

THESIS OF DOCTORAL DISSERTATION

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False belief understanding and language: developmental relations

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Introduction

The developmental relations between false belief understanding and language has been flourishing research topic in the past 15 years, which is reflected by the numerous studies, research articles and books focusing on this topic. The Dissertation aims to gain more insight on disclosing the nature of this developmental relation by testing it with different aspects of language and focusing on the kindergarten age.

Different theoretical models suggest different relation between the two developing abilities, however as we will see many times these models are not unitary. There are two major approaches regarding this relation. The first suggests that there is no special role of language in the development of theory of mind. However, one can get to this conclusion from various perspectives about the nature of ToM. Probably the most obvious supporters are the nativist modularist theorists. Since the approach suggests that ToM is innately specified and develop in a separate module, language is not necessarily needed for its proper development. It is important to note that by assuming the modular architecture of the mind, one can suggest a very different relation between ToM and language. Sperber (2000) and Sperber and Wilson (2002) for instance propose that there may be more than one theory of mind mechanisms (ToMM)—and that the communication system may possess its own dedicated metarepresentational competence: ‘. . . the recognition of communicative intentions might be a biologically differentiated and stabilized sub-system of human naive psychology’ (Sperber, 2000 p. 133).

The other approach claiming that language has no special role in ToM development clearly denies both the innateness and the modularity of ToM, moreover even its domain specificity. They suggest that ToM abilities rest on domain general cognitive processes, and language is needed only to implement these cognitive processes. What these domain general processes are, that might be different in different approaches. Other researchers, such as Gopnik, Wellman (1994) and Perner (2000) still denies nativist modularity, they argue that the role of language is just a natural way of providing children with the information they need to build up, or construct a theory of mind. Finally, regardless of the theoretical models, it is possible that even if we find such a relation between these two

abilities it is only a by-product of the verblity of theory of mind tasks (Chandler, Fritz, & Hala, 1989).

On the other side, however, there are the theorists, who believe that the relation between the two abilities is fundamental and causal. But this approach is also far from being unitary. The major question is whether there is a specific aspect of language that plays a special role in ToM development or language in general has this special role. And if there is such an aspect what it is? One of the aspects received a lot of attention recently is sentential complements.

Although the broader question refers to the relation between theory of mind (ToM) and language, the Dissertation focuses only on the specific aspect of ToM; false belief understanding, the testing of which became the 'litmus test' of ToM after Dennett's famous paper (1978). However, the test itself clearly does not reflect the complexity of ToM capacity.

As we will also see, one of the major criticisms of studies testing this relation is that false belief understanding was assessed with a verbal test, which leaves open the possibility that whatever relation is found is due to the verblity of false belief tests (FBT), and does not reflect the real relation (e.g. Astington & Jenkins, 1999). That is why the first and second studies of the Dissertation focus on the development of a new nonverbal FBT. One of the language aspects, the role of which in FB understanding created active arguments, is sentential complement. De Villiers radical/strong statement of an essential, causal relation between complement syntax and FB understanding motivated a number of studies to test this phenomenon. In *Study 3* I will also follow this line of research, however unlike the studies before, I will access FB understanding with a nonverbal FBT. Moreover, not only the original version of the de Villiers complement hypothesis will be tested but in *Study 4* also its modified version combined with word-learning. The idea comes from Happé and Loth's (2002) study, where they found that children passed FBT earlier if it was combined with a word-learning task, thus I applied this paradigm to the complement task too to test further hypothesis regarding de Villiers statement. Some of the hypotheses of the Dissertation were also tested on atypically developing children; on children with developmental language impairments (DLI) and on children with autism spectrum disorders (ASD). The relevance of these special populations is to test the

relation on children when one of these abilities is impaired by definition and to explore whether and/or how it modifies the other ‘intact’ or not necessarily impaired ability.

Study 1.

The aim of Study 1 was to develop a new nonverbal FBT, which has additional features compared to the already existing few nonverbal FBT. The other aim was to test the relation between language (tests: PPVT-receptive vocabulary, TROG-H – receptive grammar) and false belief understanding when it access not only with the standard verbal FBT but also with the new nonverbal FBT. In Study 1 both typically developing (TD) children and children with developmental language impairment (DLI) were tested. Children with specific language impairment (SLI) got into the focus of research in this topic, because a delay was found their ToM development (they passed FBT around the age of 6-7) (Miller, 2001; Gillott, 2004, Tucker, 2004). It has been a question whether this delay reflects real deficit/delay in ToM development or if it is due to the verbosity of FBT, in which case the delay should disappear when FB understanding is accessed with a nonverbal test. Although our hypothesis were based on children with SLI, due to pragmatic difficulties (e.g. lack of standardized language tests, relatively difficult access to this special population) our sample did not meet all of the criteria of SLI therefore I will refer to this group as children with DLI.

Our questions regarding the TD children were the follows:

- (1) Is the new nonverbal FBT a valid test of false belief understanding?
- (2) Can children pass the nonverbal FBT at least at the same age as the verbal FBT.
Therefore we expect children to pass the test around the age of 4-5.
- (3) Does the nonverbal FBT have a relation to the language tests (Peabody & TROG-H)? While such a relation is expected between the verbal FBT and the language tests.

Our questions regarding the DLI children:

- (1) Do children with DLI have a delay in the performance on the nonverbal FBT, just like in it was found in their performance on the verbal FBT?
- (2) What is the relation between their performance on the two (verbal and nonverbal) FBTs and the language tests?

The participants were 48 typically developing children and 22 children with developmental language impairment from Budapest, Hungary. In the typically developing group the participants were 16 3-year-old children, 16 4-year-old children, and 16 5- and 6-year-old children. In the developmental language impairment group there were 14 boys and 7 girls, ranging in age from 5;0 years to 7;7 years. The range of the Leiter (nonverbal) IQ was 68-109 and the range of nonverbal mental age was from 4;3 years to 8;7 years. All children were tested with the language tests (PPVT, TROG-H), with the verbal and the nonverbal FBT.

Results and conclusion

One of the most important findings of the validation process was the similar developmental trajectory found between the verbal and nonverbal FBT. Children from the age of 4-5 are able to pass both verbal and nonverbal FBT. This result is in accordance with literature data. Although there was no correlation between the two FBTs we argue that the new nonverbal FBT is a valid method to assess FB understanding, since when only the children were entered into the analysis whose performance was consistent through the trials, the correlation became significant. A really interesting result was obtained for *Study I*, the focus of the Dissertation: the relations found between the language tests and the FBTs. While we found a positive correlative relation between the language tests and the verbal FBT, just like the majority of the studies do, there was no relation between the language tests and the nonverbal FBT. It suggests that the relation found in the earlier studies was probably due to the verbosity of the test.

Our data on children with DLI confirmed the delay in FB understanding that was found in the research. Five to 7;7-year-old Children with DLI did not pass either the verbal or the non-verbal FBT significantly above chance. Also, based on earlier research (Miller, 2001) it was expected that children with DLI would perform better if the linguistic demand of the task is reduced, that is, they would perform better on the non-verbal than on the verbal FBT. In contrast, it was found that children with DLI performed somewhat better on the verbal FBT, although the difference was not significant. After creating more homogeneous subgroups with statistical method within the sample, a more and a less advanced subgroups were found with significant differences between both of FBTs and language tests. Interestingly, no relation was found within the 2 subgroups between false belief understanding (verbal and nonverbal) and language ability, moreover between the two language tests either. This suggests an atypical pattern of development within which these capacities develop independently.

Study 2.

The aim of Study 2 was twofold; (i) by shortening the new nonverbal test to decrease the cognitive (mainly memory) demand of the test and (ii) to test a possible criticism of the new nonverbal test, namely that it can be passed by using non-mentalistic strategy (e.g. by associating the character with his hiding place). That is why (i) the tuning phase of the nonverbal FBT was shortened from 3 trials to 1 and (ii) a fourth trial was added to the test trials: a location change true belief trial (TBT).

Our questions:

- (1) Do children pass the short nonverbal FBT earlier than the verbal FBT, around the age of 3-4.
- (2) Do children show similar relations between the language tests and the two FBT like in Study 1; namely significant correlation between the verbal FBT and both the Peabody and the TROG-H?

The participants were 39 typically developing children, 21 3-year-old and 18 4-year-old children. The children were tested with the same language and FBTs as in Study 1 (except that the nonverbal FBT was shorter, and that a location change TBT was added to both FBTs).

Results and conclusion

The results suggested that children find the location change TBT difficult, and by adding the trial to the tests children's performance decreased on both FBTs. Although these results are surprising, they are not without precedent. Lohmann et al. found very similar results at the 3-year-olds. Another example in the literature is Happé & Loth's study. Roth & Leslie (1998) found the same phenomena using the TBT; younger children performed better on the task than older children around the age of 4., however the difference did not reach significance neither in our study nor in theirs. In summary, we argue that the new nonverbal FBT is a valid measurement of FB understanding, and therefore the version presented in *Study 1* will be used in the further studies.

Study 3.

In Study 3 de Villiers complement hypothesis was tested with the nonverbal FBT both on TD children and children with autism spectrum disorders (ASD). De Villiers claims that the mastery of early sentential complements is the prerequisites of passing FBT (de Villiers & Pyers, 2002; most recently, de Villiers, 2007) when a collection of FBTs and language tasks were administered 3 different times within about a half a year period. de Villiers hypothesis was tested on children with ASD too.

In earlier studies (e.g. Happé , 1995) a close relation was found between language ability and FB understanding in individuals with ASD (or at least in those who have at least some language and pass FBT). Thus, if de Villiers' hypothesis is true, we can expect at least the same or even stronger relation between sentential complements and FBT. Both in the Tager-Flusberg (2000) and in the Lind & Bowler (2009) studies a strong relation was found between complements and FB understanding with verbal FBT. Krisztina

Stefanik (2005) using the new nonverbal FBT introduced in Study 1, found that “relatively higher functioning”¹ children with ASD performed somewhat better on the verbal FBT than on the nonverbal FBT, however the difference was not significant. Another interesting result of the Krisztina Stefanik’s PhD Dissertation (2005) regarding the nonverbal FBT is that it correlated with the ASD children’s social/communicative behavior (measured by ADOS), while the verbal FBT did not show such a relation (also in Györi et al, 2007). According to the authors these findings suggest a closer relation between the everyday social behavior and the nonverbal FBT but not with the verbal FBT. These findings also bring on the possibility of verbal compensation, which will be further discussed after the current study.

Questions regarding the TD children:

- (1) Will the de Villiers’ data be replicated when false belief understanding is measured by a nonverbal test?
- (2) Will I find the same predictive relation between the different language tests and verbal FB tests?
- (3) Will de Villiers’ result be replicated in Hungarian language too?

Questions regarding children with ASD

- (1) Do children with ASD show the same or even stronger relation between the verbal FBT and the language tasks including the complement task in Hungarian language too?
- (2) Will the relation be significant even if FB understanding is assessed with the nonverbal FBT?

Two groups of children participated in our study; typically developing children and children with autism spectrum disorder, all children were native Hungarian speakers. Thirty-four *typically developing children*, twelve 3-year-olds, thirteen 4-year-olds, and ten five-year-olds participated in the study. Sixteen *children with autism spectrum disorder* (1 girl) aged 7;7 to 11;9. The main criterion of selecting children was the verbal

¹ The ASD sample was not strictly high-functioning children with ASD, but their nonverbal IQ (Leiter I.S) was above 60.

mental age based on the investigation of Happé (1995) according to which children with autism do not tend to pass the (verbal) false belief tests under the verbal mental age of seven, but they reach ceiling effect above the verbal mental age of thirteen. In addition to the language and FBTs presented in Study 1, TD children were tested with the Memory for Complements task, while children with ASD were tested with a more advanced version of it, Complements in wh-questions.

Memory for complements task: an example; The girl said to her sister that she brought some apples, but she really brought some oranges. “What did the girl say?” The correct answer was “that she brought some apples” (“apples” was accepted as correct answer too).

Complements in wh-questions: an example; A boy was having chocolate in the school at noon. Later he went home and played with his toys. That evening he said to his mum “I ate chocolate this noon!” We asked then two questions: (1) When did the boy say what he ate? The correct answer was “that evening”. (2) When did he say he ate? The correct answer was “that noon”.

Results and conclusion

In the TD sample we found a correlative relation between all of the language tests, including the complement test and verbal FBT, however there were a couple of children – more than in de Villiers study – who did pass the verbal FBT but performed poorly on the complement task. This is not surprising if we consider that Hungarian children in our study passed the complement task later as it was indicated by de Villiers earlier studies with English speaking children. Moreover, when the effect of the Peabody test, which measures children’s vocabulary and strongly correlates with general language ability was controlled for, the only correlation that was still found was with children’s grammatical ability. These results agree with Astington and Jenkins (1999) findings, however they also warn that these results might be due to the verbosity of the FBT. Indeed, when the FB understanding was tested with the nonverbal FBT, we did not find any relations between the FBT and the language tests, neither with the TROG-H, nor with the complement task.

Children with ASD were also tested with this paradigm, since they represent a very relevant population in this question. Children with ASD have difficulties in passing FBT. Recent research found that the poor performance under this verbal mental age is not due to the verbosity test, because even when FBT was presented completely nonverbally, ASD children still performed at chance (Colle et al, 2007; Senju et al, in press). Our results are in line with these findings; older ‘higher functioning’ children with ASD performed at chance on the nonverbal FBT. Nevertheless, their performance on the verbal FBT was better, however not significantly better. Moreover, we found a very strong relationship between the language tests, especially between the complement task (CIW) and the verbal FBT, but only with the verbal FBT and not with the nonverbal FBT, the implication of which can be twofold: (i) it could suggest that children with ASD who pass the verbal FBT used verbally mediated compensatory strategy (ii) de Villiers complement hypothesis is not tenable for the following reasons. The relation is found only when ToM capacity is tested with a verbal FBT, suggesting that it is only a byproduct of the verbosity of the test, and only in the ASD population, in which, when compared to typically developing children, a stronger relation was found between their language ability and ToM capacity (Happé, 1995; Fisher et al, 2005). Also note that the relation found in this study was only correlational, which does not indicate a causal relation, however this possibility cannot be rejected. In summary, the de Villiers hypothesis is not tenable either in typically developing children or in the ASD children. In both samples any relations between the mastery of complements and the performance on the verbal FBT is due to the verbosity of the test – since no such a relation was found with the nonverbal FBT –, and does not reflect an essential causal relation.

Study 4.

In a recent study, Happé & Loth (2002) tested the Sperber and Wilson’s (Sperber, 2000; Sperber & Wilson 2002) hypothesis of distinct sub-module within theory of mind or as they refer to the ability, mind-reading by creating a word-learning FBT; children had to track a false belief in order to learn a novel word (see 5.4.4. for the description of the task). They found that in spite of the increased task complexity, significantly more 3-5

year-old children passed the false belief task when it was combined with a word-learning task, than when presented in its standard form. Happé and Loth – after excluding other possible explanations of their findings – interpreted these results that they support Sperber and Wilson’s hypothesis; the theory of mind mechanism might be not a unitary mechanism but it might consist of more – at least two – component mechanisms; one for inferring the communicator’s intentions and the other is for inferring the actor’s intentions, moreover developmental trajectories of these components may be different. These findings are not only a new assumption of theory of mind module, but also they challenge the de Villiers’s complement hypothesis. If there is version of the standard FBT (word-learning FBT) based on metarepresentation that children can pass earlier, then it might be another argument to reject the complement hypothesis. However, even if it is found, that children pass the word-learning FBT earlier than the complement task (Memory for Complements), one could argue that similar modification of the complement task, namely embedding it into a word-learning context, could reduce the age of the passers, just like in the case of the word-learning FBT². Thus I tried to make the two tasks; word-learning FBT and Memory for Complements task make as similar in this respect as possible by embedding them into a word-learning context. That was the motivation of creating the word-learning Complement task (WLCT). However, if it is found that by embedding the word-learning context into the complement task, more children pass it than the standard Memory for Complements task, than it questions Happé & Loth’s interpretation of their results, and suggest that the word-learning context makes – at least these two – tasks easier (either by making the task more interesting or by decreasing the executive demands).

After replicating Happé & Loth’s results our questions would be as follows:

- (1) Can children pass the word-learning false belief task earlier than the complement task?
- (2) Can children pass the word-learning complement task earlier than the standard complement task?

² Note that such a criticism would probably come from an alternative interpretation of the Happé & Loth (2002) study; the word-learning FBT has less cognitive (e.g. executive function) demand, than the standard FBT.

(3) The *extended de Villiers hypothesis*: the mastery of sentential complements predicts verbal false belief understanding not only in the standard, but also in the word-learning context.

(4) The better performance in false belief understanding in word learning contexts is due to a more general effect of this context, which is either decreasing the cognitive demands of the task or to increase the attention of the children - e.g. by making the task more interesting – and not to the different developmental trajectories of two separate mechanisms of theory of mind.

Fifty-one children were included in the final sample (and were divided into four groups: 2.5-3 years: 5 children (the low number of the youngest children is due to the floor effect was found at this age); 3-4 years: 15 children; 4-5 years: 16 children; 5-5.5 years: 15 children) their mean age was 4;2 years.

Results and conclusion

The better performance on the word-learning FBT compared to the standard FBT could not be replicated on children at kindergarten age. If we accept these data over Happé and Loth's results, we have no reason to question the unitarity of ToM capacity, at least not because of these findings – note that our facilitation hypothesis was not supported either. The opposite results, the word-learning FBT is more difficult than the standard FBT can be explained by a more parsimonious way; the higher complexity of the word-learning FBT led to this difference. Because of these data our further hypotheses with the word-learning complement task were not valid hypotheses anymore.

General Discussion

In the Dissertation we could see how a nonverbal FBT, that requires acting out, modifies the earlier findings regarding the relation in question. If we accept our new nonverbal FBT as a valid test to measure FB understanding, we can conclude that the relation(s) some of the earlier studies found was due to the verblity of the FBT and does not reflect

an essential causal relation. The approach of 'no special role for language in Tom development' have different perspectives too. Our results could be clearly explained by a nativist modular approach; both language and ToM are innately specified, thus the results suggest that by eliminating/canceling the verbality of the ToM the performance limitations decreased. That is, the better performance found with the nonverbal FBT still supports this approach, however these findings were not consistent. However, as we saw our findings do not support all kinds of modularity thesis. Sperber and Wilson (2002) proposed a unique role of language; developments that are requisite for effective conversation are encapsulated within the language module; thus the child might be able to use ToM knowledge appropriately in language tasks, but not in other tasks outside of language. Our findings are clearly in opposition with this approach.

Also note, however, one does not necessarily need to assume either innateness or modularity to explain our data. For instance, Chandler et al (1989) claim that the role of language is only superficial since passing a standard FBT requires a certain level of language ability, but they do not assume an adult-like competence in the infant's mind. Finally, since the Dissertation focuses strictly on the two abilities in question, the possibility of another, third factor's essential role in ToM development still cannot be excluded. These are interesting questions and ideas that further research needs to explore.

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