Abstract

This study examined the relationship between children's developing theory of mind and their ability to engage in two social behaviours which have, as their cognitive underpinning, the representation that what one knows may not be accessible to others. Children of 3, 4 and 5 years, in a quasi-naturalistic setting, played hide-and-seek and also were required to keep a secret about a surprise. The ability to play hide-and-seek was significantly related to children's ability to refrain from disclosing the secret, and there was a significant relationship between these behaviours and children's social cognition, as measured by theory of mind tasks. The relationship between these social behaviours and tasks measuring executive function was not significant once age was taken into account. With regard to the development of these social behaviours, few 3-year-olds, but most 4-year-olds, and almost all 5-year-olds could successfully play hide-and-seek and keep a secret. This study demonstrates the importance of the conceptual understanding of mental states in the young child's social world.

Keywords: theory of mind; executive function; hide-and-seek; keeping secrets

Representing the mental world in children's social behaviour: Playing hide-and-seek and keeping a secret

Studies on children's theory of mind (ToM) have focused not on young children's social behaviour, but on their social cognition, in particular their ability to attribute a false belief in an experimental paradigm (Flavell, 2000; Wellman, Cross & Watson, 2001). But after we know what children know, we need a detailed account of how this knowledge, or lack of knowledge, is actually expressed in the social behaviour of normal populations of young children.

Such research is often difficult to carry out and is usually studied by means of naturalistic observations of children's spontaneous social interactions with known members of their community (Brown & Dunn, 1991; Dunn, 1991). However, spontaneous behaviour yields data that, by its very nature, is often infrequent, anecdotal and lacking in the controls of the experimental method.

Two social behaviours which have not been systematically studied, but appear to involve children's developing understanding of the mental world, are the game of hide-and-seek, and the ability to keep a secret about a surprise. Both of these social interactions seem to involve the conceptual understanding that what one knows may not be accessible to others. The first aim of the study was to examine these two "real-world" correlates of laboratory-based theory of mind tasks in a naturalistic, yet controlled, paradigm.

An important question is whether the two social behaviours of playing hide-and-seek and keeping a secret, both of which seem to be dependent on an understanding of the inaccessibility of one's mental states to the outer world, appear at the same time as each other. If children's maturing conception that people may differ in terms of their state of knowledge, is an important

predictor of real world social behaviour, one would expect a co-relation in the developing abilities to keep a secret and play hide-and-seek.

Furthermore, if both of these behaviours have, as their cognitive foundations, the representation that others may be ignorant of what one knows to be true, it seems likely that individual differences in the appearance of such social behaviours would be related to performance on ToM tasks. Recently there have been some attempts to combine observational and experimental methods in studying the real world consequences of children's false-belief understanding in the lives of normally developing children. Results have been somewhat mixed: While ToM performance was found not to be related to total amount of pretend play, performance was related to two observational measures of sophisticated pretend play (Astington & Jenkins,1995; Jenkins and Astington, 1996; Jenkins & Astington, 2000). Children who passed ToM tasks were observed to be better able to assign pretend roles, such as, "I'm the Mommy, you be the baby," and make joint plans, such as, "Let's go shopping." Relationships between observations of sophisticated pretend play and performance on ToM tasks have also been demonstrated by Schwebel, Rosen and Singer (1999), Taylor and Carlson (1997) and Youngblade and Dunn (1995). Studies have also found a relationship between individual differences in performance on ToM tasks and teacher ratings of social-emotional maturity (Lalonde and Chandler, 1995); teacher ratings of social skills with peers (Watson, Nixon, Wilson & Capage, 1999); emotion understanding (Hughes and Dunn, 1998); boys' moral justifications (Dunn, Cutting & Demetriou, 2000); and mental state talk (Brown, Donelan-McCall, & Dunn, 1996; Hughes and Dunn, 1998). However, while success on experimental tasks involving deception has often been used as a proxy for ToM understanding (Hala & Chandler, 1996; Peskin, 1996), a recent longitudinal study (Newton, Reddy & Bull, 2000) found no correlation

between both the quantity and variety of young children's everyday deceptions - as observed by their mothers - and their performance on a battery of ToM tasks.

Another mechanism which may play a role in the development of children's social behaviour is executive function. Executive function is a broad and not clearly specified term which covers those processes needed to hold in mind a goal amidst distracting alternatives (Griffith, Pennington, Wehner, & Rogers, 1999; Hughes, 1998). It covers functions such as inhibitory control (inhibition of a prepotent but irrelevant response) and working memory, although these processes themselves are highly interrelated. There is strong evidence that theory of mind development is related to executive control (Carlson & Moses, 2001; Carlson, Moses and Hix, 1998; Zelazo and Frye, 1998), although the explanation for these observed developmental correlations is still not well understood (Perner, Lang & Kloo, 2002). Individual differences in executive function may also contribute to variation in children's developing social behaviours. For instance, not divulging a secret, as well as successfully playing hide-and-seek, both require an ability to inhibit a response. In hide-and-seek, for instance, the child must remain hidden when playing the role of hider, and not peek when acting as the seeker. When told a secret about a surprise, the child must refrain from disclosure. Performance on tasks measuring executive function has been found to correlate negatively with anti-social behaviour and poor understanding of emotion in hard-to-manage preschoolers (Dunn & Hughes, 2001; Hughes, Dunn & White, 1998; Hughes, White, Sharpen & Dunn, 2000); however, little is known about the contribution of executive function to variability in typically-developing children's social behaviours.

A second aim was to examine the ages at which children begin to successfully play hide and seek, and keep a secret about a surprise. While experimental paradigms have often involved

concealing information about or hiding *objects*, usually in partnership with a play character (Baron-Cohen, 1992; Bridges & Rowles, 1985; Freeman, Lewis and Doherty, 1991; Hala & Chandler, 1996; Hughes & Donaldson, 1979; Peskin, 1992; Sodian, 1991; Szarkowicz, 1999), the development of children's actual behaviour when they have to hide themselves in the popular, universal and age-old game of hide-and-seek, has not been investigated.

What we know is largely anecdotal. Perner (1991), for instance, cites an anecdote involving Heinz Wimmer's three-year-old son, Theo.

"Heinz is hiding in the pantry. After some searching Theo finds him. Heinz asks, 'How did you know I was in here?' to which Theo answers, 'Because I opened the door.' Then it is Theo's turn to hide. Right in front of Heinz (!) he 'hides' in the pantry. Heinz plays along and calls out, 'Where are you?' Theo giggles and answers, 'in the pantry.'" (p. 153).

There has also not been systematic research on when children develop the ability to keep a secret about a surprise. In the 1920's, the French psychologist, Janet, noted that children's discovery of the concept of a secret is a huge achievement in that it signals an understanding of an 'inner' world separate from that of the 'outer' world (Meares & Orlay, 1988). The child can now represent that someone else may not know something that the child knows to be true. Using a semi-structured interview, Meares & Orlay found that, during children's fifth year, they developed a concept of secrecy, but these authors did not study children's actual behaviour in keeping a secret. Later research on when children keep secrets has been motivated by the need to validate eyewitness testimony in child abuse cases, and has involved older children (Watson & Valtin, 1997) and/or the concealing of a transgression (Pipe & Goodman, 1991; Wilson and Pipe, 1996).

In the present study, in a staged situation to elicit quasi-naturalistic social interaction, children from the ages of 3 to 5 years were shown a birthday cake that was to be a surprise for an experimental confederate. The children were told that this was a secret. Each child also engaged in hide-and-seek play. In addition to observations of the children's social behaviours, children were given two ToM tasks and two tasks designed to measure executive function.

Method

Participants

The participants were 54 children who attended a private laboratory school attached to a University. The children came from middle to upper middle class families, and with the exception of two children, English was the first language. The children were drawn from three age groups: 18 participants of 3 years (11 girls and 7 boys; mean age 3-7, range 3-0 to 3-11), 18 participants of 4 years (8 girls and 10 boys; mean age 4-6, range 4-1 to 4-11) and 18 participants of 5 years (8 girls and 10 boys; mean age 5-5, range 5-1 to 5-9).

Procedure and Materials

In order for the children to play hide-and-seek with the experimenter, it was important that the 3-year-olds, in particular, feel very comfortable. With this purpose in mind, the experiment was carried out in the school's kitchen, a room which had positive associations for the young children because it was the location of their weekly baking class. Furthermore, prior to the formal part of the testing, each child engaged in hide-and-seek play using playfigures in a large doll's house set up in the kitchen. It should be noted, in addition, that rotating student teachers were always present in the classrooms of this laboratory school, and the children were therefore at ease with new adults.

Children were tested individually. The testing was carried out by the experimenter (E) and confederate (Vicky) and an attempt was made to create a set up that was as naturalistic as possible.

<u>Setting the stage</u>

First the stage was set for both the secret and for videotaping the child while playing hide-and-seek: E opened the refrigerator and pointed out food for the teachers' lunch. She then told the child that today was Vicky's birthday. Vicky chatted about her birthday and how she had received a video camera as a gift. E said, "Vicky, why don't you get your new camera and show it to (child's name)." While Vicky left the room, ostensibly to get the camera, E excitedly unwrapped an opaque plastic bag in which was an iced and brightly decorated birthday cake. E told the child that she was only going to give it to Vicky when school ended so Vicky could take it home to her family. E continued in a hushed, conspiratorial voice, "It's a secret. Don't tell Vicky the secret. Let's put the cake back in the bag before Vicky comes back." The cake was fully covered but remained on the kitchen table. Vicky then re-entered the room and excitedly showed the child her video camera saying, "I'm going to try it out right now."

Each child then played hide-and-seek with playfigures in a large "Sailor Moon" doll's house. E introduced it saying, "Here is a Daddy and here is a little girl/boy. The little girl/boy says, 'Daddy, will you play hide-and-seek with me?' The Daddy says, 'Sure, I will.' (To the child) You hold the Daddy and the little girl/boy, and let them play hide-and-seek." Vicky videotaped the child's play so that they would become quite relaxed with the camera for the formal part of the testing.

After setting the stage, formal testing began. The child was asked, "Tell me how you play hide-and-seek," and the answer was recorded. This was followed by observations of two social

behaviours, performance on two ToM tasks, and two executive function tasks, all given in counterbalanced order.

<u>Social behaviours</u>

Hide-and-seek

E told the child, "Now you and I are going to play hide and seek in the kitchen. Let's look at some hiding places where we can hide." E pointed out four different hiding places: under the eating table covered with a table cloth; under the kitchen sink which had been closed in using a sheet; and inside two empty cupboards. Then, to make the young children feel comfortable, E climbed under the table and asked the child to join her, saying, "Isn't this a cozy hiding place." Next, she hid with the child under the kitchen sink, again saying, "Isn't this a cozy hiding place." E then said, "I don't know how to play hide-and-seek very well, so you tell me how we should play." If there was no response, E continued, "What should I do now? You tell me how we're going to play." A round of hide-and-seek was played, based on the child's instructions, such as, "You be the hider," or "You count." Then, if the child did not spontaneously tell E to switch the hider/seeker roles, E asked, "Ok, now what do we do? What happens now?" If more help was needed, E said, "Now we're going to play again. What do we do this time?" E followed the child's instructions even for the few who did not appear to understand that each person should have a different role. This will be discussed in greater detail in the qualitative description of children's hide-and-seek play in the results section. No attempt was made to correct a child. Vicky videotaped the hide-and-seek game. Only one of the three-year-olds refused to play and was excluded from the study.

To be scored as successfully playing the game of hide-and-seek, the child needed to demonstrate an understanding of the game as one involving mental states, in that the seeker is

ignorant of the hider's location. In operational terms, if children made any one of the following errors they were scored as not correctly playing the game: When hiding, if the child told E where he or she was going to hide; did not attempt to hide from view; hid before E's vision was blocked; or did not remain physically hidden and quiet. When playing the role of the seeker, if the child told E where to hide; or if the child did not turn around and/or cover his or her eyes; or if the child peeked. Any of the above errors, whether hider or seeker, disqualified the child from being scored as successful. The no-peeking part of the criteria might appear to be stringent, as even children who can well-represent mental states do "cheat." However, Vicky was standing just a few feet from the child, "trying out" her video camera, which effectively eliminated any possibility of successful cheating. No 5-year-olds cheated. One 4-year-old began to peek as E was looking for a place to hide, but glanced at the video camera and did not cheat again.

Although an attempt was made to create some kind of quantitative scale of the children's performance, difficulties arose in deciding how to weight such a scale, and more importantly, a scale exaggerated the problem of children's differential experience in playing hide-and-seek. For instance, children who have a lot of experience playing hide and seek might be quite adept at much of the game, but may reveal, in just one way, that they do not understand that it is a game which involves knowledge states. Such a child would obtain a high score on a scale, whereas a less experienced child would obtain a low score, yet both children are identical in not understanding that the seeker must be ignorant of the hiding place. For these reasons it was decided to simply assign a score of "0" - or fail - if the child made any one of the errors described above, and a "1" if no errors were made. A qualitative description of the children's hide-and-seek behaviour will be given in the results section.

Keeping a secret

E made an excuse to leave the room leaving Vicky alone with the child. Vicky said, "I'm very hungry. I wonder whether there is anything to eat in this kitchen." Vicky repeated this twice, noting whether the child pointed to, or told about the birthday cake hidden in the bag, or whether the child was able to keep the secret (usually telling Vicky to look for food in the fridge). Children who pointed to the cake and/or told Vicky that there was a birthday cake, received a score of "0." All others received a "1."

ToM tasks:

Location

The experimenter acted out the task using the doll's house and playfigures. "The boy has a dinosaur. He puts it away in his school bag. He goes upstairs. While he's gone his sister takes the dinosaur out of the schoolbag. She plays with it, then she puts it away. She puts it away in the box. Then the girl goes outside. The boy comes back. He wants to play with his dinosaur." The child was asked the false belief Location question, "Where does the boy think the dinosaur is?" and two control questions, "Where is the dinosaur really?" and "Where did he put the dinosaur before he went upstairs?"

Contents-Self and Contents-Other

The child was shown the box of a videotape apparently starring "Franklin," a favorite story/video character, and asked, "What do you think is inside this box?" After answering, the child opened it to find Lego pieces inside. The Contents-Self question was then asked, "What did you think was inside this box before you opened it?" This was immediately followed by the Contents-Other question about Michael, a child in the class who had not yet been tested: "Michael hasn't yet seen inside this box. When he comes in, what will he think is inside it before he opens it."

There were, therefore, three ToM experimental questions altogether, that is, Location, Contents-Self, and Contents-Other. Children were given a score of "1" for pass and "0" for fail for each of these three questions.

Executive function tasks:

Two frequently used tasks were given which required children to respond counter to a prepotent tendency (Carlson & Moses, 2001):

Day/night task

This was based on the Stroop-like task adapted by Gerstadt, Joo Hong, & Diamond (1994). E initially confirmed that children associate a black card showing the moon with 'night time' and a white card showing a large sun with 'day time'. The children were then shown the moon card and told, "When you see this card, I want you to say 'day' _____ Can you say 'day' again?" The child was then shown the sun card and told, "When you see this card, I want you to say 'night'_____ Can you say 'night' again?" E then showed each of the two cards again, asking, "What do you say for this one?" When the child was correct on both cards, the test began. If the child was not correct, E repeated the rules and the two practice trials. If necessary this was to be repeated once more, that is up to six trials but, in fact, no child needed more than two sets of trials. Each child then received 12 trials without feedback in a fixed random order so that their final score was out of 12. If the child used a different term from that of E, for instance, "dark" instead of night, or "morning" instead of day, this was counted as correct.

Card sort

This was based on the dimensional change card sort task (Frye, Zelazo & Burack, 1998; Zelazo & Frye, 1998). The child was instructed to sort cards according to one dimension (shape or color) and later asked to sort by the other dimension, thus requiring them to inhibit the

previous sorting rule. Materials consisted of two shallow boxes with a ten inch high board attached to the back of each. On one of the boards was a drawing of a red flower, and on the other, a blue car. E then showed the child a stack of cards depicting either a blue flower or a red car. The test instructions were the following: "We are going to play a game. This is the colour game. The colour game is different from the shape game. In the colour game, all the red ones go in this box (point to the red flower), and all the blue ones go in that box (point to the blue car). Let me try a couple of turns first. All the red ones go here, and all the blue ones go there. Here's a red one. I'll put it in this box because that's where the red ones go in the colour game." To be repeated on every trial: "All the red ones go here, and all the blue ones go there. Here's a red/blue one. Where does it go?" Each child received six pre-switch trials, with the cards presented in a random order. Feedback was given only after the first trial.

The post-switch instructions were, "Ok, now we are going to switch. We are not going to play the colour game anymore; we are going to play the shape game. The shape game is different from the colour game. In the shape game, all the cars go in this box, and all the flowers go in that box." To be repeated every trial: "All the cars go here, and all the flowers go there. Here's a car/flower. Where does it go?" Each child received six post-switch trials with no feedback, and their score was out of six for the post-switch trials. Half of the children, in counterbalanced order, received the shape game first and had to switch to the colour game.

Results

With regard to the practice trials on the Day/night task, only four 3-year-olds and one 4-year-old did not succeed on the first two practice trials. As these numbers were so low, following Gerstadt et al (1994) the practice trials were used only to ensure that the children

understood what we were asking of them, and the dependent measure was the number of correct

trials after the practice trials.

Results will be reported as follows: First, differences between the three separate age

groups, 3-year-olds, 4-year-olds, and 5-year-olds, when playing hide and seek and keeping a

secret will be described. Secondly, the relations between individual differences in social

behaviour (hide-and-seek and keeping a secret), social cognition (ToM tasks), and tasks

measuring executive function will be provided for the total sample of children. Thirdly, there

will be a qualitative description of children's hide-and-seek play.

Group differences in playing hide-and-seek and keeping a secret

As can be seen in Table 1, when playing hide-and-seek, only 3 (17%) of the 3-year-olds

ensured that the seeker did not know where the hider was hidden. However 14 of the 4-year-olds

(78%) and 17 of the 5-year-olds (94%) demonstrated an ability to play hide-and-seek

appropriately. A two-way contingency table analysis demonstrated that the relationship between

age and playing hide-and-seek was significant, Pearson χ^2 (2, $\underline{N}$ = 54) = 25.9, $\underline{p}$ = .001.

Similarly, there was a significant relationship between age and telling a secret. While

only 6 (33%) of the 3-year-olds kept the secret, 12 (67%) of the 4-year-olds and 16 (89%) of the

5-year-olds refrained from disclosure, Pearson χ^2 (2, $\underline{N}$ = 54) = 12.07, $\underline{p}$ = .01.

--- Insert Table 1 about here ---

The children's performance on the ToM and executive function measures is also shown

on Table 1. It is worth noting that, within each of the three age groups, the total number of

children who successfully played Hide and Seek and kept a secret was similar to the total number

of children succeeding on the Theory of Mind tasks. It is more difficult to make such

comparisons for the executive function tasks as EF tasks traditionally involve a number of trials.

Relations between individual differences in social behaviour behaviour, ToM, and executive function

A χ^2 analysis was carried out to examine whether there was a significant relationship between the three false belief questions, that is, Location, Contents-Other, and Contents-Self. Contents-Other and Contents-Self were significantly related, Pearson χ^2 (1, $\underline{N}$ = 54) = 35.729, $\underline{p}$ < .001, Phi = .813, and Location was related to both Contents-Self, Pearson χ^2 (1, $\underline{N}$ = 54) = 12.834, $\underline{p}$ < .001, Phi = .488, and Contents-Other, Pearson χ^2 (1, $\underline{N}$ = 54) = 17.182, $\underline{p}$ < .001, Phi = .564. Because the tasks appeared to be tapping a common underlying construct, a ToM aggregate score (number correct out of the three questions) was calculated for each participant.

Similarly, the two social behaviours of hide-and-seek and keeping a secret were found to be significantly related, Pearson χ^2 (1, $\underline{N}$ = 54) = 19.63, $\underline{p}$ = .001, Phi = .603, and were, therefore, aggregated to comprise a social behaviour measure (SB aggregate).

The raw correlations between the two measures of Card sort and Day/night were also significant, $\underline{r}$ (52) = .28, $\underline{p}$ < .05 and were, therefore, standardized and aggregated to create an executive function aggregate measure (EF aggregate). While this correlation may appear somewhat weak, most EF tasks have been found to have only weak to moderate relationships with each other, and a correlation of .28 would be above the median in, for instance, the large study on ten EF tasks by Carlson & Moses (2001).

As can be seen in Table 2, all the raw correlations between the individual ToM and executive function measures and the two social behaviours were significant. These measures were significantly related to age, but not to gender. The analyses were, therefore, rerun controlling for age in months.

--- Insert Table 2 about here ---

The partial correlations carried out on the non-dichotomous variables in the data set can be seen in brackets in Table 2. The relationship between the social behaviour aggregate measure and the ToM aggregate remains statistically significant even after controlling for age, but the social behaviour aggregate is no longer significantly correlated with any measure of executive function.

To control for age among the dichotomous variables, logistic regressions were carried out with hide-and-seek and keeping a secret as the dependent variables. In each analysis, age was entered on the first step and the various ToM or executive function measures were entered on the second step. The effect of age was significant in every model at the .001 level and will not be further reported. The results of these incremental tests on step 2 of the models can be seen in Table 3. The significant relationship between hide-and-seek and the ToM Location task, as well as the significant relationship between keeping a secret and the Contents-Other task are intriguing. Both hide-and-seek and Location involved the representation of ignorance regarding the location of the hidden object or person; and both keeping a secret and Contents-Other involved the representation of someone else's ignorance regarding what was inside a container.

--- Insert Table 3 about here ---

A further logistic regression showed that there was a significant relationship between the two social behaviours themselves even after controlling for age in months. With hide-and-seek as the dependent variable, age was entered on the first step and keeping a secret was entered on the second step, χ^2 (1, $\underline{N} = 54$) = 4.53, $\underline{p} < .05$.

Finally, because the aggregate of the ToM tasks was significantly related to the aggregate of the executive function tasks even after age was partialled out, $\underline{r}$ (51) = .33, $\underline{p} < .05$, it was decided to partial out executive function in addition to age. The aggregate of the ToM

measures was still significantly correlated with the aggregate of the social behaviours, $\underline{r}$ (50) = .38, $\underline{p}$ < .01 after controlling for both age and executive function.

To control for age and executive function among the dichotomous variables, logistic regressions were carried out where age and executive function are entered on the first step. As can be seen in Table 4, being able to keep the secret continues to be significantly related to Contents-Other as well as to the ToM aggregate, but the relation between hide-and-seek and the ToM location task is reduced slightly and is no longer significant.

--- Insert Table 4 about here ---

Qualitative description of children's hide-and-seek play

With regard to children's responses to the question, "Tell me how you play hide-and-seek," 17 (94%) of the 3-year-olds mentioned the two roles in the game structure, that is, hiding on the one hand, and counting or finding on the other, for instance, "Someone hides. Someone counts." Or "hide and find." Or "A person counts and you hide. And then it's your turn, the other person's turn." Other than a few missing pronouns, these responses were no different in structure or detail from the responses of the successful 4- and 5-year-olds. While this does not mean that the 3-year-olds' understanding of the word "hide" was the same as that of the older children, that is, involving a representation that the seeker should be ignorant of the hiding place, it does demonstrate that the younger children knew the surface rules of the game. However, their performance was poor.

Of the 20 children who failed the hide-and-seek task, three 3-year-olds and one 4-year-old did not follow the role distribution within each round of hide-and-seek: Three of these children told E to hide and then the child also hid; and one child set up two seekers and no hider, instructing E, "You go to the door and I'll go to the fridge and we'll both look in different

places." Of the remaining 16 children who failed hide-and-seek, 14 of the children did not correctly play the role of the hider, for instance, telling E where he or she was going to hide (two children); and/or hiding before the seeker turned around (six children); and/or not attempting to hide from view (three children); and/or not remaining physically hidden (seven children) and/or not remaining quiet (two children). In the role of the seeker, 11 of the children did not ensure that they remained ignorant of the hiding place, for instance, instructing the hider where to hide (seven children) or facing the hider and counting with their eyes open (four children).

An interesting observation was that of a ritualistic hide-and-seek routine. This was an accidental finding resulting from the small space into which E - when playing the role of the hider - had to squeeze herself, which left clear bulges in the sheet so that the children knew where she had hidden. This did not affect the aim of the research, which was to examine whether children knew to remain ignorant of E's hiding place while they were counting; and it usually helped E by shortening the time she had to spend crouched in a hiding place. It did, however, allow the observation of four children (three who failed hide-and-seek and one who passed) carrying out a mock search, pretending to search for E in other places, loudly verbalizing, "She's not here. She's not here," before lifting the cover, with a loud, "Here she is."

Discussion

This study found that children's developing ability to think about the mediating role of the mental world, as determined by tasks that measure a false belief, contributed to variability in their actual social interactions. The behaviours of playing hide-and-seek and keeping a secret were significantly correlated both with each other and with children's performance on ToM tasks even after controlling for age in months and executive function. With regard to the development

of these social behaviours, few 3-year-old children, but most 4-year-olds, and almost all 5-year-olds, could successfully play hide-and-seek, and refrain from disclosing a secret about a surprise.

In examining the particular types of mental representations required in social behaviours, there is evidence of a rather intriguing relationship: First, after controlling for age, there was a significant correlation between having to represent someone's ignorance of an object's hidden location in the false belief Location task, and representing a person's hidden location in actual social behaviour when actually playing hide-and-seek. Secondly, after controlling for both age and executive function, there was a significant relationship between having to represent someone's ignorance of what is inside a container in the false belief Contents-Other task, and representing someone's ignorance about the cake (contained in an opaque bag) when keeping a secret. That there could be a relationship between specific types of mental representations and types of behaviour was not anticipated and should be further investigated.

With regard to executive function, although the children had to inhibit the telling of the secret about the birthday cake, and needed to remain quietly hidden when playing hide-and-seek, there was not a significant relationship between these social behaviours and measures of inhibitory control once age was partialled out. As discussed in the introduction, the relationship between executive function and social behaviour has previously been studied with atypical populations. For instance, poor performance on tasks of inhibitory control is significantly related to poor understanding of emotion and anti-social behaviour in hard-to-manage children (Dunn & Hughes, 2001; Hughes, Dunn & White, 1998; Hughes, White, Sharpen & Dunn, 2000). In the current study, however, a typically-developing population of young children engaged in normal social activities, and inhibitory control did not contribute to variability. This is interesting in that, in the present study, as in previous studies (Carlson & Moses, 2001; Zelazo and Frye, 1998),

executive function was significantly related to children's ToM. Inhibitory control seemed to play a role in tasks that aim to measure children's social *cognition*, but, did not appear to play a significant role in the children's social *behaviour.* Russell (1996) proposed two possible accounts of the relationship between executive function and theory of mind. In a "performance" account, immature executive function prevents young children from demonstrating their knowledge. In the more deep-seated "competence" account, difficulty with executive function prevents children from thinking about the mental world and actually impedes conceptual development. The present study provides some evidence that the relationship between individual variability in executive function and the ability to represent that one's mental states may not be accessible to others, is a result of performance issues rather than competence, as the relationship between executive function and mental state representation appears to be task-specific: On ToM tasks, which are somewhat artificial and outside the realm of young children's usual activities, executive function was significantly related to task performance. On the other hand, when children were emotionally engaged in actual social interactions which required the representation of the mental world, individual variability in inhibitory control was unrelated to their success in concealing a secret and playing hide-and-seek.

In Piaget's writings on the language and thought of the developing child, he seemed to wrestle with the contributory roles of the two mechanisms that have been examined in the current research - inhibiting one's natural tendency, as well as thinking about other people's points of view. He writes that "the child up to an age as yet undetermined, but probably somewhere about seven, is incapable of keeping to himself the thoughts which enter his mind. He says everything. He has no verbal continence" (1926/1955, p. 59). This would appear to be an explanation in terms of not being able to inhibit one's responses. However, in a later comparison

of the child and the adult, Piaget describes the child as having "less verbal continence simply because he does not know what it is to keep a thing to himself. Although he talks almost incessantly to his neighbor, he rarely places himself at their point of view" (1926/1955, p. 60). In the present study, where 3-year-olds blurted out the secret, there appears to be some support for Piaget's assertion that the lack of "verbal continence" is because the child does not yet think about the mental world of another: Between the ages of three and five years the ability to inhibit one's responses did not seem to play a role in individual variability in keeping the secret, but the ability to take another's "point of view" as required in the ToM tasks, was shown to be significantly related.

On the other hand, differing from Piaget's predictions regarding age norms, the present study showed that children were able to keep a secret well before the age of "seven." Two-thirds of the 4-year-olds and nearly 90% of the 5-year-olds in the study did not reveal the secret. It should be noted that these children came from middle to upper middle class homes, and the age of success on ToM tasks, for instance, is somewhat later when the sample is from low income families (Astington, 2000).

Previous studies on keeping a secret have examined secrets involving a transgression, such as breaking a toy, where disclosure would result in an offender getting "into trouble" (Pipe and Goodman, 1991). In the present study, however, the secret involved positive affect in that disclosure was likely to result in pleasure. Despite this difference in the specificity of the secret, the developmental trajectory appears similar, with few 3-year-olds but many to most 5-year-olds being willing to conceal the transgression or the surprise. The exact numbers in the telling of any secret will of course be dependent on the context within the secret is embedded. For instance, in the present study, having the cake in view, and Vicky announcing that she was hungry, most

likely influenced the younger children to blurt out the secret. More interesting, however, is that, despite Vicky's announcement and the cake in front of them, only one 5-year-old revealed the surprise birthday cake. By the age of 5 years, children could well represent Vicky's ignorance.

With regard to the game of hide-and-seek, Garvey (1990) notes that games are play activities that have become institutionalized. They involve an explicit set of rules that have been learnt. And Piaget (1962) writes that playing marbles and hide-and-seek are closely related in that "in both cases there are rules which have been handed down by the social tradition of children" (1962, p. 108). He later comments, "Games with rules rarely occur before..age 4-7" (Piaget, 1962, p. 142). In the present study nearly 80% of the 4-year-olds successfully played hide-and-seek, which makes the game a very early example of a rule-based game. The study examined not only the children's actual behaviour but also their explanation as to how one plays the game, and while 3-year-olds could not successfully play hide-and-seek, they could successfully state the primary rule of the game. As discussed in the qualitative results section, other than a few missing pronouns, as in a response such as "Hide and find," their rule explication was no different from that of the 5-year-olds. Katherine Nelson, in describing language development, writes that there is often use before conceptual understanding (Nelson, 1996). Enculturation before conceptual understanding can also be seen when children tell faulty riddles, laughing uproariously before understanding the concept of a riddle (Olson, 1994). In the case of hide-and-seek, while 3-year-olds did not understand the point of the game - that the seeker must be ignorant of the hiding place - all but three of them appeared to have had experience in following the surface rules of hide-and-seek, that is, a turn taking routine whereby one person hides while the other person counts and then searches, which is then followed by a role change. The influence of culture was further evident when a few children demonstrated a

ritualized routine, often carried out by parents, of pretending to seek in the wrong place even when the correct hiding place was known.

In addition to the conceptual and cultural components of the game of hide and seek, there is an affective component. In this study the situation was staged in order to elicit fairly naturalistic social interaction. There was an attempt to bring the social world, with its emotional content and vividness into the laboratory. The children seemed genuinely excited by the secret birthday cake, and intensely engaged in their playing of hide and seek. As described in the qualitative results section, nine of the children, when hiding, attracted attention to themselves by giggling loudly or jumping out of the hiding place before being found. Is it possible that these children understood the point of the game but that it was emotionally more satisfying to make themselves known? From an early age children find the notion of disappearance and appearance pleasurable and engaging. In a study on young children playing "peekaboo," Bruner talks about a "preadapted readiness to respond to disappearance and reappearance" (p. 72), and Bower (1971) has shown that the "looming" nature of the appearance in peekaboo produces much excitement. In the current study it was as if some of these children were playing peekaboo, delighted to be found. However, while this delight may have been rewarding, it is more likely that playing hide-and-seek as peekaboo is a result of not understanding the importance of mental states: All but three of these nine children demonstrated in an additional manner that they did not understand the point of hide-and-seek, most commonly by failing to be ignorant of E's hiding place when playing the role of the seeker.

In conclusion, the study found that few 3-year-old children can successfully play hide-and-seek and keep a secret. These two social behaviours share, as their cognitive underpinning, the need to represent someone's ignorance of what the child knows to be true, and to act on this

knowledge by concealing information. Not only was the onset of successful performance on both of these social behaviours related to each other, but successful performance appears to be related more to young children's developing ability to represent someone's ignorance, than their developing ability to inhibit a salient response. This study supports the importance of a conceptual understanding of mental states in the development of young children's social behaviour.

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TABLE 1

Total number of children in each age group (n = 18) who passed tasks assessing social behavior and ToM, and total number of children as well as mean performance on tasks measuring executive function.

	Age groups		
Task	3-year-olds	4-year-olds	5-year-olds
Social Behaviors			
Hide & Seek	3	14	17
Keep Secret	6	12	16
ToM			
Location	8	12	16
Contents-Self	7	13	18
Contents-Other	3	13	17
Executive Function			
Card Sort			
All trials correct	9	13	18
Mean score out of 6 trials	3.7	5.1	6
Day/Night			
All trials correct	5	8	17
Mean score out of 12 trials	8.2	9.9	11

TABLE 2

Correlations between measures of social behaviour, ToM and executive function

	ToM				Executive Function		
	Location	Contents-Self	Contents-Other	ToM Aggregate	Card Sort	Day/Night	EF Aggregate
Social Behaviors							
Hide and Seek	.52 ***	.51***	.57***	.62***	.47***	.49***	.59 ***
Keep Secret	.43 ***	.51***	.65***	.62***	.47***	.32*	.50***
SB Aggregate	.53***	.57***	.68***	.69*** (.42**)	.52*** (.21)	.45**(.10)	.61***(.24)
Executive Functions							
Card Sort	.50***	.50***	.46***	.56*** (.30*)			
Day/Night	.35**	.40**	.41**	.45*** (.13)			
EF Aggregate	.54***	.57***	.55***	.64*** (.33*)			

Note: For the non-dichotomous variables, partial correlations controlling for age in months are shown in parentheses. N = 54

* = p ≤ .05   ** = p ≤ .01   *** = p ≤ .001

TABLE 3

Predictions of measures of social behavior from ToM and executive function, controlling for age: Step 2 χ_2 (df=1) from logistic

regressions where age is entered on first step

	ToM				Executive Function		
Social Behaviors	Location	Contents-Self	Contents-Other	ToM Aggregate	Card Sort	Day/Night	EF Aggregate
Hide and Seek	3.75*	.94	.86	.11	.41	1.04	.24
Keep Secret	2.50	2.84	7.91**	6.43**	1.89	.00	.32

* = $\underline{p} \le .05$ ** = $\underline{p} \le .01$ *** = $\underline{p} \le .001$

TABLE 4

Prediction of measures of social behavior from ToM controlling for age and executive function:

Step 2 χ_2 (df=1) from logistic regressions where age and EF are entered on first step

Social Behaviors	ToM			
	Location	Contents-Self	Contents-Other	ToM Aggregate
Hide and Seek	3.02	.69	.66	2.04
Keep Secret	1.43	2.11	7.37**	5.14*

* = p ≤ .05   ** = p ≤ .01   *** = p ≤ .001