

## HIGHER-ORDER THEORY OF MIND AND SOCIAL COMPETENCE IN SCHOOL-AGE CHILDREN

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**Abstract.** Theory of mind, or the ability to make inferences about the mental states of other people, is thought to be the proximate mechanism underlying humans' ability to function in complex, collaborative social networks. Here we present a set of stories and questions for investigating higher-order theory of mind functioning in school-age children, and also a scale for obtaining ratings of children's social competence. Ten and eleven year old children master first and second level theory of mind problems, are slightly above chance on third level problems, and perform at chance on fourth level. Theory of mind performance is positively correlated with teacher ratings of the child's social competence. We also find poorer performance in a relatively deprived school than a relatively affluent one.

**Keywords.** theory of mind, perspective-taking, social competence, social development

### INTRODUCTION

The human way of life consists of a complex web of collaborative social relationships and transactions. There is abundant evidence that humans are oriented towards collaboration with other individuals to a far greater extent than is true of, say, chimpanzees (JENSEN, HARE, CALL, and TOMASELLO, 2006; SILK et al., 2005). Many authors have assumed that the proximate mechanism which facilitates this highly developed sociality is Theory of Mind (ToM), which is defined as the ability to make inferences about the beliefs and desires of other people (see, for example, DUNBAR, 2004). There are individual differences in theory of mind performance. However, direct demonstrations of the role of ToM in maintaining social networks are very rare. Stiller and Dunbar (in press) showed that performance on an advanced ToM task correlated with the size of the network of friends that the person reported being in contact with. In this study, we examine ToM performance in school age (10 and 11 year-old) children, to investigate the effects of individual dif-

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ferences in ToM functioning on social competence, by which we mean the ability to deal effectively with the demands of everyday social interaction.

There has been a great deal of prior research on ToM in children. Much of this has been concerned with establishing the chronology and sequence of ToM acquisition (for useful recent overviews, see WELLMAN, CROSS, and WATSON, 2001; WELLMAN and LIU, 2004), mainly but not exclusively by using a variety of tests of understanding of false belief (WIMMER and PERNER, 1983). The consensus of such studies is that, through a progression of stages starting at around 2 years, normally-developing children have acquired full competence on first-order ToM tasks by 5 years of age (WELLMAN et al., 2001).

One strand of this research has concerned individual differences in timing of acquisition, with evidence emerging that ToM development is affected strongly by non-heritable factors (HUGHES et al., 2005), and is positively affected by quality of parental interaction (MCELWAIN and VOLLING, 2004; MEINS et al., 2002; SYMONS and CLARK, 2000), and quantity of sibling and extended-family interaction (LEWIS, FREEMAN, KYRIAKIDOU, MARIDAKI-KASSOTAKI, and BERRIDGE, 1996; PERNER, RUFFMAN, and LEEKAM, 1994). Moreover, the development of theory-of-mind may be adversely affected by social deprivation and maltreatment (CICCHETTI, ROGOSCH, MAUGHAN, TOTH, and BRUCE, 2003; CUTTING and DUNN, 1999; PEARS and FISHER, 2005). Such differences in ToM development can be behaviourally significant, since ToM abilities correlate with conversational skills, sophistication of joint play, and interpersonal sensitivity (CUTTING and DUNN, 1999; JENKINS and ASTINGTON, 2000), and children with conduct disorder are impaired on theory of mind (HAPPE and FRITH, 1996).

It is likely that individual differences in ToM performance persist through school years and beyond, into adulthood. However, a problem with the assessment of such variation is that, with the exception of individuals with pervasive disorders such as autism, performance on first-order belief tasks is usually at ceiling in individuals over 5 years old. For this reason, some researchers wishing to measure higher-level theory of mind skills have moved away from belief tasks to use emotion-recognition tasks (BARON-COHEN, JOLLIFFE, MORTIMORE, and ROBERTSON, 1997), tasks centred around the detection of humour, irony or non-literal meaning (HAPPE, 1994), or self-rated, personality-style questionnaires (BARON-COHEN and WHEELWRIGHT, 2004). Researchers working on adults, however, have developed more demanding tasks by probing recursive ToM understanding (second level: inferences about a belief about a belief; third level: inferences about a belief about a belief about a belief, and so on, up to fifth or in one case, eighth, level; KINDERMAN, DUNBAR, and BENTALL, 1998; STILLER and DUNBAR, in press). Such tasks involve reading or hearing multi-character stories, and inferring what one character believes about another character's belief, etc. Most adults perform much better than chance up to fourth level, but the error rate increases dramatically above this point (KINDERMAN et al., 1998).

The emergence of higher-order recursive ToM skills in children has been much less studied than the emergence of first-order ToM. There are a small number of tasks available testing second-level ToM (Perner and Wimmer, 1985; Sullivan, Zaitchik, and Tager-Flusberg, 1994). Perner and Wimmer (1985) initially claimed that second-order competence does not develop before 6 years old, though this conclusion has been disputed, using different materials, by Sullivan, Zaitchik and Tager-Flusberg (1994). To date, there is no task that assesses ToM up to the third and fourth levels for children, nor any assessment of what the behavioural consequences and correlates of variation in these more subtle levels of ToM might be.

The present study develops and tests materials for assessing higher-order ToM (up to 4<sup>th</sup> level) performance in children of school age (10 and 11 years old). The aims are threefold. Firstly, we present a set of materials for assessing higher-order ToM skills in children, itself a novel tool. Second, we investigate at what level of recursion the children's performance becomes indistinguishable from chance. Third, and most importantly, we investigate the relationship between higher-order ToM performance and social competence. To do this, a social competence rating scale was developed for teachers to rate their pupils, and these ratings were compared to the pupils' higher-order ToM performance. Finally, although we do not directly address possible social influences on higher order ToM development here, our data do allow us to compare performance across three schools differing significantly in socioeconomic composition, finding significantly higher ToM skills in a relatively affluent as compared to a disadvantaged school.

## METHODS

### Participants

Participants were a random sample of 60 10 and 11 year-old children from three primary schools in West Yorkshire, England (10 boys and 10 girls from each school). The UK government uses the percentage of children at a school eligible for free school meals as a simple index of socio-economic disadvantage. These percentages are 59% for school 1, 35% for school 2, and 9% for school 3. Schools 1 and 2 have higher rates of free school meals than the national average, whilst school 3, serving a relatively affluent area, has an unusually low rate.

### Higher-order ToM task

A set of higher-order ToM tasks was devised to match the procedure used for adults by Stilller and Dunbar (in press). Five stories were produced with suitable content for children, involving social situations that required the participant to be aware

of the perspective of multiple characters (stories are reproduced in Appendix 1). The stories were read out individually to one participant at a time to prevent any bias from reading ability. The children were tested in a room with only the researcher present.

After each story, the participants were asked a series of forced-choice questions about information in the preceding story. The questions were statements and participants had to select the true one. Each story had four associated questions, two with ToM content, and two factual memory questions. The ToM questions ranged in level from level 0 to level 4. Level 0 questions involved inference about a desire or preference. Understanding of desires appears earlier than understanding of beliefs (WELLMAN and LIU, 2004), and so these items were included as minimal-level ToM questions. Level 1 questions were classic inferences about belief, whereas level 2 corresponded to what are generally known as second-order theory of mind tasks (inferences about someone's belief about another's belief). Levels 3 and 4 involved one and two further levels of embedding (for examples of all items, see *Appendix 1*).

The number of questions per story was kept to two ToM and two memory to avoid fatigue and loss of concentration. Thus, only two of the five ToM levels were tested after each story. Over the set of stories, each ToM level was tested twice. Participants were given a score out of 10 to measure their global ToM performance.

### **Social competence rating questionnaire (SCRQ)**

We devised an original questionnaire (the SCRQ) for teachers to rate the social competence of the children. Item content was derived from STERNBERG, CONWAY, KETRON, and BERNSTEIN, 1981 and KOSMITZKI and John, 1993. STERNBERG et al (1981) asked participants to rate the importance of 250 behaviours which were earlier deemed to be characteristic of academic intelligence and everyday intelligence. Factor analysis of the results generated a factor of 'social competence', which was independent of academic intelligence, and which included behaviours such as 'accepts others for what they are', 'admits mistakes' and 'thinks before speaking and doing'. A similar study by KOSMITZKI et al (1993) found 18 behaviours that make up people's concept of social intelligence, such as 'is good at dealing with people' and 'is warm and caring'. An appropriate subset of the descriptors of social competence unearthed by these studies was used in the SCRQ. There were 14 items in total, half positively and half negatively scored. Teachers were asked to indicate on a Likert rating scale how accurate each of the 14 statements was of each child. The questionnaire can be found in *Appendix 2*.

## RESULTS

### Higher-order ToM performance

The ten memory questions concerning the stories were overwhelmingly answered correctly (mean score 9.73, s.d. 0.07, lowest score 8). The number and percentage correct ToM answers, by level, are shown in *Table 1*. As the table shows, performance deteriorates smoothly from 100% correct for level 0 to around chance (49%) for level 4. Performances at levels 1 and 2 are strongly above chance, by Binomial test. Level 3 is significantly above chance if the Binomial test is considered as one-tailed, since the hypothesis is a directional one. However, the departure from chance behaviour is not very great (58% correct).

*Table 1.* Number and percentage of correct responses to the ToM questions, by level of ToM. The p value is the Binomial probability of achieving the observed score by guessing

| ToM Level | Correct | Percentage | p      |
|-----------|---------|------------|--------|
| 0         | 120     | 100%       | <0.001 |
| 1         | 100     | 83%        | <0.001 |
| 2         | 97      | 81%        | <0.001 |
| 3         | 70      | 58%        | 0.08   |
| 4         | 59      | 49%        | n.s.   |

Considered by individual child, the mean ToM score was 7.45 (s.d. 1.82). There was a trend toward better male than female performance, which is on the cusp of significance at the 5% level (Boys: Mean = 7.90, s.d.=1.81; Girls, Mean = 7.00, s.d.=1.74;  $t_{(58)}=1.96$ ,  $p = 0.05$ ).

### Social competence rating questionnaire

Factor analysis of the 14 items of the SCRQ produced three factors with Eigenvalues greater than one. However, factor 1 accounts for 48.7% of the variance, as opposed to just 11.1% and 7.5% for factors 2 and 3. Moreover, all 14 of the scale items load on factor 1, with loadings ranging from 0.43 to 0.90, and the scale has a Cronbach's  $\alpha$  of 0.91. The highest loading is for 'The child is good at dealing with others'. We therefore considered it justified to treat the first factor derived from the ratings as a measure of social competence, in the sense defined above of facility in dealing with the demands of social life. The SCRQ social competence factor from the teacher's ratings was significantly positively correlated with ToM score ( $r = 0.49$ , d.f.= 59,  $p < 0.001$ ).

### Inter-school comparisons

Means and standard deviations per school for ToM score and the social competence factor are shown in *Table 2*. ToM score is lowest in the most deprived school and highest in the most affluent. Though the differences between the three schools do not reach significance ( $F_{(2,57)}=2.48$ ,  $p = 0.09$ ), the difference between the two extremes, schools 1 and 3, is significant ( $t_{(38)} = 2.06$ ,  $p < 0.05$ ). There are no significant differences between the schools in terms of social competence as rated by the teachers ( $F_{(2,57)} = 1.52$ ,  $p = 0.23$ ).

*Table 2.* Means (and standard deviations) per school for ToM scores and the social competence factor.

|          | % free school meals | ToM         | Social competence |
|----------|---------------------|-------------|-------------------|
| School 1 | 59                  | 6.75 (1.77) | -0.03 (1.17)      |
| School 2 | 36                  | 7.65 (1.63) | -0.26 (0.68)      |
| School 3 | 9                   | 7.95 (1.91) | 0.29 (1.06)       |

### DISCUSSION

These 10 and 11 year-old children clearly engaged with and attended to the stories, as evidenced by the overwhelmingly correct answers to the factual memory questions. As expected from previous research, the children mostly master first and second level ToM problems embedded within the stories. However, their mean performance at third level is only slightly better than chance, and at fourth level is at chance. This contrasts with adults, who perform much better than chance at fourth level but not fifth (KINDERMAN et al., 1998). Thus the data suggest that recursive ToM abilities continue to develop through the school years.

We can thus add third and fourth level mental state understanding to the array of demanding ToM tasks that continue to develop well after children have reached threshold on classic first and second level belief problems. Using these stories to probe complex recursive understanding is an additional avenue to investigate alongside such issues as emotion reading (BARON-COHEN et al., 1997) and irony, humour, and other discrepancies between real and apparent emotions (HAPPE, 1994; WELLMAN and LIU, 2004), in developing an overall understanding of the development of social cognition. The relationships between the developmental progressions of the different abilities that make up the overall package of fully adult ToM remain to be investigated.

In this study, we found a trend towards better performance amongst boys than amongst girls. This is in contrast to the pattern more widely observed in children (BOSACKI and ASTINGTON 1999) and adults (e.g. BARON-COHEN and WHEELRIGHT

2004), which is a substantial female advantage in ToM. There is no obvious sampling explanation for this unusual pattern. It is possible that some aspects of the stories engaged boys more successfully than it did girls, though the girls, just like the boys, performed close to perfectly on the factual memory questions, suggesting that they were attending. The sex difference on this task thus awaits further investigation.

The items of the SCRQ were well correlated, and produced a useful measure of teacher-rated social competence. The results also show that there is a substantial correlation between this social competence rating, and performance on the ToM problems. As most children got the zero-, first-, and second-order problems correct, the variation was largely accounted for by differences in performance on the third and fourth level questions. This suggests that these more subtle, recursive mental-state understandings are genuinely important for social behaviour. Delay in their appearance may be related to disruptiveness in childhood. The non-appearance of complex ToM by adulthood is known to be associated with reduced social networks (STILLER and DUNBAR, in press), paranoia (KINDERMAN et al., 1998) and diverse psychopathologies (BRUNE, 2005; INOUE, TONOOKA, YAMADA, and KANBA, 2004; LANGDON and COLTHEART, 1999). Thus, measurement of higher-order recursive ToM abilities may be a useful avenue for the identification of children prone to behavioural and social difficulties.

However, we must stress that in this preliminary study with these materials, no measurement of general intelligence or executive function was made. Higher order ToM skills may co-vary considerably with these more general measures of psychological functioning. Thus, we cannot claim that higher-order ToM is uniquely or differentially predictive of social competence until further studies that control for these other variables are carried out.

There is a significant difference in ToM performance between a relatively deprived school, and a relatively affluent one, with the difference largely accounted for by poorer performance on the higher-level problems in the deprived school. These findings are consonant with the increasing evidence of social and environmental influences on the development of ToM (CUTTING and DUNN, 1999; HUGHES et al., 2005), though our study does not address the precise sources of the differences. The findings do have implications for socio-economic gradients in classroom behaviour. Inter-school differences in the teacher rated social competence were not found. However, this may be because teachers were rating individual pupils relative to the norm of their school, not more generally.

The methods used here have certain limitations. As the items increase in level of ToM embedding, they also increase in syntactic complexity. Performance may thus be affected by individual differences in linguistic abilities or attention as well as the purely ToM mechanisms under study. This problem also applies to the stories used by Kinderman, DUNBAR and BENTALL (1998) and STILLER and DUNBAR (in press). A future priority will therefore be the cross-validation of tasks based on stories and recursive ToM questions with other kinds of ToM tasks. As mentioned

above, the inter-correlations of these ToM skills and more general psychological measures such as intelligence and executive functioning also need to be established. In addition, as the task relies on two-alternative, forced-choice questions, it is impossible over five stories to discriminate guessing from genuine understanding at the level of the individual child. Thus the technique as it stands is more useful for establishing population-level correlates of ToM than it is for diagnostic work with individual children.

These limitations aside, we believe this study has several important offerings. It is the first to provide a technique for measuring third and fourth level recursive theory of mind abilities in a form accessible to children. It provides a social competence questionnaire for teacher ratings that appears to be reliable. It also demonstrates that recursive theory of mind performance is related to teacher-rated social competence. This is a novel piece of evidence consistent with the widely-held belief that it is humans' advanced ToM capacities which form the proximate mechanism underlying their smooth functioning in the collaborative social networks in which they live. Finally, the study provides some suggestions of socio-economic differences that await further investigation in future research.

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### Appendix 1 – ToM Stories and associated questions

#### Story 1. BOBBY'S CHOCOLATE BARS

Bobby loves chocolate. Bobby's mum knows that chocolate is Bobby's favourite thing in all the world. He keeps lots of chocolate bars in the cupboard in his bedroom.

Bobby's mum doesn't like him eating chocolate. It might spoil his tea! One day when he has gone to his friend's house, Bobby's mum moves the chocolate bars and she puts them into her pink shopping bag.

Memory:

- a) Bobby went out to a chocolate factory.
- b) Bobby went out to his friend's house.

ToM Level 0:

- a) Bobby's favourite thing in the world is chocolate.
- b) Bobby's favourite thing in the world is going out with his friends.

Memory:

- a) Bobby's mum's shopping bag was yellow.
- b) Bobby's mum's shopping bag was pink.

ToM Level 1:

- a) Bobby thinks his chocolate is in his mum's shopping bag.
- b) Bobby thinks his chocolate is in his cupboard.

#### Story 2. MUM'S BIRTHDAY

There was a little girl called Anna who had a big problem on her mind. It was her mum's birthday the very next day. Anna wanted to get her mum a birthday present, but she just didn't know what to buy. She thought and she thought. Tomorrow was nearly here! Anna remembered that her brother, Ben, had already asked mum what mum would like most of all for her birthday. Ben was out riding his bike so Anna decided to look around his room to see if she could find what present he had got for mum. Anna went in and found a big bunch of beautiful flowers with a little card that said: 'Happy Birthday Mum, love from Ben.' Anna thought to herself 'mum must want flowers for her birthday!' Just as Anna was leaving the room, Ben was coming up the stairs, but he didn't see Anna leaving his room. Anna didn't want Ben to know that she had been snooping round his room, so she said to Ben: "Ben, have you got mum a birthday present?" Ben thought for a minute, he didn't want Anna to copy him and get mum the same present, so he said: "Yes, Anna, I have. I have got mum some perfume. What have you got for her?" Anna replied: "Erm, nothing yet, Ben" and she walked away.

Memory:

- a) Ben was Anna's friend.

b) Ben was Anna's brother.

ToM Level 4:

a) Ben thinks that Anna believes that he knows that Mum wants perfume for her birthday.

b) Ben thinks that Anna knows that he knows that mum wants flowers for her birthday.

Memory:

a) Anna's mum's birthday is tomorrow.

b) Anna's mum's birthday is next week.

ToM Level 1:

a) Anna thinks Ben has bought mum some perfume.

b) Anna knows Ben has bought mum some flowers.

### Story 3. THE VIDEO DILEMMA

Sarah and Joe are in the same class at school. Sarah and Joe often sit next to each other. Their teacher is Mrs Brown. One day Mrs Brown suggests that Sarah and Joe should bring a video in to school to watch with the other children as a treat for being good in class. Mrs Brown also says to them: "Make sure you bring in something really funny that I will like too!" Sarah's favourite videos are cartoons. Joe's favourite videos are adventure films. Which will it be? Cartoons or adventure films? Joe says to Sarah: 'We just can't decide so I think that we should take in the film that Mrs Brown would like. Sarah, do you know which Mrs Brown would like best?' Sarah has a little think. She doesn't have a clue which film Mrs Brown would like! But Sarah decides to tell Joe that she knows that Mrs Brown likes cartoons best. Sarah thinks that this will make Joe decide to take cartoon videos in to school. Joe listens to this and then Joe says; "We will take in a video of cartoons then." So Sarah gets to enjoy her favourite cartoons!

Memory:

a) Joe and Sarah are in the same class at school.

b) Joe and Sarah are in different classes at school.

ToM Level 0:

a) Sarah likes cartoons better than adventure films.

b) Sarah likes adventure films better than cartoons.

Memory:

a) Mrs Brown asks Sarah and Joe to bring in something funny to watch.

b) Mrs Brown asks Sarah and Joe to bring in something scary to watch.

ToM Level 4:

a) Sarah hoped that Joe would know that she didn't know what Mrs Brown wanted.

b) Sarah hoped that Joe would believe that she knew what Mrs Brown wanted.

### Story 4. THE SCHOOL FOOTBALL TEAM

Johnny and Bob are best friends. They really enjoy playing football together. Johnny and Bob both want to play on the school football team. The school football team plays every Monday after school. Johnny thinks that he is not as good at football as Bob is. He thinks that the football manager is more likely to choose Bob for the football team. But the football manager thinks that both Johnny and Bob are good football players. He wants them both to play in the school football team. But the manager knows that Johnny doesn't think he will get on the team.

Memory:

- a) The football team play on Fridays.
- b) The football team play on Mondays.

ToM Level 3:

- a) The manager thinks that Johnny knows he wants him to be on the football team.
- b) The manager knows that Johnny doesn't know that he wants him to be on the team.

Memory:

- a) Johnny and Bob are best friends.
- b) Johnny and Bob are brothers.

ToM Level 2:

- a) Johnny doesn't know that the manager wants both him and Bob on the team.
- b) Johnny thinks that the manager wants both him and Bob on the team.

Story 5. THE TEST

Class 4 were having a spelling test on Friday. Mrs Smith, the teacher for class 4, told all the children to work really hard. Hard work meant they would do really well in the test. Kirsty wanted to do well. She wanted to please her mum. She learned all the words that she knew would be in the test. When Kirsty went into class on Friday, she told Mrs Smith that she had been learning the words all week so that her mum would be pleased with her test score. When the spelling test started, Mrs Smith turned to James first. James was a friend of Kirsty but sometimes he was rather lazy. "James," said Mrs Smith. "How do you spell balloon?" James had not been learning his spellings. He could not remember how to spell balloon. He did not know how to spell balloon. But James did remember that there was a poster in the classroom which had balloons on it. He knew the word "balloon" was written on that poster. The poster was behind Mrs Smith. She could not see it. James cheated and spelt out that word "balloon" from the poster - b-a-l-l-o-o-n. Mrs Smith said: "Well done, James, that's correct."

Memory:

- a) Kirsty worked very hard for the spelling test.

b) James worked very hard for the spelling test.

ToM Level 2:

a) Mrs Smith thought that Kirsty wanted to do well on the test.

b) Mrs Smith didn't know that Kirsty wanted to do well on the test.

Memory:

a). Class 4 were having a spelling test.

b) Class 4 were having a test about balloons.

ToM Level 3:

a) James thinks that Mrs Smith believes that he knows how to spell 'balloon'.

b) James thinks that Mrs Smith knows that he doesn't really know how to spell 'balloon'.

**Appendix 2. The Social Competence Rating Questionnaire**

- 1 = Very Inaccurate
- 2 = Moderately Inaccurate
- 3 = Neither Accurate nor Inaccurate
- 4 = Moderately Accurate
- 5 = Very Accurate

- 1. The child accepts others for what they are.
- 2. The child can admit their mistakes.
- 3. The child doesn't display an interest in the world at large.
- 4. The child doesn't think before speaking and doing.
- 5. The child is sensitive to other people's needs and desires.
- 6. The child doesn't stick with tasks.
- 7. The child is warm and caring.
- 8. The child has no knowledge of rules and norms in human relations.
- 9. The child is good at dealing with others.
- 10. The child has a large social network.
- 11. The child is disruptive in the classroom.
- 12. The child is not confident.
- 13. The child shies away from challenges.
- 14. The child has good academic performance.