < .001$ .

As a second step in the analysis, the understanding of intentions vs. desires in the two age groups was analyzed by applying a 2 (age group: younger vs. older)  $\times$  3 (type of score: IDS1 vs. IDS2 vs. IDS3) mixed ANOVA, with age group as a between-subjects factor, type of score as a within-subjects factor and number of correct responses as the dependent variable. The important difference between the question types used in the first analysis and the scores used here is that the IDS1, IDS2 and IDS3 only take into account correct "intention responses", for which the "desire responses" were also correct. The IDS1 consists of correct responses for the Try question and the IDS2 consists correct responses for the Think question, given a correct response on the Like question. The IDS3 is a score of answering both the Try and the Think question correctly, given a correct response on the Like question. Because of violation of sphericity, the Greenhouse-Geisser correction was used for within-subject effects. Again, a significant main effect of age was found,  $F(1, 34) = 4.96$ ,  $p = .033$ , partial  $\eta^2 = .127$ , indicating a better performance of the older group ( $M = 2.47$ ,  $SD = 1.18$ ) compared to the younger group ( $M = 1.47$ ,  $SD = 1.51$ ). There was a significant

main effect of type of score,  $F(2, 33) = 8.68$ ,  $p = .002$ , partial  $\eta^2 = .203$ . There was no interaction between age and type of score,  $F(2, 33) = 1.09$ ,  $p = .348$ . Further analyses using planned contrasts with Bonferroni correction showed that there was no significant mean difference between the IDS1 (measuring understanding of the *intention in action*,  $M = 2.47$ ,  $SD = 1.71$ ) and the IDS2 (measuring understanding of the *prior intention*,  $M = 1.94$ ,  $SD = 1.55$ ),  $p = .193$ . However, both mean performance on the IDS1 and the IDS2 differed significantly from mean performance on the IDS3 (measuring understanding of both *prior intention* and *intention in action*,  $M = 1.58$ ,  $SD = 1.54$ ), with  $p < .001$ ,  $d = 0.55$ , and  $p = .050$ ,  $d = 0.23$  respectively (see Figure 8 for an illustration).

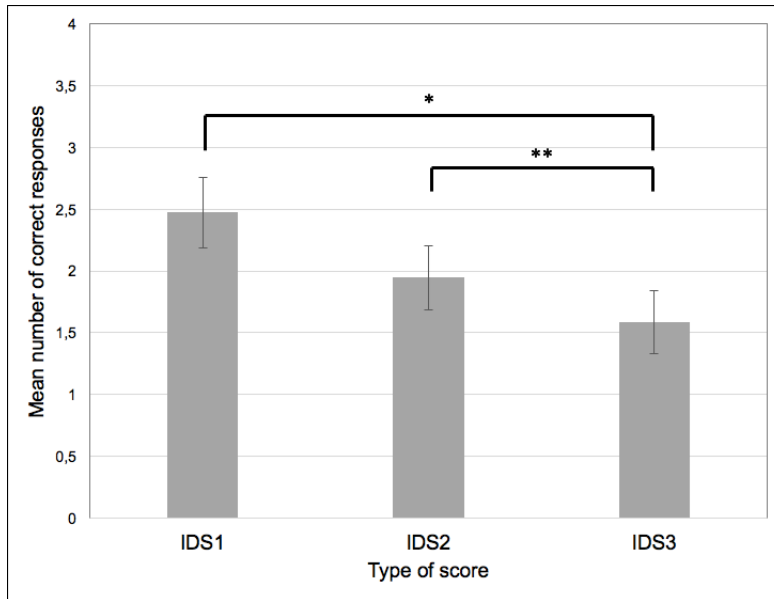


Figure 8. Differences between mean scores (error bars indicate standard errors) for the IDS1, the IDS2 and IDS3. \*  $p < .05$ , \*\*  $p < .01$

Between-group  $t$ -tests comparing the younger and the older group for each type of score revealed a significant difference between the performance of the older group ( $M = 3.16$ ,  $SD = 1.34$ ) and the younger group ( $M = 1.71$ ,  $SD = 1.79$ ) on the IDS1,  $t(34) = 2.76$ ,  $p = .009$ ,  $d = 0.95$ , whereas performance of the older group ( $M = 2.26$ ,  $SD = 1.41$ ) and performance of the younger group ( $M = 1.59$ ,  $SD = 1.66$ ) on the IDS2 were not significantly different,  $t(34) = 1.32$ ,  $p = .196$ . Likewise, the older group ( $M = 2.00$ ,  $SD = 1.45$ ) did not perform significantly better than the younger group ( $M = 1.12$ ,  $SD = 1.54$ ), on the IDS3,  $t(34) = 1.77$ ,  $p = .086$ . For an illustration of the results, see Figure 9.

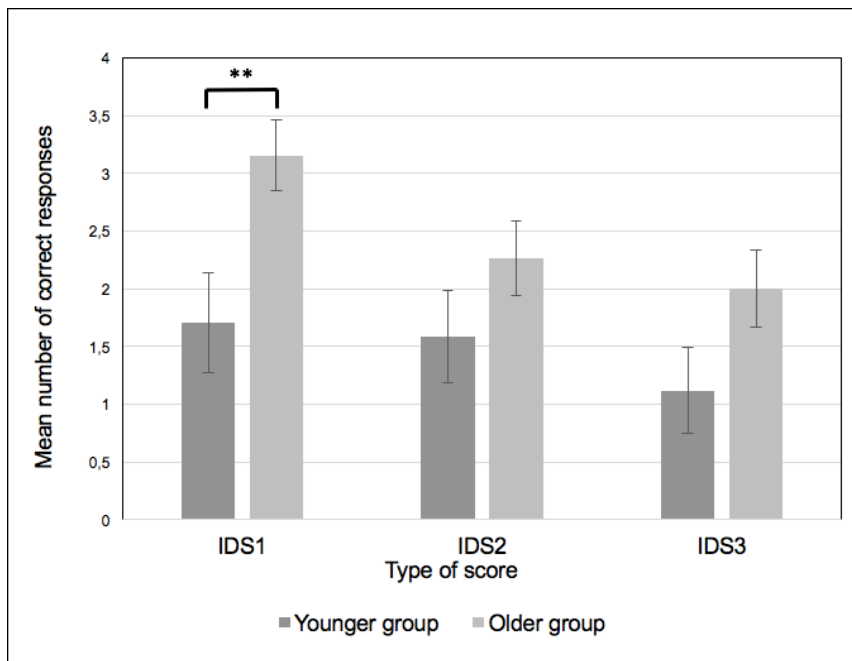


Figure 9. Differences between mean scores (error bars indicate standard errors) of the older group and the younger group on the IDS1, the IDS2 and the IDS3. \*\*  $p < .01$

As a third step, correlational methods were applied to investigate the possible association of language abilities and understanding of intentions. Therefore, as a pre-analysis, possible influences of confounding variables were assessed. The factor of gender proved to be irrelevant in this respect, as boys ( $n = 14$ ) and girls ( $n = 22$ ) neither differed in their language abilities, as measured by standardized TROG scores,  $t(34) = -.012$ ,  $p = .905$ , nor in any of the assessments of intention understanding,  $p > .05$  for all of them. Similarly, the factor of siblings was not relevant, as no difference was found between children without siblings ( $n = 11$ ) and children with siblings ( $n = 25$ ) regarding language abilities measured by standardized TROG scores,  $t(34) = 1.24$ ,  $p = .228$ , and regarding intention understanding,  $p > .05$  for all scores. Also, being monolingual or multilingual did not have any effects, as monolingual children ( $n = 27$ ) and multilingual children ( $n = 9$ ) did not differ in standardized TROG scores,  $t(34) = 1.55$ ,  $p = .078$ , and in none of the scores of intention understanding, all  $p > .05$ . The possible influence of SES (household income and educational background) was investigated with Spearman's correlations for ordinal data. None of the correlations between household income and language abilities and between household income and intention understanding were significant, all  $p > .05$ . However, educational background was significantly correlated with the standardized TROG score,  $\rho = .387$ ,  $p = .020$ , and with the IDS3 (see Table 1). The influence of the supposedly important factor of age was assessed by applying Pearson's correlations. As expected, age was significantly correlated with the TROG raw score,  $r = .562$ ,  $p < .001$ , but not with the standardized TROG score,  $r = .147$ ,  $p = .392$ . Age was significantly correlated with the Try question, the Like Question and the IDS1, but not with other measures of intention understanding (see Table 1 for an overview). Based on these analyses, age and educational background were included as control

variables in the correlation between language competence and intention understanding. The partial correlation was based on Pearson's *r*. Controlling for age and educational background, language abilities were significantly correlated with correct answers on Q3 (measuring *understanding of desire*), on the IDS1 (measuring understanding of *intention in action vs. desire*), on the IDS2 (measuring understanding of *prior intention vs. desire*) and IDS3 (measuring understanding of *both types of intention vs. desire*), as can be seen in Table 1.

Table 1.

Pearson's correlations of age and scores of intention understanding, Spearman's correlations of educational background and scores of intention understanding, and partial correlations of standardized language score and scores of intention understanding.

|                                                                                                | <b>Q1</b><br>(Try<br>question) | <b>Q2</b><br>(Think<br>question) | <b>Q3</b><br>(Like<br>question) | <b>IDS1</b>  | <b>IDS2</b>  | <b>IDS3</b>  |
|------------------------------------------------------------------------------------------------|--------------------------------|----------------------------------|---------------------------------|--------------|--------------|--------------|
| <b>Age</b>                                                                                     | <b>.351*</b>                   | .120                             | <b>.386*</b>                    | <b>.407*</b> | .236         | .322         |
| <b>Educational<br/>background</b>                                                              | .307                           | .324                             | .094                            | .257         | .237         | <b>.407*</b> |
| <b>Standardized<br/>language score</b><br>controlling for age<br>and educational<br>background | .333                           | .323                             | <b>.408*</b>                    | <b>.400*</b> | <b>.431*</b> | <b>.372*</b> |

\*  $p < .05$

## 7. Discussion

### 7.1. Summary of results

The aim of the present study was to investigate the development of intention understanding and its relation to syntactic abilities in children aged from 3 to 6 years. The first research question concerned the assumed shift in intention understanding occurring in preschool years, approximately around the age of 4 years. The first hypothesis was that younger children (from 3 to 4.5 years) would not be able to understand *prior intentions* and *intentions in actions*, which do not overlap with desires and outcomes, in contrast to older children (above 4.5 to 6 years). Indeed, the analysis yielded a significant effect of age. The older group performed significantly better than the younger group on the Try question, which measured understanding of *intentions in actions* that are not consistent with desires and outcomes. Whereas the older group performed significantly better than chance on the Try question, the younger group performed at chance level. Interestingly, on the Think question, which measured understanding of *prior intentions* that are not consistent with desires and outcomes, performance of the older group and the younger group did not differ significantly, and scores of both groups were not significantly different from chance. Unexpectedly, there was a significant difference in performance on the Like question (measuring understanding of desires) between the older and the younger group, but still both groups performed above chance level on the Like question. Comparisons between question types (Try vs. Think vs. Like) revealed that overall, scores for the Like question were significantly better than scores for the Try question, and even more so, scores for the Like question were significantly better than scores for the Think question.

As I was specifically interested in the understanding of intention as a concept independent from that of desire, in a second analysis, only those answers on the Try question and the Think question were counted as correct, for which the accompanying Like question was also answered correctly. This was done in order to exclude those stories, for which responses to intention questions were in fact correct (e.g. skating rink), but for the desire question there was given the same response (e.g. skating rink), which was wrong. In these cases, it is unclear if children could really grasp the intention, or if they just gave a correct answer on the Try question or the Think question because they conflated intention and desire. Three scores were computed, the IDS1 for stories in which the Try and the Like question were answered correctly, the IDS2 for stories in which the Think and the Like question were answered correctly, and the IDS3 for stories in which the Try, the Think and the Like question were answered correctly. Results again show a better performance of the older group compared to the younger group. Strikingly, the difference in performance

between the older group and the younger group was only (and very highly) significant for the IDS1, with the older group having a mean score almost twice as high as the younger group. Differences between the IDS2 and the IDS3 of the older group and the younger group were not statistically significant.

The second research question concerned the relation of intention understanding and syntactic abilities. Without making explicit assumptions about causality, the second hypothesis was that intention understanding would be positively correlated with syntactic abilities, even when effects of age were controlled for. Based on some pre-analyses, age and educational background were included as control variables in the correlation between language scores and intention scores. When controlling for age and educational background, significant correlations between syntactic abilities (standardized TROG scores) and performance on the Like question, and between syntactic abilities and the IDS1, the IDS2 and the IDS3 were found. Thus, besides a relation of syntactic abilities and understanding of desires, syntactic abilities were also related to understanding of *prior intentions* and *intentions in actions*, which were different from desires and outcomes.

## **7.2. Interpretation of results**

With regard to the first research question, it can be stated that the results are in line with the hypothesis that older children (above 4.5 to 6 years) would have better understanding of intentions than younger children (from 3 to 4.5 years), when intentions do not overlap with desires and outcomes. These results replicate older studies, in which similar material was used (Feinfield et al., 1999) and in which intentions and desires were disentangled (Schult, 2002). However, the results have to be looked at in more detail.

A major age difference in intention understanding was found only for understanding *intentions in actions* (the Try question). Although there were visible cues for the *intention in action*, like the character in the story packing e.g. skates, and explicit verbal statements about the *intention in action* (e.g. "Now Lisa gets on the bus to go to the skating rink"), the younger age group failed to correctly report the *intention in action* when asked where the character *tried* to go, especially when they correctly reported the original desire, which differed from the intention. The older age group could mostly report the correct *intention in action*, also when they reported a differential original desire. Younger children's poor performance might be due to misinterpretations of two different kinds: First, it could be that younger children interpreted the question "Where did [the character] try to go?" as referring to the initial desire. As there are also visible cues of the character's emotional state (e.g. a sad face while packing the skates), a young child might just represent the character together with an associated desired outcome (e.g. not going to the skating rink, but to a friend's house). When asked for what the character tried to do, with the visible outcome of the

originally desired destination, young children might think that was what the character tried to achieve in the first place. So, younger children might confuse trying with wanting. A second explanation could be that younger children do not represent intentions as distinct from actions. As, for instance, Lisa's action of getting on the bus leads to the outcome of going to her friend's place, children simply infer that was what the character tried to do. It is interesting that in this study, children up to 4.5 years were still using an erroneous strategy to infer intentions, whereas it has been reported that 4-year-olds perform well above chance level on the Try question (see Feinfield et al., 1999).

While it was hypothesized that the older age group would show better intention understanding in general, this was not found for the Think question. Both age groups performed poorly on the Think question. This is indeed a very relevant finding. Contrary to the hypothesis that children above 4.5 years would be able to differentiate *prior intentions* from desires, in this study children up to 6 years did not perform better than chance level when asked for a *prior intention*, that was both different from an initial desire and an end state. Possible reasons include memory demands or children's lack of metarepresentational ability. If children are not able to metarepresent that the character in the story represents his/her intention in his/her mind, it is plausible that the child cannot understand and respond adequately to questions like "Where did Lisa decide to go? Where did Lisa think that she was going?" The thinking process and the decision were made as explicit as possible in the story with the use of a thinking bubble, verbally accompanied by "Now Lisa thinks ... and then she decides where to go" and with an illustration of the character who, as a consequence of the decision, packs the right things to go to the intended location. It was also made explicit that the character was sad about this decision. Even though most children could correctly recall the *prior intention* (the decision) after telling the story until this point, and were corrected if they couldn't, after completion of the story, children in the younger group reported the correct *prior intention* not even in half of the cases, and children in the older group in slightly more than half of the cases. Again, one cannot really determine if children were referring to the desire or to the outcome when they were giving the wrong response. However, the memory check indicated that children could correctly recall the *prior intention* before they were confronted with the contrasting outcome. This could indicate that children could hold in mind an intention that was different from an initially stated desire. But until this point, the visible action was also completely in line with the intention (packing things for the intended location). So, it's possible that children just inferred the intention from the action they observed. It can definitely be stated that overall, children between 3 and 6 years did not have a stable concept of *prior intention*. This is again not in line with previous findings that 4-year-olds, in contrast to 3-year-olds performed better than chance on the Think question (Feinfield et al., 1999). In general, understanding of desires was better developed than understanding of intentions. Unexpectedly, there was a difference in understanding

desires between the younger and the older group, but both age groups performed above chance when it came to understanding of desires.

Taken together, there is indeed a difference in intention understanding between younger preschoolers and older preschoolers, but this is primarily the case for understanding *intentions in actions* and not for understanding *prior intentions*. It is striking that it has been widely reported that starting from about 4 years of age, children are able to understand false beliefs (see Wellman et al., 2001, for a review) and thereby demonstrate that they possess a representational model of the mind, but that in this study, children up to the age of 6 years could not consistently give correct responses to questions about decisions or beliefs, that were not overlapping with desires and did not correspond to real outcomes. The Think question in the IDT could effectively be seen as a question about a false belief ("Where did Lisa think she was going?"). Therefore, it can be concluded that preschool children aged from 3 to 6 years still struggle to understand a character's false belief about her/his own action, and cannot metarepresent that the character represents a *prior intention* in her/his mind that is independent from an initial desire and from an outcome that follows. While there seems to be a shift in understanding *intentions in actions*, contrasting the younger with the older group, this is not the case for understanding of *prior intentions*. This also becomes evident considering the fact that age was only significantly correlated with understanding *intentions in actions* and not with understanding *prior intentions*.

Regarding the second research question concerning the relation of syntactic abilities and intention understanding, syntactic abilities were, as previously hypothesized, positively related to all scores measuring understanding of intentions that were in conflict with desires (and outcomes). This relationship could not be accounted for by age. The overall association of receptive syntactic abilities and performance on the IDT can be interpreted in different ways. First, it could be an artifact of task factors. Tasks tapping understanding of mental states often require quite advanced language abilities. Children who have better understanding of complex sentences might understand the questions about the mental states better than children who cannot understand, for instance, embedded sentences. However, it has been shown that language abilities are positively correlated with performance on ToM tasks with varying linguistic demands (Milligan et al., 2007) and even low-verbal ToM tasks (Schick et al., 2007). So, it is likely that language development is indeed related to ToM development, regardless of linguistic task demands. As in this study a simple correlational design was applied, no valid conclusions can be drawn about the directionality of the effect. Based on theoretical accounts and previous findings (e.g. de Villiers & Pyers, 2002, J. de Villiers & de Villiers, 2014), it is probable that language development plays a causal role for understanding mental states because it promotes metarepresentational ability. Following this line of reasoning, the relation can be explained by stating that children who have already acquired advanced syntactic abilities, are therefore

better able to metarepresent intentions as representational mental states of someone, which makes it possible to grasp intentions as separated from desires or outcomes of actions. This seems like a valid explanation of the significant correlation between syntactic abilities and the IDS2 (measuring understanding of *prior intentions*). But what about the *intentions in actions*? The hypothesis was that syntactic abilities would be related to both form of intention understanding, because the *intention in action* was not as easy to understand as in most other paradigms and required an understanding of intentions not just in terms of connecting desires with outcomes. It had to be understood that the *intention in action* was motivated by a *prior intention* and even though the outcome matched the desire, it was not the *intention in action* that caused the outcome. It has already been found that children failed to correctly report if an action was intentional or not when the outcome of an action satisfied a desire (Schult, 2002). Language abilities may help to understand *intentions in actions* differentiated from desires and outcomes because they allow children to reason about intentions and intentional actions on a higher level instead of using a simple desire-outcome matching strategy. This could explain the relation of syntactic abilities and the IDS1. There was actually no specific hypothesis about the relation of syntactic abilities and understanding of desires, because it was assumed that children would all score near ceiling on the Like question. Notably, syntactic abilities were also related to the understanding of desires. Even though it has been claimed that desires are understood already at 2 to 3 years of age (Wellman, Philips, & Rodriguez, 2000), the complicated relationship of desire, intention and action in this study might have contributed to an overall slight deterioration in understanding desires. Considering the relation of language abilities and ToM development (Milligan et al., 2007), it is plausible that in this case, syntactic ability may have also contributed to desire understanding. Not surprisingly given the other results, children's syntactic abilities were also related to the IDS3, which was a score of stories in which Try, Think and Like questions were all answered correctly.

These results indicate that the ability to understand complex relations in sentences is related to the ability to understand complex relations between mental states, as has already been found in other studies (Astington & Jenkins, 1999; Smith et al., 2003). While I do not exclude the possibility of a bidirectional relationship between language abilities and intention understanding, meaning that some parts of intention understanding could contribute to language development (Tomasello, 1995), for this study, it is assumed that syntactic abilities foster complex and abstract intention understanding (and not the other way around). It should be noted that assessments of syntactic abilities always include semantic ability as well, because without understanding the meaning of words, it is impossible to understand the meaning of sentences. Therefore, it has been claimed that common syntax tests assess a combination of syntax and semantics, and that reported correlations of ToM abilities and performance on syntax tests do not indicate a special role

of syntactic ability in contrast to semantic ability (Slade & Ruffman, 2005). It is indisputable that semantics is involved in every test of sentence understanding, but as the TROG-D uses a fixed set of nouns and verbs throughout the test and blocks vary mainly in syntactic complexity, it is safe to assume that it tests *mainly* understanding of syntax. In contrast to the claim of J. de Villiers and de Villiers (2000, 2009, 2014), that understanding of sentential complements is most relevant for metarepresentation and ToM, in the present study an association of overall syntactic abilities and intention understanding was found. Even though the questions of the IDT contained sentential complements, it was assumed that sentential complements do not play an outstanding role for intention understanding, but that general syntactic abilities contribute to intention understanding (Astington & Jenkins, 1999; Milligan et al., 2007; Slade & Ruffman, 2005). However, the possibility that children who performed best at the TROG-D would also perform best on a memory for complements task cannot be excluded. Still, more basic syntax, like it is assessed in the TROG-D, e.g. understanding simple 3-element-sentences, understanding pronouns, understanding past tense etc. was found to be related to intention understanding. As has been put forward in the introductory chapters, the relationship between language and intention understanding presumably relies on the fact that the syntactic system of a language provides a means for metarepresentation. The shift from a non-representational to a representational model of the mind requires just this kind of ability, to metarepresent someone's representational state of mind. Taking a Vygotskian perspective, language provides us with a symbolic system enabling us to reason about mental states (to mentalize), and to metarepresent others' representational mental states, even when do not conform to reality, like in the case of false beliefs or failed intentions. Even though intention understanding likely relies on several, presumably domain-specific precursors like detection of agency or detection of goals from behavior, higher-level understanding of intentions as representational mental states requires a domain-general capacity for metarepresentation, which is connected to development of syntactic abilities.

### **7.3. Limitations and implications for future research**

Even though the present study showed that there is a change in intention understanding throughout preschool years and that syntactic abilities are indeed related to intention understanding, some limitations of the study have to be considered. While some confounding factors like age or education of parents were controlled for, it is possible that other underlying factors may explain the association of syntactic abilities and intention understanding. These include general cognitive abilities or working memory. In order to establish a valid link between syntactic abilities and intention understanding, not only age, but also overall intellectual ability, should be controlled for. Although working memory does not seem to mediate the relation of language abilities and false belief understanding (Slade

& Ruffman, 2005), it would be worth looking at possible relations of working memory and intention understanding.

In assuming that syntactic abilities foster metarepresentation, which then promotes better intention understanding, a complex and indirect relationship is postulated. Still, it is possible that syntactic abilities may be more directly related to tests of intention understanding, because they facilitate understanding of the test questions. Then the relation would be simply explained as an artifact of task factors. To exclude this possibility, one needs to provide evidence for a relation of syntactic abilities and non-verbal tests of intention understanding. Since most non-verbal tests of intention understanding, e.g. behavioral re-enactment procedures (Aldridge et al., 2000; Meltzoff, 1995), do not require an understanding of intentions as mental states distinct from desires, one would have to design a non-verbal test, that still makes this distinction. This is a challenging assignment for future research. Also, future research should investigate if children with language delays show impaired intention understanding in spite of otherwise intact cognitive function. This could shed light on the question whether language abilities make a *unique* contribution to intention understanding.

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# Appendix

## Abstract

While an understanding of intentions that is based on observable actions has been studied widely in very young children, the development of an understanding of intentions as representational mental states has not been investigated to the same extent. Also, factors that promote the shift from an action-based understanding to a representational understanding of intentions have not been clearly identified. Language abilities have repeatedly been associated with “theory of mind” development, and some authors have stressed the importance of syntactic abilities for the understanding of mental states. The aim of the present study was to investigate the development of intention understanding and its relation to syntactic abilities in children aged from 3 to 6 years. The Test for Reception of Grammar in the German version (TROG-D) and a test of understanding intentions in contrast to desires (Intention Desire Task, IDT) were administered. Results showed that children younger than 4.5 years could not correctly report an *intention in action*, that was not consistent with desire or outcome, in contrast to children above 4.5 years. Irrespective of age, children struggled with reporting a *prior intention* that was different from desire and outcome. Importantly, there was a significant positive correlation between scores of the TROG-D and the IDT, even when controlling for age. This indicates that syntactic abilities may help children to metarepresent others’ representational mental states, and thus contribute to an elaborate understanding of intentions.

**Key words:** intention understanding, children, syntactic abilities, metarepresentation

## **Zusammenfassung**

Während das Verständnis von Intentionen, das auf beobachtbaren Handlungen basiert, bereits bei sehr kleinen Kindern ausgiebig untersucht wurde, wurde die Entwicklung eines Verständnisses von Intentionen als repräsentative mentale Zustände bisher nicht im selben Ausmaß untersucht. Auch Faktoren, die den Wandel von einem handlungsbasierten Verständnis zu einem mental-repräsentativen Verständnis von Intentionen fördern, sind größtenteils unbekannt. Sprachfähigkeiten sind wiederholt mit der „theory of mind“-Entwicklung in Verbindung gebracht worden, und einige Autoren haben die Bedeutung von syntaktischen Fähigkeiten für das Verständnis von mentalen Zuständen hervorgehoben. Ziel der vorliegenden Studie war es, die Entwicklung des Intentionsverständnisses und den Zusammenhang zu syntaktischen Fähigkeiten bei Kindern im Alter von 3 bis 6 Jahren zu untersuchen. Dabei wurden ein Test zur Überprüfung des Grammatikverständnisses (TROG-D) und ein Test des Verständnisses von Intentionen im Gegensatz zu Wünschen (Intention Desire Task, IDT) vorgegeben. Die Ergebnisse zeigten, dass Kinder unter 4,5 Jahren eine Intention, die nicht im Einklang mit Wunsch oder Ergebnis stand, in einer Handlung nicht erkennen konnten, im Gegensatz zu Kindern über 4,5 Jahren. Kinder jeden Alters hatten Probleme mit dem Verständnis einer mentalen Intention, die sich von Wunsch und Ergebnis unterschied. Es gab eine signifikante positive Korrelation zwischen den Ergebnissen des TROG-D und den Ergebnissen des IDT, auch wenn das Alter kontrolliert wurde. Dies deutet darauf hin, dass syntaktische Fähigkeiten Kindern helfen können, durch Metarepräsentation die repräsentativen mentalen Zustände anderer Personen zu begreifen und so zu einem elaborierten Verständnis von Intentionen beitragen.

**Schlüsselwörter:** Intentionsverständnis, Kinder, syntaktische Fähigkeiten, Metarepräsentation