Theory of Mind and Social Behavior: Causal Models Tested in a Longitudinal Study

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The aim of this study was to test two competing causal models concerning the relationship between children’s social behaviors and theory of mind. Children between 3 and 4 years of age (n = 20) at the time of first testing were assessed three times over approximately 7 months. Theory of mind was assessed using false belief tasks. Children were videotaped during play with a friend, and measures of pretend play, joint planning, and explicit role assignment were made on the basis of transcripts. Theory of mind understanding was found to predict joint planning and role assignment, after taking into account initial performance on joint planning and role assignment, as well as contemporaneous language ability and age. There was no evidence that social behaviors predicted children’s theory of mind.

Children’s understanding of their own and others’ minds undergoes a profound change toward the end of the preschool years. Children come to realize that another person may have and act on beliefs that are different from their own, and therefore false from their point of view (Wimmer & Perner, 1983). They recognize that they themselves may sometimes hold false beliefs (Gopnik & Astington, 1988). They understand that an object may appear different from what it really is, so that they or another person might hold a false belief about its identity (Flavell, Flavell, & Green, 1983). The contemporaneous development of these insights leads to what is called children’s representational theory of mind (Astonigton, Harris, & Olson, 1988).

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The term "theory of mind" also has been used more broadly to refer to children's social understanding, as revealed in their talk about people's thoughts, intentions, and desires. This development usually begins in the second year of life (Bretherton, McNew, and Beeghly-Smith, 1981). Here we use the term theory of mind in a narrower sense. We use it to refer to the attribution of false belief and the ability to distinguish between appearance and reality that emerges when children are between 3 and 4 years old. Our focus in this paper is on relations between this specific aspect of theory of mind and children's social behavior.

The development in children's ability to represent their own and others' beliefs might be expected to have important consequences for children's social interactions. A general assumption is made that this is the case (Moore & Frye, 1991), although until recently there has been little study of relations between children's theory of mind and their behavior in natural settings. Some authors have remarked on changes in children's behavior, such as the way they play hide-and-seek, that develop around the same age as that at which they start to pass false belief tasks (Perner, 1991; Wellman, 1990). More to the point, some recent empirical studies directly relate social behavior to theory-of-mind task performance (Aston- ton & Jenkins, 1995; Frith, Happe, & Siddons, 1994; Lalonde & Chandler, 1995; Taylor, Gerow, & Carlson, 1993). However, in only one project have such relations been examined over time (Dunn, 1995; Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991; Youngblade & Dunn, 1995).

Children with autism have severe difficulties with social interaction and generally fail false belief tasks. The minority who pass false belief tasks are rated more highly for both social and antisocial behaviors that depend on recognizing and manipulating other people's mental states (Frith et al., 1994). Likewise, 3- and 4-year-olds' false belief task performance correlates with ratings of their social maturity on a subscale of items judged to require understanding other minds (Lalonde & Chandler, 1995). Three- and 4-year-olds who score higher on a composite theory-of-mind measure also engage in more fantasy and pretend, controlling for age and verbal intelligence (Taylor et al., 1993). Considering relations over time, children aged 3;4 who were able to explain actions based on false beliefs had engaged at the age of 2;9 in more role enactment in pretend play, participated in more conversation about feelings and causal relations, and cooperated more with their siblings (Dunn et al., 1991; Youngblade & Dunn, 1995). Later, in kindergarten, these children were more likely to understand conflicting emotions, showed more sensitivity to criticism, and had more negative perceptions at the beginning of the school year than children who failed the false belief explanations task at age 3;4 (Dunn, 1995).
The correlations described in all of these studies suggest that the experimental assessment of children's theory of mind, using false belief and other tasks, is tapping a genuine change in children's cognition, because this change is associated with naturally occurring everyday behaviors. Some authors suggest that the association found between pretense and theory of mind is consistent with the view that early pretend play encourages the development of theory of mind (Flavell, Flavell, & Green, 1987; Taylor et al., 1993; Youngblade & Dunn, 1995). Nonetheless, all of them refrain from making causal claims from their findings.

Similarly, when we found that performance on false belief tasks was correlated with proposing joint activities and assigning roles in pretend play, we conceded that we could not make any claim about the direction of causality that might be operating (Astington & Jenkins, 1995). In that study 30 children aged 3;1 to 5;5 were given four false belief tasks and a standard test of language ability, and they were videotaped during 10 min of pretend play. Controlling for age and language ability, we found significant correlations between false belief task performance and the frequency with which children explicitly made joint proposals or assigned roles to themselves or another during the pretend play. False belief understanding was not related to the amount of pretend play, only to these specific aspects of the play.

These findings were consistent with the hypothesis that pretend play supports theory-of-mind development. However, they are equally consistent with the alternative view that developing an understanding of others' minds changes the nature of children's pretend play, increasing the frequency with which children generate explicit joint plans and make explicit role assignments. We argued that the ability to simultaneously represent multiple and contrasting beliefs will lead to social behavior in which multiple roles are adopted by participants and plans with multiple agents are proposed between people, precisely because such social skills rely on the simultaneous representation of multiple belief states. The acquisition of false belief understanding makes children more likely to see the need to be explicit within the ambiguous context of pretend play because they understand that beliefs can differ between people. They are more likely to initiate joint plans because this ability to hold in mind multiple and potentially conflicting beliefs allows them to be more skilled in coordinating their own plans, intentions, and beliefs with those of other people. The alternative causal model would argue that practice in generating joint plans and making role assignments leads to the development of false belief understanding.

The present study was designed to test these competing hypotheses. We hypothesize that the development of a theory of mind has conse-
quences for children's ability to interact with other people, which is seen in the quality of their pretend play. As children acquire the ability to represent their own and others' beliefs, they develop social behaviors such as the ability to make plans with another child, and to communicate explicitly about aspects of play that may be ambiguous. Hence, in this study we test such a causal model of the relationship between children's theory of mind and their social behaviors during interaction with other children.

METHOD

Participants

Twenty children in the nursery class at a university laboratory school were the participants in this study. They were between 34 and 45 months old when the study commenced, and data collection continued for 7 months. At the laboratory school, parents give written consent at the beginning of each school year to a general class of studies involving cognitive and social-emotional measures. Children give their verbal consent to participation.

Procedure

Children were assessed on all measures at three time points approximately 3.5 months apart. At each point, theory-of-mind tasks and a general test of language ability were administered and children were videotaped during play with a partner.

Measures

Theory of mind. The children were given three theory-of-mind tasks at each time. The order of the tasks and of test questions within tasks was counterbalanced across children. One task was a standard "change in location" story acted out with dolls (Wimmer & Perner, 1983). A doll leaves an object in one place and while he is away it is moved to a new place. Then he returns and the child is asked where the doll will look for the object. A different story, with different dolls, objects, and locations, was used at each time. The second task was a standard "unexpected contents" false belief task (Hogrefe, Wimmer, & Perner, 1986). A familiar box was shown to the child and then opened to reveal an unusual content. After this was replaced in the box the child was asked what he or she had thought was in the box before it was opened and what a friend (named in the test question) would think was in the box before it was opened. A dif-
ferent box and content was used each time. At the end of the test session at each time point children were asked what was in a box that did contain its usual content. We included this item so that children would not think that every box we showed them had an unexpected content. The third task was similar to the second, including questions about own belief and friend’s belief, but used standard appearance-reality test materials (Flavell et al., 1983).

The three tasks yielded six scores: three from questions about another person’s false belief, two from questions about the child’s own false belief and one appearance-reality question. The six scores were summed to give the child’s theory-of-mind score (range 0–6). Internal consistency of this measure was examined at each time point. In each test period the appearance-reality question was the only question that reduced the reliability of the overall measure. Consequently this measure was dropped from the summed score. The internal consistency, assessed by Cronbach’s alpha was 0.67 at Time 1, 0.65 at Time 2, and 0.86 at Time 3. Although the main analyses of this study involve a composite measure of theory-of-mind understanding, in preliminary analyses in the Results section, findings for individual tasks are presented.

General language ability. The Test of Early Language Development (Hresko, Reid, & Hammill, 1981) was used to assess children’s general language ability. This test, which has been standardized on children between 3 and 7 years, assesses syntactic and semantic skills of children, and both their expressive and receptive abilities. Good test-retest reliability and internal consistency are reported in the manual (Hresko et al., 1981). The test-retest reliability coefficient was found to be .90, when 177 children were tested with a time interval between testing sessions of 2 weeks. Internal consistency, assessed in a sample of 500 children, was found to be $\alpha = .90$. In a previous study (Jenkins & Astington, 1996), this measure was found to be highly correlated with the sentence memory measure in the Stanford Binet ($r = .76$).

Pretend play video observation. Children played together in pairs in a small room equipped with dress-up clothes and props that would encourage pretend play. The experimenter withdrew behind the camera once play was under way. Children were videotaped for a period of approximately 10 min. Videotapes were transcribed with descriptions of what the child was holding or who they were talking to when this was necessary to determine whether they were engaging in pretend play. All transcripts were coded by someone uninformed about the theory-of-mind scores of children, using the same coding scheme as that used in our previous study (Austingon & Jenkins, 1995). Tapes were segmented into speaker turns. A speaker turn was defined as one child’s utterance
bounded by another child’s utterances, or, if only one child was speaking, a speaker turn was one utterance separated by a silence of 5 s or more prior to the next utterance. All comments to the experimenter were excluded from analysis.

**Amount of pretend play.** Each turn was coded for the presence of pretense. This was any speech concerned with nonliteral play and included playing or assigning a role, discussing an imaginary activity, substituting one object for another, and using replica objects as real objects. Speaker turns that were not coded as pretense included acknowledgments of other children’s utterances (e.g., “Oh OK,” “Yes”), unfinished phrases too minimal to code as pretense (e.g., Well . . .), and repetition of someone else’s pretense without any evidence of new elements of pretense (e.g., a child saying “Let’s go to bed now” when he said the same on his previous speaker turn).

All pretend turns were coded for two elements: whether explicit joint proposals were made and whether there was evidence of explicit role assignment. The raw frequencies of joint proposals and role assignments were converted to proportions of the total amount of pretend play. This was done because of slight variation in the length of play sessions and in the extent of children’s participation. The proportions ensured that the measures reflected the type of pretend play skills children demonstrated when they were involved, independently of their level of involvement.

**Joint proposals.** For this to be coded, reference had to be made to another person and to the self within the same turn. For example, “Pretend you’re squirting me again.” Reference to self and other was also achieved by the use of first-person plural pronouns such as we, us, or our to specify the self and other, for example, “There we go, under the umbrella in case someone squirts us.” One child did not engage in any pretend play during the session and received a score “0” on the proportion of pretend turns involving joint play and role assignment.

**Role assignment.** This was defined as children assigning a pretend role to themselves or to another child. This had to be done verbally and explicitly, such as “Let’s be firegirls now” or in addressing their peer, “Oh hello teacher.” Role assignment was not coded if a child was playing at being someone, as evidenced by their dress, actions, or change in voice, but the child never explicitly said who they were pretending to be.

**Interrater reliability.** A second person independently coded 10 transcripts (33% of the total) randomly chosen from the three time points. Reliability was assessed in two ways. First we examined the extent to which coders agreed on each individual instance of pretense, joint planning, and role assignment. This was assessed using Cohen’s kappa and the resulting kappas were pretense, $\kappa = .63$; joint planning, $\kappa = .86$; role
Table 1. Means and Standard Deviations of All Variables at Three Points in Time

<table>
<thead>
<tr>
<th></th>
<th>Time 1</th>
<th></th>
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<th>Time 2</th>
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<th>Time 3</th>
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<th></th>
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<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>M</td>
<td>SD</td>
<td>N</td>
</tr>
<tr>
<td>Theory of mind understanding</td>
<td>1.05</td>
<td>1.31</td>
<td>19</td>
<td>2.90</td>
<td>1.52</td>
<td>20</td>
<td>3.00</td>
<td>2.00</td>
<td>18</td>
</tr>
<tr>
<td>Joint planning</td>
<td>0.18</td>
<td>0.18</td>
<td>19</td>
<td>0.20</td>
<td>0.13</td>
<td>20</td>
<td>0.28</td>
<td>0.17</td>
<td>18</td>
</tr>
<tr>
<td>Role assignment</td>
<td>0.01</td>
<td>0.02</td>
<td>19</td>
<td>0.08</td>
<td>0.06</td>
<td>20</td>
<td>0.07</td>
<td>0.12</td>
<td>18</td>
</tr>
<tr>
<td>Age (in months)</td>
<td>39.56</td>
<td>3.29</td>
<td>19</td>
<td>43.50</td>
<td>3.35</td>
<td>20</td>
<td>46.74</td>
<td>3.23</td>
<td>18</td>
</tr>
</tbody>
</table>

As the scores used in the analysis were the summed score of role assignments (or joint planning) divided by the sum of pretend turns, we also examined the reliability of these proportional measures. Reliability (assessed by Cronbach’s alpha) for the proportion of pretend turns that involved joint planning was \( \alpha = 0.98 \), and for the proportion of pretend turns that involved role assignment was \( \alpha = 0.93 \).

RESULTS

Two cases had incomplete data over the three time points. One child did not speak during the videotaped play session at Time 1, and this same boy refused to be included in the pretend play session at Time 3. The family of another child had moved away before Time 3 videotaped play sessions occurred. For analyses including Time 1 variables, \( N = 19 \). For analyses including Time 3 data, \( N = 18 \) children.

Table 1 shows the mean and standard deviation of each variable at Times 1, 2, and 3. Three repeated-measures analyses of variance (ANOVAs) were carried out to determine whether there was a significant increase in theory-of-mind understanding, joint planning, and role assignment over the 7-month period. Children showed an increase in theory-of-mind understanding as a function of time, \( F(2,16) = 12.7, p < .001 \). It is evident from Table 1 that the difference between times is largely accounted for by the increase in understanding that takes place between Time 1 and Time 2. Children also showed a significant increase in role assignment, \( F(2,16) = 15.7, p < .001 \). As is evident from Table 1 this increase occurred between Time 1 and Time 2. It should be noted that at Time 1 only two children (5%) showed any instance of role assignment. By Time 2, 15 children (75%) showed at least one instance of role assignment. With so little variability at Time 1, it is unlikely that this measure will be found to predict change in any other variables. Consequently,
negative findings in relation to Time 1 role assignment must be viewed cautiously. Children did not show a significant increase in joint planning across the three time periods, \( F(2, 16) = 1.4, p < .27 \). Six children (30%) showed no joint planning at Time 1, but this dropped to two children (5%) at Times 2 and 3.

It was evident from examination of all variables that Time 3 role assignment was skewed, and to reduce the effect of outliers in the multivariate analysis, square root transformation was necessary. Analyses were run with and without this transformation and significant effects were the same. Results cited are based on the transformed variable.

Table 2 shows the intercorrelation of theory of mind, joint planning, and role assignment at and across the three time points. These correlations give an indication of the stability of the theory of mind and social behaviors over time. The closer the measures of theory of mind are to one another in time, the more strongly they are related to each other: \( r(18) = .47, p < .05 \), between Times 1 and 2; \( r = .72, p < .001 \), between Times 2 and 3; compared with \( r(18) = .39, p < .11 \), between Times 1 and 3. Time 1 and Time 2 measures of joint planning are strongly related to one another, \( r(18) = .68, p < .002 \), but measures at other time points are not related to one another. None of the measures of role assignment are significantly related to one another, although there was a weak association between Time 1 and Time 3 role assignment, \( r(18) = .42, p < .09 \).

Next, contemporaneous relationships were examined between theory of mind and joint proposals. None of these associations were significant, although Time 1 theory of mind was weakly related to Time 1 joint planning, \( r(18) = .41, p < .09 \), and the relationship at Time 2 was in the expected direction. The negative correlation between Time 3 theory of mind and Time 3 joint planning, although nonsignificant, was opposite to our prediction.
Finally, we examined contemporaneous relationships between theory of mind and role assignment. Time 1 theory of mind was related to Time 1 role assignment, \( r(18) = .48, p < .05 \), and correlations between Time 2 and 3 variables were in the expected direction, although not significant.

Although our main theory-of-mind measure is a composite score, because few studies use multiple measures of theory-of-mind understanding across time, it was also of interest to examine the consistency of children’s performance on the different tasks. We calculated the mean percentage pass rate across the different tasks. The change in location task was the most difficult with a mean percentage pass rate of 37% across the three time periods. This task also had the lowest pass rate at Time 1. The unexpected contents task was next most difficult with mean percentage pass rates of 39% (other belief) and 42% (own belief). The appearance-reality task was the easiest task with mean percentage pass rates of 54% (other belief) and 59% (own belief). Children showed greatest variability in their performance across individual measures at Times 1 and 2 (as previously indicated by Cronbach’s alpha, reported in the Measures section).

Children’s performance on the different tasks within each time period were compared, and the percentage agreement was determined across two tasks (i.e., the percentage of children who failed both tasks or passed both tasks). This was carried out for all 10 combinations of tasks (treating own and other belief as separate tasks). Agreement in responses to own and other belief questions within each task was high at each time period for both the unexpected contents task (range = 89%–95% for the three different time points) and the appearance-reality task (range = 74%–80%). At Time 1 the range across the remaining 8 combinations of tasks was 57% to 84%. Thus, in the combination of tasks that produced the most discrepancy in children’s performance (the worst case combination), 43% of children at Time 1 passed one task but not another. At Time 2 the range across the remaining 8 combinations of tasks for children showing the same responses on two tasks was 40% to 65%. Thus, in the worst case combination of tasks, 60% of children at Time 2 passed one task but not another. At Time 3 the range across the remaining 8 combinations of tasks for children showing the same responses on two tasks was 67% to 94%. There was no evidence that one particular combination of tasks was more problematic than any other, when these combinations were compared across time periods.

These results indicate that there is substantial variability in children’s performance across different theory-of-mind tasks, especially when the development of their understanding is in the early stages. Particularly at
Times 1 and 2, a substantial proportion of children are able to pass one task but not another. Although there is sufficient consistency in individual scores to treat the phenomenon as a unitary construct, as evidenced by the internal consistency statistic, there is also enough variability across tasks to make it clear that development in this area is not an “all-or-none phenomenon.” Children seem to acquire this understanding gradually, as previously noted (Jenkins & Astington, 1996).

**Analytic Strategy**

To establish the direction of effect between theory of mind and social behaviors, two different global causal models were compared: (a) theory of mind affects social behaviors and (b) social behaviors affect the development of theory of mind.

To test the model that theory of mind affects social behaviors, two multivariate multiple regressions were run: one in which Time 1 theory of mind predicted Time 2 and Time 3 social behaviors, and one in which Time 2 theory of mind predicted Time 3 social behaviors. By carrying out a multivariate multiple regression, the risk of a Type 1 error was reduced and allowed us to determine whether the criterion variables both within and across time were redundant. If it is the case that theory-of-mind development affects the development of social behaviors, we would expect to see Time 1 theory of mind related to Time 2 and Time 3 joint planning and role assignment and Time 2 theory of mind related to Time 3 joint planning and role assignment.

**Does Time 1 theory of mind predict Time 2 and Time 3 social behaviors?** The multivariate multiple regression was significant, $F(4, 13) = 3.18$, $p = .05$. A step-down analysis was performed to examine the unique contribution of each criterion variable to the composite dependent variable. In this analysis, criterion variables are hierarchically ordered in terms of theoretical significance. Each successive criterion variable is tested with the higher priority criterion variables acting as covariates in the analysis, to determine whether the new criterion significantly adds to the combination of criterion variables already tested. The criterion variables were given the following order of priority: Time 2 joint planning, Time 2 role assignment, Time 3 joint planning, Time 3 role assignment. This order was adopted because in our earlier paper (Astington & Jenkins, 1995) theory-of-mind understanding was more strongly associated with joint planning than role assignment.

The variable that was significant on step-down analysis was Time 2 joint planning, step-down $F(1,16) = 7.12$, $p < .02$. Univariate analyses showed that Time 1 theory of mind was associated with Time 3 role
assignment, $F(1,16) = 6.19$, $p < .03$, but this relationship was already accounted for in the composite criterion variable by the higher priority criterion variables, and this variable was found not to be significant on step-down analysis, step-down $F(1,13) = 2.46$, $p < .14$. Time 2 role assignment was not significant on univariate analysis, $F(1,16) = 0.02$, $p < .89$, or step-down analysis, step-down $F(1,15) = 0.05$, $p < .82$. Time 3 joint planning was not significant on univariate analysis, $F(1,16) = 1.36$, $p < .26$, or step-down analysis, step-down $F(1,14) = 2.07$, $p < .17$. In summary, performance on Time 1 theory-of-mind tasks predicted children's performance on joint planning approximately 4 months later.

**Does Time 2 theory of mind predict Time 3 social behaviors?** The same analysis was carried out with Time 2 theory-of-mind scores as the predictor variable and Time 3 social behaviors as the criterion variables. The multivariate multiple regression was significant $F(2,15) = 4.9$, $p < .03$. The only variable found to be significant on step-down analysis was Time 3 role assignment, step-down $F(1,15) = 7.9$, $p < .02$. Time 2 theory of mind was not related to Time 3 joint planning either on step-down analysis, step-down $F(1,16) = 1.33$, $p < .27$, or on univariate analysis. In summary, Time 2 theory of mind predicted role assignment during play assessed approximately 4 months later.

**Alternative Model: Social Behaviors Encourage Development of Theory of Mind**

Although one causal direction was hypothesized, we wanted to compare our hypothesized causal model with the alternative. The other causal model to be tested was that social behaviors encourage the development of theory of mind. If this is the case, we would expect to see joint planning and role assignment at Time 1 predicting theory of mind at Time 2 or Time 3, and joint planning and role assignment at Time 2, predicting theory of mind at Time 3.

**Do Time 1 social behaviors predict Time 2 or Time 3 theory of mind?** A multivariate multiple regression was conducted with Time 2 and Time 3 theory of mind as the criterion variables and Time 1 social behaviors as the predictor variables. The multivariate multiple regression was not significant, $F(4,30) = 0.69$, $p < .60$. Neither of the social variables was a significant predictor of Time 2 or Time 3 theory of mind on univariate or step-down analysis.

**Do Time 2 social behaviors predict Time 3 theory of mind?** A multiple regression was carried out with Time 3 theory of mind as the criterion variable and Time 2 social behaviors as the predictor variables. This was not multivariate because there was only one criterion variable. Neither of
the Time 2 social behaviors was found to predict Time 3 theory of mind, $F(2,15) = 0.07, p < .93$.

In summary, these two sets of analyses demonstrated that there is stronger support for the proposed hypothesis that theory-of-mind development has a significant effect on social behavior than the alternative hypothesis that social behaviors have a significant effect on theory-of-mind development. Both joint planning and role assignment at two different time points were found to be affected.

More Stringent Tests of the Causal Hypothesis

We followed up the multiple multivariate regression with a multiple regression for each of the predictor/criterion relationships that had been found to be significant on the multivariate analysis. The aim of this set of analyses was to test a causal model more rigorously. This was done in two ways. First, by entering in the regression first the repeated measure that preceded the criterion measure, any subsequent measure that entered the regression was predicting change between the earlier measure of the criterion and the later measure. Thus, if we hypothesize that theory of mind predicts later Time 2 joint planning, by entering Time 1 joint planning into the equation first, we account for all of the variance of Time 2 joint planning that was attributable to Time 1 joint planning. The unaccounted for variance in Time 2 joint planning is the extent to which joint planning has changed since Time 1. By entering Time 1 theory of mind into the equation next we can see whether performance on this variable predicts changes on the criterion between Time 1 and Time 2.

The second aim of these hierarchical regressions was to control for other variables that might account for the relationship between predictor and criterion variables. In our previous work (Aistngton & Jenkins, 1995), we found that age and language ability mediated the relationship between theory of mind and social behaviors, although weakly. In testing a causal model we wanted to ensure that changes in criterion variables could not be accounted for by age or language ability. The measure of language ability that was entered was contemporaneous with the criterion variable. Regressions were rerun dropping covariates when (a) the covariate added nothing to the prediction of the criterion variable, and (b) the covariate was not acting as a suppressor variable.

For each regression that was carried out, multicollinearity was tested for. No combination of predictor variables accounted for more than .50% of the variance of any other predictor variable.

Prediction of Time 2 joint planning. In the first hierarchical regression, Time 2 joint planning was the criterion variable. Time 1 joint plan-
ning was entered first into the regression followed by age, language, and Time 1 theory of mind. Language ability added nothing to the prediction of Time 2 joint planning and was dropped from the analysis. Age was retained as it was acting as a suppressor variable. After Step 3 with all predictor variables in the equation, multiple $R = .77$, $F(3,15) = 7.1$, $p < .003$. After Step 1 with Time 1 joint planning in the equation adjusted $R^2 = .41$, $F(1,17) = 13.5$, $p < .002$. After Step 2 with Time 1 joint planning and age in the equation, there was no significant increase in $R^2$, adjusted $R^2 = .38$, $Finc(1,16) = .18$, $p < .68$. After Step 3 when Time 1 theory of mind was entered into the equation, there was a significant increase in $R^2$, adjusted $R^2 = .51$, $Finc(1,15) = 5.1$, $p < .04$. Thus Time 1 theory of mind accounted for approximately 13% of the variance in the change between Time 1 and Time 2 joint planning.

**Prediction of Time 3 role assignment.** In this hierarchical regression, Time 3 role assignment was the criterion variable. Time 2 role assignment was entered first into a hierarchical regression followed by age, language, and Time 2 theory of mind. Neither language ability nor age was found to make a significant contribution to the prediction of role assignment, nor did they act as suppressor variables, and they were dropped from further analysis. After Step 2 with both variables in the equation, multiple $R = .57$, $F(2,15) = 3.7$, $p = .05$. After Step 1 $R^2 = .05$, $F(1,16) = .82$, $p < .38$. After Step 2 when Time 2 theory of mind was entered into the equation, $R^2 = .33$, $Finc(1,15) = 6.3$, $p < .03$. In summary, Time 2 theory of mind predicted 28% of the variance in the change in role assignment from Time 2 to Time 3.

**DISCUSSION**

Our interest was to examine the relationship over time between theory-of-mind development and children's play interactions with peers. In a previous study we demonstrated contemporaneous associations between theory of mind, joint planning, and role assignment during play interaction with peers (Astoning & Jenkins, 1995). In the present study our aim was to examine a causal model in which we hypothesized that developments in theory of mind lead to increased abilities to initiate joint plans and to assign roles.

We confirmed our previous results that joint planning and role assignment are associated with theory of mind. Theory of mind at Time 1 predicted 13% of the variance in change in joint planning from Time 1 to Time 2. This was the case after controlling for the amount of children's joint planning at Time 1, as well as controlling for effects of age and con-
temporaneous language performance. Thus, changes in joint planning were predicted by performance on theory-of-mind tasks.

In addition, theory of mind at Time 2 was related to the amount of time that children spent during play in explicitly assigning a role to themselves or their play partner. This was also the case after controlling for the amount of children's role assignment at Time 2, as well as controlling for effects of age and contemporaneous language performance. Thus, earlier theory-of-mind performance predicted 28% of the variance in change in role assignment between Time 1 and Time 2.

The theory-of-mind construct is sometimes treated as if an understanding of other minds is either present or absent. Yet our results relating to children's performance on different tasks make it clear that at the first two testing points many children are passing some tasks and failing others. This suggests that theory of mind is gradually acquired when children are between the ages of 2 and 5 years. We obtained the same results when we tested a larger group of children on a series of theory-of-mind tasks (Jenkins & Astington, 1996).

Why should theory-of-mind development affect the development of these social behaviors? Our view is that being able to represent multiple beliefs of the self and other simultaneously, including beliefs that contrast with one another, allows for social interactions that are potentially less ambiguous and are more geared to the joint endeavors of participants. Others have found relationships between sociodramatic play and developments in children's metacognitive skills. For instance, higher levels of sociodramatic play have been found to be associated with children's greater ability to take the perspective of the other (Connolly & Doyle, 1984; Rubin, 1976). Perspective-taking tasks are not equivalent to false belief tasks, but they do assess the child's ability to operate from a perspective that is not their own, thus showing some similarity to false belief tasks. More recently relationships between sociodramatic play and theory of mind have been demonstrated by others (Youngblade & Dunn, 1995).

There has been much less investigation of the relationship between the variable that we have called joint planning and theory-of-mind development. As humans we have to learn how to cooperate in a complex world in which there are multiple agents, each with multiple goals and in which unknown and unpredictable elements operate (Oatley, 1992). Infants communicate with their parents in expressing goals as well as modifying their own goals over time to cooperate with their caregivers. Accounts of the way in which parent-infant interaction is highly synchronized and mutually responsive demonstrate that some form of cooperative action is present in early infancy (Stern, 1985). We see our variable
of joint planning as representing a new stage in the development of cooperative action. We propose that part of one's ability to carry out complex cooperative plans comes with being able to represent the mental states of others that may contrast with one's own. Thus, as children improve in representing multiple and contrasting beliefs, they become more skilled at the complex undertaking of cooperative action.

We found no evidence for the opposite causal model to that which was hypothesized (i.e., that joint planning and role assignment affect the development of theory of mind). One reason for this may be methodological. There was very little variability on Time 1 role assignment, making it unlikely that an association with any other variables would be found. Although this may explain the lack of relationship between Time 1 role assignment and Time 2 and Time 3 theory of mind, it is not the explanation for the failure in the prediction of Time 1 or Time 2 joint planning, or Time 2 role assignment. The variability on these variables was good, but they still did not predict later theory-of-mind task performance. Given this, we conclude that it is more likely that theory of mind affects the development of these social behaviors, rather than the opposite causal model. The sample size for this study was small, however, and replication with a larger sample will be important.

Of course, it is not possible from a naturalistic study to be certain about the direction of effect in these relationships. In a quasi-experimental study these results are only suggestive. Considering only the results from the naturalistic longitudinal study, it is still possible that a third variable, related to both theory of mind and social behaviors, accounts for the relationship between them. Although an attempt was made to examine the role of a third variable in explaining the association between theory of mind and social behaviors (by partialling out effects of age and language ability in the regression analyses), it is still possible that other variables, not tested in this study, were responsible for these relationships.

For instance, Plaut and Karmiloff-Smith (1993) have suggested that developments in representational architecture underlie the child's ability to pass false belief tasks. It is not difficult to imagine that this is also responsible for the child's growing capacity to communicate explicit role assignments to another person, as well as offer a plan for the self and other simultaneously. If this is the case, theory of mind has no causal role in affecting joint planning or role assignment, but changes along with these other variables, as a consequence of changes in representational architecture. Of course, one of the difficulties in hypothesizing a latent structure such as representational architecture is that one cannot measure it and differentiate it from those observable behaviors that it affects. Training or intervention studies may throw light on these causal relationships,
as well as providing opportunities for operationalizing these hypothetical constructs.

Youngblade and Dunn (1995) found that children aged 2;9 who engaged in more pretend play role enactments performed better on a false belief explanations task at age 3;4, and they argue that pretend play scaffolds theory-of-mind development, as we mentioned earlier. “Role enactment” was coded if the child gave any evidence of playing a particular pretend role, without explicitly defining it. Explicit definition of a role was coded as “role play,” which corresponds to our variable “role assignment.” Youngblade and Dunn did not find that role play at 2;9 was related to the ability to give false belief explanations at 3;4. We, on the other hand, found that children’s earlier false belief task performance predicted their later production of role assignments.

We do not believe that our results and those of Youngblade and Dunn (1995) contradict each other. Harris (1991) argues that children’s pretend play fosters their ability to simulate feelings and desires not currently held and to imagine states of the world not currently existing. Further, he argues that it is these abilities that lead to theory-of-mind development, allowing the child to understand that other people may hold different beliefs about the world and to perform correctly on false belief tasks. From this perspective we would expect that some aspects of pretend play, such as acting out different roles (Youngblade and Dunn’s “role enactment”), would precede and support the development of false belief understanding, whereas other aspects of pretend play, such as making one’s role explicitly clear to one’s play partners (our “role assignment”), would follow and result from false belief understanding. This is because children need to know that people may have different beliefs about the world if they are to see the need to make their own view clear in situations where it may not be so, such as the potentially ambiguous context of pretend play. As Youngblade and Dunn put it, “role enactment involves mental representation by exemplifying a category of action. Role play, in contrast, is genuinely symbolic; the child’s behavior designates the behavior of another person or character” (1995, p. 1476). That is to say, role play (viz., “role assignment” here) is more sophisticated because it requires explicit representation of two conflicting states—who the child really is and what character he or she is depicting. Thus, we would argue that pretend play and theory of mind have a complex and interdependent relationship.
REFERENCES


