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The development of theory-of-mind and the theory-of-mind storybooks

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Document Version

Publisher's PDF, also known as Version of record

Publication date:

2008

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Blijd-Hoogewys, E. M. A., & Blijd-Hoogeweys, E. M. A. (2008). *The development of theory-of-mind and the theory-of-mind storybooks*. s.n.

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CHAPTER 1

Introduction



Abstract: This dissertation presents four studies aimed at measuring the development of Theory-of-Mind in both typically developing children and children with PDD-NOS. In this chapter, the reader can find an overview introducing Theory-of-Mind and PDD-NOS, elaborating on the objectives of this dissertation, leading to the construction of the Theory-of-Mind Storybooks and concluding with the outline of this dissertation.

Theory-of-Mind in young children

Theory-of-Mind is an important social cognitive ability children develop for the most part between their third and sixth year of life. It refers to the ability of children to read minds. More precisely, it is the ability to attribute mental states to oneself and others and to use these attributions in understanding, predicting and explaining behavior of oneself and others. By imagining the interior of others (their mental states), children try to understand and predict the exterior of others (their behavior). Typically developing children acquire the understanding that behavior is mainly driven by mental states (such as desires and beliefs) and not by the objective reality in itself (Wellman, 1990). Theory-of-Mind is a core human capacity needed to fully understand the social environment and for showing socially adequate behavior (Astington & Jenkins, 1995). It is important for social interaction: to explain and predict others' actions; for communication: to assess the listener's knowledge state and to tailor messages; and for narrative: to understand the motives, intentions, desires and beliefs of characters.

Over the years this capacity has been referred to by many names: consciousness of the feeling of their fellows, folk psychology, imputation to others of firsthand experience, naive psychology, second order intentionality, inter-subjectivity, meta-representation, belief-desire reasoning, belief-desire psychology, natural psychology, common sense psychology, social referencing, conceptual role-taking, mindreading, mental simulation, mentalising, social intelligence, perception of intentionality, mental attribution, mentalistic theory of behaviour and representational theory of mind (Whiten, 1994). However, it is best known under the name 'Theory of Mind', and is in this dissertation further abbreviated as ToM.

The term 'Theory of Mind' was coined by Premack and Woodruff (1978), who did research on a 14-year-old chimpanzee. They demonstrated that this chimpanzee could understand mental states of humans and as a consequence could also predict their behaviors. They suggested that this ability to reflect on mental states was theory-like because mental states are unobservable entities which we infer to be underlying people's actions and because reference to mental states allows us to explain and predict other people's behavior with remarkable power (Baron-Cohen & Swettenham, 1997).

Since the article of Premack and Woodruff, a massive amount of ToM research followed. Soon it was picked up by developmental psychologists and research was undertaken in both typically developing children and clinical groups. Research focused mainly on the mastering of

false beliefs, which is considered a cornerstone in ToM development. A belief is a thought or an idea. It is a mental representation of reality, which can be true or false. A false belief is a belief that does not correspond with reality. Mastering a false belief means that a child is able to comprehend that a person can have a wrong belief and will also react upon this wrong belief. Thus, a child can predict the behavior and/or emotion of another person based upon the wrong belief of that person. For instance, take two girls named Sally and Anne. They are in a room. Sally has a ball and puts this ball in a basket. She then leaves the room. Next, Anne takes the ball out of the basket and puts it in a box nearby. And then she leaves. A bit later, the first girl Sally comes back and looks for her ball. If a child were asked “Where will Sally look for her ball?” and that child would answer “in the basket”, this child clearly comprehends that Sally has a false belief and will act upon this false belief. A child that answers “in the box” however does not (yet) comprehend false beliefs and is misled by its own true belief. The former experiment is known as the Sally and Anne test (Baron-Cohen et al., 1985) and is often used in ToM research. It is considered a typical false belief task.

A considerable amount of research has been undertaken in the field of ToM, covering a variety of perspectives (for substantive overviews, see Baron-Cohen et al., 2000; Frith & Hill, 2003). Research has focused on the origin of ToM, the development of ToM and its precursors (such as joint attention and perception). Research has been undertaken in animals (such as apes and birds), in children and adults, in people with autism and other clinical conditions (such as mental retardation, prelingual hearing loss and schizophrenia). Also other aspects have been investigated, for instance influencing factors (such as test situation, language, verbal intelligence, executive function, central coherence, culture, upbringing, presence of older peers in the family, social economical status and gender), neurobiological aspects (role of (orbito)-frontal cortex and limbic system in particular hippocampus and amygdale) and clinical aspects (such as ToM training). Not much research is undertaken into the developmental patterns of ToM and the ToM abilities of children with PDD-NOS, a lesser variant of autism.

Children with PDD-NOS

Autism is a severe developmental disorder characterized by impairments in social relatedness and communication, and a pattern of stereotypical or repetitive behaviors (APA, 1994, 2000). In 1985, Baron-Cohen and colleagues suggested that children with autism lack a ToM; they lack the ability to attribute independent mental states to themselves and others. This has been linked to their abnormal social, communicative, and imaginative development (Baron-Cohen, 1995). Despite the massive amount of research on ToM problems in autism (for an overview see Baron-Cohen, 2000) little is known about the ToM functioning of children with PDD-NOS.

PDD-NOS is the abbreviation for Pervasive Developmental Disorder Not Otherwise Specified. In other words there are no specific diagnostic criteria for this disorder. To provide insight in what PDD-NOS is, we first describe the pervasive developmental disorders that are well described, namely the autistic disorder and Asperger's syndrome (also see Table 1). Children with an autistic disorder have problems in three domains: they have qualitative impairments in social interaction, qualitative impairments in communication (verbal & non-verbal) and restricted repetitive and stereotyped patterns of behavior, interests, and activities (impairments in flexible thoughts and actions) (APA, 1994, 2000). These problems are observable before the age of three. Children with Asperger's syndrome have approximately the same problems, but they do not have clinically significant delays in language, cognition and adaptive skills. This does not imply that individuals with Asperger's syndrome have no problems with communication (APA, 2000, pp. 80). For instance, they evidence pragmatic problems. Children with PDD-NOS also have pervasive developmental problems, but they do not satisfy the criteria for an autistic disorder or for Asperger's syndrome. It is a group of children with a severe and pervasive impairment in reciprocal social interaction and problems in one of the other two autism domains, namely an impairment in communication skills or stereotyped behavior, interests or activities (DSM-IV-TR). Taken together, they comply with three to a maximum of five criteria of autism (Buitelaar & Van der Gaag, 1998) and do not meet the criteria of a specific pervasive developmental disorder.

Table 1: *Diagnostic criteria for autistic disorder and PDD-NOS (DSM-IV-TR, 2000)*

299.0 Autistic Disorder

- A. A total of six (or more) items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3):
1. qualitative impairment in social interaction, as manifested by at least two of the following:
 - marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction
 - failure to develop peer relationships appropriate to developmental level
 - a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest)
 - lack of social or emotional reciprocity
 2. qualitative impairments in communication as manifested by at least one of the following:
 - delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)
 - in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
 - stereotyped and repetitive use of language or idiosyncratic language
 - lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level
 3. restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:
 - encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
 - apparently inflexible adherence to specific, nonfunctional routines or rituals
 - stereotyped and repetitive motor manners (e.g., hand or finger flapping or twisting, or complex whole-body movements)
 - persistent preoccupation with parts of objects
- B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.
- C. The disturbance is not better accounted for by Rett's Disorder or Childhood Disintegrative Disorder.

Table 1: *Diagnostic criteria for autistic disorder and PDD-NOS (DSM-IV-TR, 2000)*

299.80 PDD-NOS (Including Atypical Autism)

This category should be used when there is a severe and pervasive impairment in the development of reciprocal social interaction associated with impairment in either verbal or nonverbal communication skills or with the presence of stereotyped behavior, interests, and activities, but the criteria are not met for a specific Pervasive Developmental Disorder, Schizophrenia, Schizotypal Personality Disorder, or Avoidant Personality Disorder. For example, this category includes "atypical autism" - presentations that do not meet the criteria for Autistic Disorder because of late age at onset, atypical symptomatology, or subthreshold symptomatology, or all of these.

Children with PDD-NOS are often not included in research, probably because PDD-NOS is not a specified disorder and is often considered a catchall diagnosis for children who do not fit the criteria for one of the other pervasive developmental disorders (Filipek et al., 1999). As a result, children with PDD-NOS are difficult to define as a group. Meanwhile, PDD-NOS is thought of as the most prevalent pervasive developmental disorder in the population, namely 15-36 per 10,000 children (compare with autistic disorder: 7-10 per 10,000; Asperger's syndrome: 2.5-8 per 10,000) (Chakrabarti & Fombonne, 2001; Fombonne, 2003; Lingam et al., 2003; Williams et al., 2006a). This high prevalence should give motive to involve this group in research, also in ToM research. Since children with PDD-NOS have a lesser variant of autism, it can be hypothesized that they also have lesser ToM problems than children with an autistic disorder or Asperger's syndrome. Therefore, this dissertation is finally aimed at the ToM functioning of children with PDD-NOS.

Objectives of this dissertation

A lot of ToM research has been aimed at isolated ToM aspects, especially on the understanding of false beliefs. Comprehending and correctly acting upon the false belief of another person is a skill no three-year-old masters, but most four-year-olds do (for a meta-analysis on false belief research, see Wellman et al., 2001), whereas children with autism tend to have serious problems with false belief tasks. On average, the latter group of children only begin succeeding on such tasks when they are eight years old and have a mental age of minimum six years old (Yirmiya et al., 1996). Hence, both

within autism research and typically developing ToM research, false belief understanding became a central issue. As a by-product, false belief understanding and ToM understanding have been put on a par, being used as exchangeable synonyms, which of course they are not. False beliefs, though a cornerstone of ToM understanding, only form a part of ToM understanding. Also other constructs play an important role, like the understanding of desires and emotions (Astington, 2001). In Table 2 (at the end of this chapter), an overview of the development of ToM and its precursors - the developmental stepping stones to an eventual awareness of mental states - in young children can be found. Only recently, the focus of research has moved to a more developmental view (Wellman & Lagattuta, 2000; Steele, Joseph & Tager-Flusberg, 2003) aiming at a wider range of ToM components.

In order to get insight in the development of ToM, it is important to test the ability of children concerning different relevant ToM aspects, like emotion understanding, belief understanding linked to actions (such as false beliefs) and emotions, desire understanding linked to actions and emotions. It would also be interesting to involve ToM related aspects, like the understanding of the difference between mental and physical entities (thinking of an apple versus holding an apple in your hands). These different ToM parts have been operationalised in different tests (for a classic work, see Wellman, 1990). These tests have often been used independently of one another, subjecting children only to a few tests at a time. From a developmental point of view though, it would be interesting to subject children to all of these tests at the same measurement. However, bombarding children with so many different tests at once would wear them out and result in less reliable test results. A compromise would be to join these different tasks in one overlapping instrument, favoring mutual comparison between the different tasks. Such an instrument would have an additional advantage of optimizing reliability, since the total score is a summation of multiple factors.

The goal of this dissertation was to get insight in the development of early ToM in children with PDD-NOS, a lesser variant of autism. We have chosen to focus on early ToM development, that is, ToM typically developing children develop between their third and fifth year. In order to get insight in development, repeated measurements were required, but no instrument existed that was easily applicable for such a purpose and that was also applicable for children from three years on. Therefore, the first objective of this dissertation was to construct a ToM instrument,

incorporating different relevant ToM tasks, applicable to a wide age range in both typically developing children and children with autism. In order to enable comparisons between children, psychometric properties concerning validity and reliability were calculated as well as norm scores. Determining the validity, reliability and norms of the ToM instrument constituted the second objective of this dissertation.

If a reliable comprehensive ToM instrument is available, the development of ToM can be mapped out as a whole, in addition to the different components within ToM. The developmental trajectories of those components can then be compared with one another. Consequently, the third objective of this dissertation was to map the development of ToM in typically developing children as a whole and for its different components. Only then, the results of children with ToM problems, such as children with PDD-NOS, can be reliably assessed and evaluated.

In order to get insight into ToM development, both a cross-sectional research design (consisting of a single measurement) and a longitudinal research design (consisting of repeated measurements) can be applied. In general, most of ToM research is cross-sectional. For the most part of this dissertation, at least for the part focusing on typically developing children, it builds on such cross-sectional findings. However, such designs are not sufficient to really describe developmental trajectories. Since the ultimate goal of this dissertation was to get insight in the development of early ToM in children with PDD-NOS, we have included a longitudinal study. This leads to the fourth objective of this dissertation, which was to map the ToM problems of children with PDD-NOS over time, again not only focusing on ToM as a whole but also on the different ToM components. Based upon the contribution of these components, in children with PDD-NOS and typically developing children, we hoped to get more insight in the properties of ToM functioning in children with PDD-NOS. This approach encompasses a more developmental perspective, which various ToM researchers have pleaded for (Steele, Joseph & Tager-Flusberg, 2003; Wellman & Lagattuta, 2000).

The Theory-of-Mind Storybooks

As discussed, we have developed a new comprehensive ToM instrument (the authors are Blijd-Hoogewys, van Geert, Serra & Loth). The instrument is called the ToM Storybooks. It contains multiple tasks on different aspects of ToM and associated aspects children develop between their third and fifth year.

The ToM Storybooks consist of six storybooks in which a main protagonist, named Sam, experiences all kinds of feelings, desires and thoughts. Concerning these experiences, many ToM and ToM related questions are asked to the child. There are five components, namely 1) recognition of emotion, 2) distinction between physical and mental entities, 3) understanding that seeing leads to knowing, 4) prediction of behaviors and emotions from desires, and 5) prediction of behaviors and emotions from beliefs.

The ToM Storybooks hold more tasks and a broader variation of tasks than the average ToM test, which makes it more stable and reliable than its competitors. However, the test is also longer than the average ToM test, it takes approximately 45 minutes. In order to hold the attention of children, we tried to keep the assessment fun by developing vivid stories, illustrated with appealing colorful pictures and also by adding some interactional objects (children can open doors, stick emotions upon empty faces, etcetera).

To enable longitudinal research, we developed three parallel series of the ToM Storybooks. The additional series contain identical tasks, based upon the same underlying test structure, but consist of different protagonists (Lotje, Pieter and Hanna) and different stories.

Outline of this dissertation

The ultimate goal of this dissertation was to get insight in the development of early ToM in children with PDD-NOS. Because a new test was developed for this purpose, first, the psychometric qualities of this test had to be dealt with (Study 1) and norm scores needed to be calculated (Study 2). Since we wanted to research the development of ToM in children with PDD-NOS, we found it also necessary to obtain a comprehensive picture of ToM development of typically developing children. Therefore, the developmental trajectory of typically developing children is researched in more detail (Study 3). After that, we returned to the original goal of this dissertation: the development of ToM in children with PDD-NOS (Study 4).

Chapter 2 presents the *construction and validation of the ToM storybooks*. First, the construction of the instrument is discussed, together with example tasks, structure of the tasks, testing and scoring procedures. Then, the validity and reliability of the ToM Storybooks is covered, in both typically developing children (n=324, 3-12 years) and children with PDD-NOS (n=30). The following questions are dealt with: Is the content validity

of the ToM Storybooks good? Is the internal consistency of the test items good? What is the test-retest reliability of results? What is the inter-rater reliability between raters evaluating the answers of children? Is there a good convergent validity with other ToM tests? And is there a good divergent validity? The final conclusion is that the ToM Storybooks have good psychometric qualities. They comply with the requirements for a good instrument and can be used for research. The next step was to calculate norm scores.

Chapter 3 focuses on *calculating norm scores*, to enable comparison between children. Two questions are asked: Are gender specific norm scores required? And, which norming procedure should be followed? In psychology, in general, monotonically rising regression models are used to calculate norm scores. We claim that a non-linear smoothing procedure, based upon a Loess or locally weighted least squares estimate, is more at place, because it more faithfully follows regressions in the raw scores. Both types of norming procedure are presented in this chapter; and their advantages and disadvantages are dealt with. Based upon the results of 324 typically developing children ToM quotient scores, confidence intervals and age equivalents were calculated. The norm scores were calculated for a broad age range, namely from three up to twelve years old. This was done, because in the end we want to evaluate the results of children with PDD-NOS. The latter group is known to have ToM problems and often function at a lower ToM developmental age than their typically developing peers. Hence, we will need to test children with PDD-NOS that are older than typically developing children for whom the test is primarily intended.

Based upon the norm scores presented in chapter 3, comparisons can be made between children. As a result, we could elaborate more on the ToM functioning of typically developing children and children with PDD-NOS (Chapter 4 and Chapter 5 respectively).

Chapter 4 presents the *ToM development of typically developing children* based upon cross-sectional results with the ToM Storybooks. The following question is dealt with: Is ToM development gradual or does it show developmental discontinuities? The latter is a well-known phenomenon in developmental psychology: before truly mastering a new ability children can show developmental regressions. This phenomenon has been illustrated in language development, social cognition, creativity, reasoning, auditory localization and face perception (see Strauss & Stavy, 1982). It is not unthinkable that it is also visible in ToM development. Temporary accelerations, delays and regressions in ToM functioning over

time were indeed found. Following this discovery, additional questions were asked: Are the observed discontinuities real or due to artefacts? Are the discontinuities supported by additional indicators of discontinuity? Are the discontinuities not only observable in the ToM total score, but also in the ToM sub-scores? And are the discontinuities gender specific? In order to answer these questions non-linear smoothing techniques and dynamic growth model building was used.

Chapter 5 elaborates on the *cross-sectional and longitudinal research findings in children with PDD-NOS*. In discussing the ToM strengths and weaknesses of these children, a two-dimensional ToM continuum is introduced. The following questions are answered: Do children with PDD-NOS evidence ToM problems in comparison with their typically developing peers? Are their ToM problems subject to age changes? Is their ToM functioning susceptible to learning effects? And is there a meaningful relationship between their ToM scores and their daily social skills?

Finally, chapter 6 gives a *summary of the findings* and offers a *general discussion*. The results of the different chapters are united, potentialities of the ToM Storybooks within research settings and clinical settings are discussed, and future research directions are dealt with.

Table 2: *A chronological review of the development of ToM and its precursors*

Neonate

Expressing emotions and reacting upon emotions of others can be considered an early rudimentary form of social interaction, developing during the first year of life. The following skills are acquired during the first months:

- 12-21 days old: imitate facial and manual gestures (Meltzoff & Moore, 1977)
- 8 weeks: social smile elicited in interpersonal contexts (Schaffer, 1996)
- first months: react to facial expressions (Meerum Terwogt & Harris, 1993)
- use of emotion expressions in order to determine own appreciation (Feinman, 1992)
- 5 months: sensitive to little changes in eye gaze during social interaction (Symons et al., 1998)
- 8-9 months: understanding intentional actions (Colonessi, 2005)
- 9 months: begin to understand others as intentional agents and start to intentionally communicate with others (Tomasello, 1999)
- 9-12 months: track the intentions and expectations of others (Reddy, 1991)
- 9-15 months: sharing, directing and following attention of others (Carpenter et al., 1997); shared attention mechanism comes online (Baron-Cohen & Ring, 1994)
- 10 months: proto-declarative pointing as a spontaneous gaze-directing behavior (Butterworth, 1991)
- end of first year: imitate what others do with objects (Meltzoff & Moore, 1983)

First year

When a child is one years old, it comprehends that it's 'self' is different from the world around. Gradually the child starts to comprehend pretence, which can be received as an indicator of mind-reading abilities (Leslie, 1987). The following skills are acquired:

- distinguish between self and other person (Baron-Cohen, 1991a; Butterworth, 1994)
- 12-15 months: pretending that objects have other identities and qualities (Baron-Cohen et al., 1992)
- 12-14 months: joint attention, following a pointing gesture to the target indicated by the direction of pointing (Mundy & Neal, 2000)
- 18-month: understand that people's actions are intentional and goal-directed (infer what action another person is trying to perform, even though the person is unsuccessful in its attempt) (Meltzoff, 1995)
- 18 months: symbolic play (Flavell, Miller & Miller, 1993)
- 18 months: sensitive to other's intentions and capable of pretence (Leslie, 1987)
- 18 months: some limited ability to reason non-egocentrically about people's desires (Repacholi & Gopnik 1997); react upon intentions (Wellman & Lagattuta, 2000)
- 18-24 months: visual perspective taking, understand what other people see from their point of view (Flavell, 1992)
- 18-24 months: object related pretend play (meta-representational capacity; Leslie, 1987)
- 18-24 months: using mental state words like seeing and wanting (Wellman 1993)

- 20 months: use of emotion words like happy, angry, sad and scared (Flavell et al., 1993)
- understand the link between emotions and behavior (Flavell et al., 1993)

Second year

Children of two years old are able to attribute mental states to others. This is easily observable in their play with dolls: attributing emotions and desires to their dolls or action mans. The following skills are acquired:

- comfort younger siblings in distress (Harris, 1989; Zahn-Waxler et al., 1992)
- 2.5 year: talk about causes and consequences of emotions (Flavell et al., 1993)
- 2.5 year: more complex understanding of desires and perspectives (Gopnik & Metlzoff, 1994; Leekam, 1993)
- 2.5 year: the child has a desire theory, it explains and predicts behavior based on desires of people (Wellman & Woolley, 1990)
- 2.8 years: use mental terms - such as think, know and remember - for mental reference (Wellman, 1990)

Third year

During the third year of life mental state understanding increases. Next to desires, children come to understand straightforward first-order beliefs: that is the child's acknowledgment of another person's mental states. They move up to a simple desire belief theory. The following skills are acquired:

- understanding the difference between physical and mental entities, even when close impostors are concerned (Wellman, 1990)
- understanding desire-based emotions (Yuill, 1984)
- understanding true beliefs, beliefs that agree with reality as the child knows it (Hala & Carpendale, 1997)
- the child talks about other's actions in terms of their desires and beliefs (Colonessi, 2005)
- the child has a simple desire belief theory; the child has a mentalistic (not yet a representational) understanding of desires and beliefs (Bartsch, 1996; Wellman, 1990)
- able to make the distinction between thinking and actual doing (Wellman & Lagattuta, 2000)
- knowing the difference between an accident and an intentional act (Leekam, 1993); understanding that the same outcome can be either intended or unintended (Shultz & Wells, 1985)
- fantasizing about things that do not exist (Flavell et al., 1993)
- understanding that own experiences are independent of those of others (Flavell et al., 1993)
- understanding that seeing leads to knowing (Astington & Gopnik, 1991; Pillow, 1989; Pratt & Bryant, 1990)

Fourth year

In this year, the child comes to comprehend false beliefs and moves up to a complete belief desire theory. The following skills are acquired:

- understanding that mental processes are subjective and independent of reality (Leekam, 1993)
- understanding that a same situation can lead to different emotions (Harris, 1989)
- understanding of cognitive emotions, like surprise (Harris, 1989)
- understanding of false beliefs (Hala & Carpendale, 1997; Wellman, 1990; Wimmer & Perner, 1983)
- complete belief desire theory (Wellman, 1990)
- tell fibs and play hide-and-peek (two forms of deception), but quite ineffective because clues revealing the truth are not taken full account of (Baron-Cohen, 2001a)
- end of fourth year: full attainment of first-order meta-representations (Baron-Cohen, 2001a, 2001b)
- 4-5 years: a representational understanding of beliefs (Gopnik, 1993; Gopnik & Astington, 1988; Perner, 1991)

Fifth year

ToM develops further:

- understanding of belief-based emotions (Hadwin & Perner, 1991)

Sixth year

ToM develops to a higher level. The child is able to comprehend second-order mental states: that is the understanding of another person's mental states about the mental states of a third person.

- understanding of second-order beliefs (Perner & Wimmer, 1985)
- understanding that earlier experiences influence mental states (Flavell et al., 1993)

Further

ToM seems fully developed at the age of six. After this period, social cognition expands further:

- 10-12 years: understanding social and self-conscious emotions (Harris et al., 1987)
- 13 years: tell the difference between irony and deception (Baron-Cohen, 2001a)
- 13 years: recognize sarcastic remarks as having a mocking and belittling purpose (Demorest et al., 1984)
- ...