Abstract

This research investigated young children’s ability to use the perspective of their communicative partner to guide their production and interpretation of referential statements. The cognitive skills associated with successful perspective-taking in referential communication were also examined. In Experiment 1, 4.5- to 5.5-year-old children were tested on two referential communication tasks during which they had to either instruct an experimenter to pick up an object (production task) or follow instructions to retrieve an object (comprehension task). They were also administered measures of inhibitory control, working memory, and cognitive flexibility. Results indicate that children used the perspective of their speaking partner to guide their communicative behaviours in both the production and communication tasks. However, children did not completely disregard their own perspective during the production and interpretation of statements. Egocentric interpretations of speaker requests were negatively correlated with children’s inhibitory control skills. No other dimensions of executive function skills related to children’s communicative perspective-taking. These findings suggest that children’s inhibitory control skills relate to their ability to inhibit their own perspective during communicative interactions. In Experiment 2, 3.5- to 4.5-year-old children were tested on the same comprehension task used in Experiment 1. To further explicate the relation between inhibitory control skills and children’s use of another perspective when interpreting statements, preschoolers were administered measures of delay inhibition and conflict inhibition. Preschoolers’ egocentric processing of the speaker’s requests were related to their performance on the conflict inhibitory control tasks, whereas their simultaneous choice of both an object visible and blocked from the speaker’s view was related to their
performance on the delay inhibitory control tasks. The results of these studies suggest young children can differentiate between information that is accessible to the speaker versus information that is available only to them, and, moreover, they can use this information to guide their communicative behaviours. Furthermore, the results suggest that children’s developing inhibitory control skills allow them to inhibit their own perspective, enabling them to make use of their communicative partner’s perspective.
Acknowledgements

I have very much appreciated the supervision by Susan Graham. I am grateful for her guidance through all stages of this project, as well as in her mentorship and support. I would also like to thank my committee members, Suzanne Hala and Glen Bodner, for their input into this research.

This research would not have been possible without the help and co-operation of the parents and children who kindly volunteered their time to participate in the studies. Many thanks to Hayli Stock, Shannon Smith, Kristan Rostad, and Val San Juan for their assistance with data collection and coding. This research was supported by a Social Sciences and Humanities Research Council Canadian Graduate Scholarship.

I would like to thank the members of the Language and Cognitive Development Lab and other friends in the graduate program for creating a fun environment to learn in. A very special thanks to my parents and sisters for their support and encouragement during the completion of my graduate education.
TABLE OF CONTENTS

Approval Page........................................................................................................... ii
Abstract....................................................................................................................... iii
Acknowledgements...................................................................................................... v
Table of Contents........................................................................................................ vi
List of Tables................................................................................................................ ix
List of Figures............................................................................................................... x

CHAPTER ONE: GENERAL INTRODUCTION................................................................. 1

CHAPTER TWO: EXPERIMENT 1.................................................................................. 5

Introduction.................................................................................................................. 5
Method............................................................................................................................ 12

Participans.................................................................................................................... 12
Materials......................................................................................................................... 12
Procedure....................................................................................................................... 14

Communication Tasks................................................................................................. 14
Production task............................................................................................................. 17
Comprehension task...................................................................................................... 18

Language Task............................................................................................................. 19

Executive Function Tasks............................................................................................. 20

Working memory measures......................................................................................... 20
Inhibitory control tasks............................................................................................... 21
Cognitive flexibility........................................................................................................ 22

Results.......................................................................................................................... 24

Communication Tasks................................................................................................. 24
Production Task............................................................................................................ 24
Comprehension Task.................................................................................................... 27
Object(s) chosen........................................................................................................... 27
Eye movement data..................................................................................................... 29
Number of looks.......................................................................................................... 30
Duration of looks.......................................................................................................... 30
Executive Function Tasks............................................... 32
The Relation between Executive Function Skills and
Communication............................................................. 34
Discussion........................................................................... 39

CHAPTER THREE: EXPERIMENT 2.................................................. 47
Introduction......................................................................... 47
Method.............................................................................. 51
Participants................................................................ 51
Materials................................................................ 51
Procedure..................................................................... 51
Comprehension Task............................................ 52
Language Task................................................... 52
Inhibitory Control Tasks........................................ 52
Conflict inhibitory control tasks...................... 52
Delay inhibitory control tasks......................... 54
Results............................................................................... 55
Comprehension Task..................................................... 55
Object(s) Chosen................................................ 57
Eye Movement Data............................................ 57
Number of looks................................................ 58
Duration of looks................................................. 59
Inhibitory Control Measures............................................. 59
Inhibitory Control and Communication................ 64
Discussion........................................................................... 68

CHAPTER FOUR: GENERAL DISCUSSION........................................ 73
Future Directions............................................................. 75
Conclusion........................................................................... 79

REFERENCES.............................................................................. 81

APPENDIX A: Experiment 1 Informed Consent, Debriefing Form,
and Parents Results letter......................................................... 88
List of Tables

Table 1. Measures of Referential Communication, Language, and Executive Function Experiment 1......................................................... 15
Table 2. Children’s Performance on the Comprehension Task Trials in Experiment 1............................................................................... 28
Table 3. Children’s Performance on Executive Function and Language Measures in Experiment 1........................................................................ 33
Table 4. Bivariate and Partial Correlations between Executive Function Measures in Experiment 1................................................................. 35
Table 5. Bivariate and Partial Correlations between Executive Function Measures and Communication Measures in Experiment 1.................. 36
Table 6. Preschooler’s Performance on Comprehension Task Trials in Experiment 2.......................................................................................... 56
Table 7. Preschooler’s Performance on the Inhibitory Control and Language Measures in Experiment 2................................................................. 61
Table 8. Bivariate and Partial Correlations between Inhibitory Control Measures in Experiment 2................................................................. 62
Table 8. Bivariate and Partial Correlations between Inhibitory Control Measures and Comprehension Task in Experiment 2............................ 65
List of Figures

Figure 1. Sample display set-ups for the three conditions tested in Experiment 1 and 2 ............................................................ 13

Figure 2. Number of adjectives used in each condition in production task Experiment 1 ................................................................... 25

Figure 3. Duration of looking time towards target object relative to the referential alternative in comprehension task (i.e., target time advantage) Experiment 1 ......................................................... 31

Figure 4. Preschooler's duration of looking time towards the target object relative to the referential alternative in the comprehension task (i.e., target time advantage) Experiment 2 ......................................................... 60
CHAPTER ONE: GENERAL INTRODUCTION

Young children acquire their native language at a striking pace, a remarkable feat considering the complexity of the language learning task. Not only must children learn the speech sounds, words, and grammar of their language, they must also acquire pragmatic competence – an understanding of how language is used for social and functional purposes. Pragmatic competence is often reflected in the referential aspects of communication, namely, how a speaker uses words and phrases to denote things and events in the world in a manner that others will understand. This skill is used to accomplish tasks such as giving instructions, providing directions, or selecting particular objects in one’s environment.

One key aspect of successful referential communication is the ability to identify information that is or is not shared with a conversational partner, such as whether a partner knows facts $x$ and $y$, or whether a partner can see object $z$. This ability to track shared knowledge or “common ground” (Clark, 1992) requires an appreciation of the social and situational context as well as the ability to adopt another person’s perspective. Consider, for example, a situation in which a speaker is directing a listener to pick up a ball from a toy box which contains a number of balls. In this situation, the phrase “Get the ball” would be ambiguous to the listener. Thus, a skilled communicator would provide additional information that would clarify the intended referent (e.g., “Get the red ball.”). Indeed, effective referential communication requires perspective-taking on the part of both the speaker and the listener. That is, if a speaker were to ignore the perspective of a listener, a statement could be ambiguous because the speaker overestimated the knowledge state of their listener and left out information necessary to clearly identify the intended meaning of a statement. Alternatively, the statement would be redundant if the speaker underestimated the knowledge state of the listener and provided information that was unnecessary.
Similarly, a listener needs to be sensitive to a speaker’s perspective in a communicative interaction. That is, a listener could use information about a speaker’s knowledge state to clarify what may seem like an ambiguous statement. For example, if a speaker was only able to see the one ball that is between her and the listener when she states, “Let’s play with that ball,” the listener, using the speaker’s perspective, will know she is referring to a game involving the commonly viewed ball rather than the ball hidden behind the listener’s back.

According to Piaget, children younger than 7 or 8 years of age are incapable of tailoring their communication to another’s knowledge state and are essentially “talking to themselves,” (Piaget, 1959, p. 38). In support of this notion, research has demonstrated that children younger than six or seven years do not successfully take into account a listener’s perspective in referential communication tasks (e.g., Deutsch & Pechmann, 1982; Glucksberg & Krauss, 1967; Sonnenschein & Whitehurst, 1984). This “egocentrism” can be seen both in children’s production of ambiguous statements and in their comprehension of instructions. For example, Deutch and Pechmann (1982) demonstrated that even by 6 years of age, only 50% of children provided adequate verbal descriptions of objects to a listener (e.g., a typical response was a child asking for the “red one” when several red objects were presented). Similarly, Glucksberg and Kraus (1967) found that more than 70% of third grade students provided inadequate descriptions of blocks to a listener even after a number of trials. Furthermore, the majority of first grade students tested in this study used pointing behaviour to identify objects even when the receiver could not see the gestures. Finally, a recent study by Epley, Morewedge, and Keysar (2004) demonstrated that 6-year-olds initially interpret communicative situations from their own perspective, rather than from the speaker’s perspective, and furthermore, tend not to correct such interpretations at later processing stages.
This tendency to display egocentric behaviour in communicative situations is puzzling given that theory of mind research demonstrates that by 4 years of age, children understand that another’s mental state, including their perspective, can differ from their own (e.g., Astington & Gopnik, 1991; Perner, Leekam, & Wimmer, 1987). For example, Perner and Leekam (1986) demonstrated that older 3-year-olds tracked the knowledge state of another person and then updated this person regarding information he or she had missed seeing about the novel action of a toy. Similarly, research on early word learning highlights children’s impressive ability to take the situational context of another person into consideration when attaching a label to a referent object (Baldwin, Markman, Bill, Desjardins, Irwin, & Tidball, 1996; Tomasello & Akhtar, 1995). For example, Akhtar, Carpenter and Tomasello (1996) demonstrated that 2-year-old children use the speaker’s perspective to attach a label to a novel object. That is, children mapped a novel label to an object that was novel to the speaker, but not novel to the children themselves.

This discrepancy between children’s successful perspective-taking in some contexts and their egocentric communicative behaviours in other contexts suggests that children may have difficulty making use of the knowledge state of their communicative partner, rather than having difficulty understanding their partner’s knowledge state per se. That is, although children may recognize the needs of their communicative partner, they might not have the cognitive capacity to make use of that information to assess and revise the content of their communications (Glucksberg, Krauss & Higgins, 1975). Thus, children disregard the perspective of their communicative partner because it imposes too much of a processing load when added to the already complex task of forming communicative utterances (Nadig & Sedivy, 2002).
The overarching goals of the present two experiments was to examine young children’s communicative perspective-taking abilities and to assess the cognitive skills that may predict children’s tendency to use the perspective of another to guide their communicative behaviours. In the first experiment, 5-year-old children’s sensitivity to another’s perspective when giving and receiving instructions was examined. In addition, children were presented with tasks that assessed three domains of executive functioning, namely, inhibitory control, working memory, and cognitive flexibility, as well as a measure of their language skills. Of interest was whether these cognitive skills contributed to children’s ability to use the perspective of their speaking partner to guide their production and interpretation of referential statements. The goal of the second experiment was to examine whether 4-year-old children were also sensitive to a speaker’s perspective during referential communication. In order to further explicate the role that inhibitory control plays in referential communication, preschoolers were administered two types of inhibitory control measures; delay inhibition tasks (requiring suppression of an action for a specified time) and conflict inhibition tasks (requiring suppression of a dominant response and generation of an alternate response). As in Experiment 1, the goal was to examine whether these cognitive skills influenced children’s ability to use a speaker’s perspective during a communicative interaction.
CHAPTER TWO: EXPERIMENT 1

Introduction

In order for successful communication to occur, a speaker must incorporate the listener’s perspective into his/her statement, and a listener must also be sensitive to the perspective of the speaker when interpreting that statement. As described earlier, research on referential communication has suggested that children younger than 6 years of age have difficulty using their speaking partner’s perspective to guide their communicative behaviours (e.g., Deutsch & Pechmann, 1982; Glucksberg & Krauss, 1967; Sonnenschein & Whitehurst, 1984). In other contexts, however, children show impressive sensitivity to the perspective of other individuals (e.g., O’Neill, 1996; Perner & Leekam, 1986).

Given the perspective-taking abilities that young children exhibit in theory of mind tasks and word learning contexts, why are they not able to make use of this information in referential communication tasks? One possible explanation is that the cognitive burden involved in successfully considering another’s perspective when engaging in communicative behaviors is too great for young children (Nadig & Sedivy, 2002; O’Neill & Topolovec, 2001). Successful referential communication requires an individual to gather together different pieces of information (e.g., contextual background information, the perspective of a speaking partner), hold this information in memory, inhibit conflicting information such as one’s own perspective, and then generate a communicative behavior. It may be that the coordination of all of these tasks imposes too great a load on young children’s cognitive processes, leading children to default to egocentric communications. If this is the case, then two specific predictions about children’s behavior in communicative tasks can be made. First, one would expect that when cognitive demands (e.g., memory, inhibitory control) are reduced in a communicative context, children would demonstrate
more successful use of another’s perspective. Second, one would expect that certain
cognitive skills such as memory capacity and inhibitory control would be related to
children’s ability to use another’s perspective in a referential communication task.

An examination of past research provides support for the first prediction. Studies
that minimize the complexity of a communicative situation in terms of linguistic demands
have demonstrated that young children can track the knowledge state of a listener and
subsequently vary their communicative behaviors accordingly (Nayer & Graham, 2006;
O’Neill, 1996; O’Neill & Topolovec, 2001). For example, O’Neill (1996) found that 2-
year-old children provided more communicative behaviors (e.g., pointing behaviors, verbal
utterances) to indicate the location of a hidden toy to their caregiver when the caregiver was
not present in the room when the toy was hidden versus when he/she was present in the
room. Similarly, when cognitive demands such as memory and abstraction are minimized
in a referential communicative task, 5- to 6-year-olds will use another’s perspective to
guide their communications. For example, Nadig and Sedivy (2002, Experiment 1)
presented children with a communicative task that required children to identify one
dimension of an object (e.g., big or small), out of a display of four objects, to successfully
complete the task. Children were seated in front of a display case, across from an
experimenter and were instructed to ask the experimenter to pick up objects from the
display. These researchers found that 6-year-old children were more likely to provide an
adjective to describe an object in a context where there were two similar objects that the
experimenter could see versus when one of the object pairs was blocked from the
experimenter’s view. This simplified task contrasts with that used by Pechman and Deutsch
(1982) who required children to identify two or three dimensions (i.e., size, colour, and
shape) of an object (e.g., a big yellow spoon) out of an array of eight objects. Thus,
children had to abstract numerous key features of one object and hold these dimensions in mind whilst formulating their verbal description. In this study, half of the 6-year-olds provided inadequate descriptions of the object. It, therefore, appears that indeed when the cognitive load on children is minimized (i.e., fewer object dimensions to identify out of fewer choices) as in Nadig and Sedivy's study, children can generate more unambiguous, less egocentric communicative utterances.

Similarly, the demands on children's cognitive skills appear to play a role in their interpretations of communicative utterances directed toward them. That is, when a task requires children to inhibit certain responses in order to communicate effectively, their performance becomes more egocentric. For example, Epley et al. (2004) asked 6-year-old children to follow instructions from a confederate about moving objects in a display case. On critical instruction trials, children were required to use the perspective of the speaker to resolve ambiguity in the instruction. For example, children were presented with a display case that contained three trucks of varying sizes, with the smallest truck hidden from the speaker's view. When instructed to "move the small truck above the glue," the correct choice would be the middle-sized truck as it was the smallest of the two trucks visible to the speaker. Epley et al. found that children tended to look at the object hidden from the experimenter's view first and then took, on average, 3647 ms to fixate on the correct referent object (i.e., the object matching the description from the speaker's perspective). Using a similar task, Nadig & Sedivy (2002, Experiment 2) found that the eye movements of 6-year-old children provided evidence of use of perspective information (i.e., which information is either exclusive to them or mutually shared with their speaking partner) within 560 ms of receiving the instruction to pick up an object. That is, they were quicker to select a target object (e.g., a big duck) when a related object that also matched a
speaker's request (e.g., a small duck) was hidden from the speaker, versus the situation where the speaker had visual access to the two objects. The discrepancy in findings between these two studies can be explained by varying cognitive demands of each task. In Epley et al.'s study, the hidden (thus egocentric) object was a better referential match than the mutually observed object (e.g., "small truck" is a better description for the smallest truck, than a larger, albeit still small, truck). Thus, children had to undo an initial egocentric communication prior to being successful. However, in Nadig and Sedivy's study, when children were asked to, "pick up the duck," the hidden object (e.g., a small duck) did not match the description any better than the mutually observable object (e.g., a big duck). Therefore, there was less demand on children's inhibitory control skills.

In summary, when a referential communication task is more cognitively demanding (i.e., in terms of memory, abstraction, inhibitory control), children's ability to successfully use the perspective of their speaking partner is reduced both when children are producing utterances and interpreting another's communications. It follows then, that children's ability to manage cognitive demands would be predictive of their ability to use another's perspective in communicative tasks. In particular, it is possible that children's executive function skills may contribute to their ability to make use of another's perspective to guide their communicative behavior. Executive functioning refers to a heterogeneous cluster of cognitive processes that are a part of goal directed behavior. There are two reasons why executive functions may play a role in referential communication. First, communicative behaviors in referential communication tasks are clearly goal-directed behaviors and thus may be governed by executive functions. Second, executive function skills have been found to underlie other forms of social understanding, including theory of mind (e.g., Frye, Zelazo, & Palfai, 1996; Russell, 1996; Hughes, 1998). Executive function abilities typically
have been broken down into three dimensions, including inhibitory control, working memory, and cognitive flexibility (Pennington, 1997; Pennington & Ozonoff, 1996).

Despite discussions in the research literature on what deficits in referential communication tasks could mean (e.g., Bishop & Adams, 1991), no research to date has investigated the basic cognitive skills that may contribute to successful referential communication. Yet, success in any of the executive function dimensions could facilitate successful referential communication. That is, children who demonstrate greater inhibitory control skills, (i.e., the ability to suppress responses) may be better able to block their own perspective, thereby allowing them to take into account the perspective of their speaking partner. Although inhibitory control may be necessary to be sensitive to the perspective of another, in order to use this information, a child may require the working memory capacity to keep this information in mind whilst generating a linguistic utterance. Thus, children who have better working memory skills may be more likely to produce communications that reflect an appreciation for the perspective of their listening partner. Finally, for a child to be able to change their interpretations about an object based on the perspective of another person (i.e., this object is seen by me, this object is not seen by the confederate) they must be able to mediate between two different representations. That is, they require a certain degree of cognitive flexibility.

In the present study, young children’s referential communication abilities were examined with specific focus on the following issues. First, young 5-year-olds’ tendency to take into account another’s perspective when generating statements, and interpreting requests, was examined. Second, the executive function skills that may predict children’s tendency to take another’s perspective in both production and comprehension tasks were examined. To address these issues, young 5-year-old children were presented with a
production task, a comprehension task, and a number of executive function tasks. In the production task, children were required to instruct an experimenter to retrieve objects from a display case. There were two key conditions of interest: In the common ground condition, both the children and a listener had visual access to two similar objects (e.g., a large duck and a small duck). In contrast, in the privileged ground condition, children could see both objects but a listener could only see one of the objects (e.g., the large duck). Of particular interest in this task was whether children's instructions to the listener differed between the common ground condition and the privileged ground condition. That is, if children were sensitive to the visual perspective of their conversational partner, they would be more likely to provide additional information in situations that were ambiguous to their listening partner (i.e., the common ground condition) relative to situations where the children possessed privileged contextual information. Thus, it was expected that children would use more adjectives to differentiate between two similar objects in the common ground condition than in the privileged ground condition, if they were using the perspective of their speaking partner to guide their communications.

The overall design of the comprehension task was similar to the production task but children were required to follow, rather than produce instructions. In this task, children's eye movements were monitored after the children were provided with instructions to pick up an object from a display case. Children's eye movements were measured as they provide an unobtrusive method for tracking information processing (Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995). Furthermore, research demonstrates that both children and adults' explicit evaluative processes are related to their fixations to objects (Halberda, 2006). Of interest in this task was whether children disregard objects that only they, but not the speaker, had visual access to in the privileged ground condition. That is, it was expected
that when the speaker (i.e., the experimenter) provided a description that matched two
similar objects, children would be less likely to look at and/or choose an object hidden from
the speaker's view.

Finally, children were tested on tasks designed to measure their executive function
skills including working memory (i.e., two measures of how well they could hold in mind
and recall information), inhibitory control (i.e., two measures to assess how well they could
inhibit prepotent responses in order to give less dominant, but correct responses), and
cognitive flexibility (i.e., how well the children could switch the ways in which stimuli
could be categorized based on different dimensional properties). To control for the potential
influence of language skills, children also were tested on the Peabody Picture Vocabulary
Test, a measure of receptive vocabulary. It was expected that children's executive function
skills would be related to their referential communication skills, independent of their
language skills and age. That is, the prediction was that children with better skills in the
areas of working memory, inhibitory control, and/or cognitive flexibility would be more
likely to take into account the perspective of their speaking partner. More specifically, it
was expected that children who performed better on the executive function tasks would be
more likely to use an adjective when needed to disambiguate between two similar objects
in the production task. Similarly, it was predicted that children who demonstrated more
proficient executive function skills would exhibit less egocentric interpretations of the
speaker's requests in the comprehension task, namely less referencing of an object hidden
from the speaker's view.
Method

Participants

The final sample consisted of 61 children between the ages of 4.5 and 5.5 years (29 girls, 32 boys; $M = 5$ years; 0 months, $SD = 4.53$ months. Nine additional children were tested but excluded from the data analysis due to failure to complete the tasks ($n = 1$) or due to experimenter error ($n = 8$). Children were recruited from health clinics, Welcome Wagon baby showers, and trade shows in the Calgary area. Participants were predominantly Caucasian from varied socioeconomic backgrounds and from homes in which English was the primary language spoken. After being informed of the procedures of the study, parents provided written consent and children verbally agreed to participate. For their participation, children received a small toy on each visit, and a certificate and T-shirt after the second testing session. See Appendix A for material provided to parents.

Materials

Two Sony Digital Video Camcorders (Model DCR-HC21) were used to record children’s performance on the tasks. A wooden display case (52cm X 52cm), with nine smaller boxes (each 17cm X 17cm) was constructed for use in the communication tasks (See Figure 1). This case was designed to hold four objects in each corner. The side of the display case facing the child was open while the side of the display case that faced the experimenter had sliding doors. The sliding doors were used to conceal one object from the experimenter’s view during each trial of the communication task. One video camera was placed on a tripod behind the children during the production task. To measure children’s eye movements in the comprehension task, another camera was placed in the middle of the display case and pointed toward the child’s face. Both communication tasks used fifteen pairs of test objects that differed either on color or size (e.g., blue/red cup, big/small
Figure 1. Sample display set-ups for the three conditions tested in Experiment 1 and 2. The dark shading represents the door blocking the second experimenter's view of one object. The central circle represents the video camera position.
elephant; See Appendix B for test object descriptions). The labels of all object pairs were familiar to children in this age range (Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994).

Procedure

Over two half-hour sessions (scheduled roughly one week apart), children were presented with tasks designed to measure their 1) referential communication skills (a production and comprehension task), 2) language skills, 3) working memory skills, 4) inhibitory control skills, 5) cognitive flexibility (See Table 1). Children’s performances during the test sessions were videotaped so that a researcher could score their responses. The tasks, described in detail below, were administered in a counterbalanced order with the exception of the communication tasks, which were never presented during the same testing session (i.e., the comprehension task was presented in one session with the production task presented in the other) and were always the first task administered in a given session.

Children were tested in a quiet room in a laboratory. Parents watched the testing procedures through a one-way mirror from an observation room adjacent to the testing room. Parents completed a form to provide basic demographic information regarding their children, including their child’s birth date, number of siblings, and sibling order.

Communication Tasks

The communication tasks used in the present investigation were modeled upon those used by Nadig & Sedivy (2002). Children’s sensitivity to the perspective of their partner was measured using a comprehension task whilst children’s ability to adapt their language to the perspective of their partner was measured using a production task.

The general procedures and conditions of the production and comprehension task were similar (See Appendix C and D for task instructions). Children were seated at a table
Table 1

*Measures of Referential Communication, Language, and Executive Function Experiment 1*

<table>
<thead>
<tr>
<th>Task</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referential Communication</td>
<td></td>
</tr>
<tr>
<td>Production Task</td>
<td>Number of adjectives provided in description</td>
</tr>
<tr>
<td>Comprehension Task</td>
<td>Object(s) chosen by child</td>
</tr>
<tr>
<td></td>
<td>Target look advantage (number of looks)</td>
</tr>
<tr>
<td></td>
<td>Target time advantage (duration of looks)</td>
</tr>
<tr>
<td>Language Measure</td>
<td></td>
</tr>
<tr>
<td>Peabody Picture Vocabulary</td>
<td>Raw test score (i.e., correct items within basal / ceiling)</td>
</tr>
<tr>
<td>Test 3rd Edition</td>
<td></td>
</tr>
<tr>
<td>Executive Function Measures</td>
<td></td>
</tr>
<tr>
<td>Inhibitory Control</td>
<td></td>
</tr>
<tr>
<td>Red dog / Blue dog</td>
<td>Correct responses across trials (/28)</td>
</tr>
<tr>
<td>Tapping Task</td>
<td>Correct responses (/10)</td>
</tr>
<tr>
<td>Working Memory</td>
<td></td>
</tr>
<tr>
<td>Object Memory</td>
<td>number of correctly recalled objects across 12 trials (/22)</td>
</tr>
<tr>
<td>Digit Span Forward</td>
<td>number of correctly recalled digits until ceiling criteria met</td>
</tr>
<tr>
<td>Cognitive Flexibility</td>
<td></td>
</tr>
<tr>
<td>Flexible Item Selection</td>
<td>number of correct Selection 2 matches (when Selection 1</td>
</tr>
<tr>
<td>Test</td>
<td>match was correct; /12)</td>
</tr>
</tbody>
</table>
beside an experimenter (E1) and in front of the wooden display case. A second experimenter (E2) was seated across from the child behind the display case. Four objects were placed in the four corner boxes of the display case for each trial. On each trial, there was a wooden sliding door that blocked E2’s view of one of the four objects. This object still remained visible to the child and E1.

Children received five trials in each of three conditions for both tasks: a *common ground condition*, a *privileged ground condition*, and a *baseline condition* (See Figure 1). During the *common ground condition*, two objects, a target object and a referential alternative, that were identical except for one feature (e.g., a large duck and a small duck) were placed in the display case along with two unrelated objects (e.g., a toy whale and a bottle). Both E1 and the child had visual access to all the objects. One of the unrelated objects (e.g., a whale) was blocked from E2’s view. In the *privileged ground condition*, a target and referential alternative (e.g., a large duck and a small duck), were again placed in the display case along with two unrelated objects. However, the referential alternative (e.g., the small duck) was blocked from E2’s view by a sliding wooden door. Both E1 and the child had visual access to all the objects. In the *baseline condition*, four unrelated objects (e.g., a duck, a toy alligator, a building block, a ball) were placed in the display case with one object designated as the target object. An unrelated object was blocked from E2’s view. The order of the communication tasks and conditions within the tasks were counterbalanced across the children. The positions of the target object, referential alternative, and door positions were randomized across the trials. The object pairs used in each condition and the order of object presentation were counterbalanced across children.

Each child was introduced to both the production and comprehension tasks with a “guessing game.” E1 placed objects in the four corner boxes of the display case whilst E2
wore a blindfold. One of the objects was hidden from E2’s view by a sliding wooden door but was still visible to the child. E2 was then asked to name the objects she could see (in the three clearly visible boxes) and to guess what was behind the sliding door. E1 and child generated clues so that E2 was able to guess what was behind the door. The purpose of this guessing game was to highlight the fact that E2 could not see what was behind the door. The child was then introduced to the 15 test trials (5 in each condition) with a “guessing game” after every three trials to reinforce the E2’s ignorance of the contents of the blocked object. Only unrelated objects were used in the guessing game. After every guessing game during the test trials, the child received a sticker.

*Production task.* During the test trials in the production task, E1 asked E2 to put on a blindfold and then proceeded to place objects in the display case. E1 then pointed to the target object and instructed the child to “Tell [E2] to pick up this one.” The child was also told that, in this game, he or she was not allowed to use his/her hands and was encouraged to keep his/her hands tucked down by his/her side. Following this instruction, E1 asked E2 to take off her blindfold and prompted the child to instruct E2 to pick up the target object (e.g., “Go ahead.”). Regardless of what the child said (i.e., whether the description was adequate or not), E2 picked up the target object and passed it back to E1. Children were not provided with feedback regarding their selection, but were encouraged with general statements throughout the task (e.g., “Good listening.”).

Of key interest in the production task was whether children’s instructions to E2 differed between the common ground condition and the privileged ground condition. Recall that in the common ground situation, E2 was able to see the two similar objects (e.g., a big duck and a small duck) whereas in the privileged ground condition, the child saw both the objects, but E2 could only see one object (e.g., the big duck). Thus, in this example, a
skilled speaker would be more likely to provide additional information in the form of a scalar adjective in the common ground situation (e.g., “Pick up the big duck.”) than in the privileged ground condition, where an adjective is not needed (e.g., “Pick up the duck.”) would provide ample information). Thus, the measure of key interest in this task was whether the children provided adjectives in order to uniquely identify a referent in the common ground condition relative to the privileged ground.

*Comprehension task.* The procedure used in the comprehension task was similar to that of the production task, however, the conversational roles were reversed. After objects were placed in the display by E1, E2 took off her blindfold and asked the child to pick up an object (e.g., “Pick up the duck.”). When she requested an object, she looked at the centre of the display and not at any of the objects. To further ensure that there was no inadvertent cuing, E2 was blind to which condition a particular trial was in and she was not informed which object was the target object versus the referential alternative. Children were not provided with any feedback regarding the accuracy of their object choice.

For a skilled listener, the statement made by E2 (e.g., “Pick up the duck.”) would be ambiguous only in the common ground condition. That is, in the common ground condition, E2 could see both target objects (e.g., big and little duck) so it was unclear which object was the referent of her request. However, in the privileged ground condition, E2 could only see the target object (e.g., big duck), thus the referent of her request was clear.

Two sets of measures were coded: object chosen and eye movements. First, we recorded the object(s) chosen by the child in response to E2’s request. If a child chose both the target and the referential alternative simultaneously, he or she was credited with picking each object. If children showed sensitivity to the perspective of their communicative partner, they would pick up the referential alternative half of the time in the common ground
conditions (because E2 could be referring to either the target or referential alternative), whereas in the privileged ground condition, the target object would be the dominant choice (because it was the only object visible to E2 as the referential alternative was blocked from her view).

Second, children’s fixations to display objects were coded from the onset of the noun (e.g., “/d/” sound of “duck” in the statement, “Pick up the duck.”) to the initiation of the child’s reach toward an object (i.e., the lifting of the shoulders as indicative of an initiation of reaching motion; See Appendix E for Comprehension Task Coding Instructions). We expected that when a request was ambiguous, children would spend more time looking at the referential alternative. Thus, if a child was sensitive to the perspective of their communicative partner, children’s eye movements in the common ground condition would differ (e.g., of a longer duration, with more looks toward the referential alternative) from their eye movements in the privileged ground condition (which would be more similar to the baseline condition because there was no referential ambiguity in either condition).

*Language Task (PPVT).*

In order to obtain a measure of language skills, children were administered the Peabody Picture Vocabulary Test – Third Edition (PPVT-III; Dunn & Dunn, 1997). The PPVT-III is an untimed, individually administered measure of receptive vocabulary skills. Children were asked to point to one of four pictures that corresponded with the word verbally presented by the experimenter. Testing time was roughly ten minutes in length. This test was administered in the standardized fashion. The number of correct items was included as the measure of language abilities in the statistical analyses.
Executive Function Tasks

Working memory measures. Two measures were used to test children’s working memory skills: Digit span, and memory for objects (See Appendix F and G for task instructions). The first measure, digit span is a simple measure of working memory that has been used frequently in the executive function literature (Carlson et al., 2002; Davis & Pratt, 1995; Pennington, 1997). This task, taken from the Wechsler Intelligence Scale for Children III (WISC-III, Wechsler, 1991), involved verbally presenting children with a list of numbers and asking them to repeat the numbers back to the experimenter in the same order. The task becomes increasingly difficult as the number string increases over trials. Children were provided with a 2-digit practice trial (which was corrected if wrong) and then given the test trials. All the children started at the lowest level of the task (i.e., repeating two numbers) and continued until they provided incorrect answers on two consecutive trials of the same number of digits. The children’s total correct number of responses, until the ceiling criterion was achieved, were recorded and used in the statistical analyses. A backwards digit span measure was also administered (i.e., where children were required to repeat back the digit string in a backwards order), but was not used in the statistical analyses as many of the children demonstrated that they did not understand the meaning of the word “backwards” when the instructions were presented (as evidenced by a number of children physically turning themselves around, asking for additional information, or not responding).

The second working memory task used in this study was a modified version of the memory for numbers task used by Ruffman, Rustin, Garnham, and Parkin (2001). In this task, children were presented with a row of three pictures and asked to identify the pictures. The pictures were viewed through a card such that only one row was visible at a time (e.g.,
The children were told that they only had to remember the last picture in every row (which was made more salient by way of a yellow box that surrounded the picture; e.g., *ball, cake*). Children were given two practice trials. In the first practice trial, they saw one row and had to remember only the last picture in that row. In the second practice trial, they were shown two rows (one at a time) and were asked to recall the last picture in each row. Children were praised for their efforts and corrective feedback was given during the practice trials. After the practice trials, children were administered twelve test trials. At the beginning of the test trials, only one row of pictures was presented and children only had to remember one picture. The number of rows presented increased to three by the end of the task and thus, on the most difficult trials, children had to remember the three last pictures that were within the yellow box. Children were administered all trials regardless of their task performance. The total number of correct pictures recalled across all test trials (out of 22) was recorded.

*Inhibitory control tasks.* The red dog / blue dog inhibitory control task used was a Stroop-like task (modified from Beveridge, Jarrold, & Pettit, 2002; See Appendix H for task instructions) wherein children were shown two cards featuring identical dogs that differed only by color (one was red whilst the other was blue). They were told that the name of the blue dog was “Red” and the name of the red dog was “Blue”. They were instructed to provide the appropriate name of the dog as the pictures of the dogs were presented. In order to correctly name the dogs, the children had to inhibit the inclination to provide a label that was consistent with the color of the dog (i.e., calling the blue dog “Blue”). Children were provided with two practice trials and given corrective feedback, to ensure that they understood the rules of the task. A total of 28 trials were administered to the children, half the cards depicted blue dogs and half the cards depicted red dogs, in a
pre-established randomized order. Children’s score on this task was the number of correct responses over the trials (out of 28).

The second task used to measure inhibitory control was a tapping task (Diamond & Taylor, 1996; Hala, Hug, & Henderson, 2003). Children were first presented with a plastic wand. The experimenter then explained that when she tapped her wand once, children were to tap their wand twice and when the experimenter tapped twice, they were to tap once. In this task, children had to inhibit the propensity to imitate the experimenter’s exact actions. After two practice trials, children were administered 10 test trials (i.e., five “one tap” and five “two tap” trials presented in a preset randomized order). Children’s score on this task reflected the number of correct responses out of 10 trials (See Appendix I for Tapping Task instructions).

Cognitive flexibility. The task used to measure cognitive flexibility was the Flexible Item Selection Task (FIST) developed by Jacques and Zelazo (2001; See Appendix J for task description and instructions). This task involved asking children to sort cards according to similar dimensions. There was a demonstration trial, two criterion trials, and twelve test trials in this task. The demonstration trial involved showing the children four cards (i.e., two sets of two cards that match on all four dimensions – namely, size, color, shape, number). The experimenter demonstrated that she was going to pick two cards that were the same and then two cards that were also the same (e.g., children are shown two cards of three large pink fish and two cards of one small orange T-shirt). The two criterion trials were the same as the demonstration trial in format except that the child was instructed to indicate that the two sets of cards that are the same, rather than the experimenter demonstrating this sorting. After the child completed the criterion trials, he or she was administered the 12 test trials. The test trials consisted of the experimenter presenting three
cards that were identical on two dimensions (therefore considered irrelevant to the matching process; e.g., color and shape) but differed on two dimensions (i.e., relevant dimensions; e.g., size and number) (e.g., one card with two big blue fish, one card with two small blue fish, and one card with three big blue fish). Two of the three cards matched on one dimension (e.g., size) and a different pair of cards matched on another dimension (e.g., number). Therefore, for all the test trials, one card (i.e., the test card) had to be used twice in the matching to provide a correct response. The order of card presentation was consistent across all the children and counterbalanced so that the test card (i.e., the card that was used twice in the matching trials) was in different positions across the trials and was never in the same position on more than two consecutive trials. The order used was identical to that used by Jacques and Zelazo (2001). The one difference between the task used by Jacques and Zelazo (2001) and the one used in the present study was that the “sock” cards were replaced by “T-shirt” cards. The reason for this replacement was that as number of items was one of the characteristics of the cards the children had to sort on, it was more appropriate to use single objects (e.g., T-shirt, fish, telephone) than an object that was comprised of two items (i.e., pair of socks – as used in Jacques and Zelazo’s task).

Children were asked to make two selections for each test trial using the same instructions provided on the criterion trials (i.e., “Show me two cards that go together in one way” then, “Show me two cards that go together in a different way,” Jacques & Zelazo, 2001, p. 580). The responses measured were; 1) children’s performance on the criterion trials (used as a check that children understood the basic task instructions), 2) children’s performance on the first selection of two cards in the test trials, 3) children’s second selection of two cards on the test trials. In order for children to be successful on the first selection, they had to correctly detect a relevant dimension on which to sort cards (i.e.,
abstraction). Success on the second selection of each trial required that children have flexibility as evidenced by their ability to sort one card (i.e., the test card) according to two different dimensions. Thus, the key measure in the statistical analyses was children’s response on the second selection when they had first demonstrated success on the first selection (i.e., to rule out that their second response was correct due to random responses).

Results

Children’s performance on the two communication tasks, five executive function tasks, and one vocabulary task were examined in the three sets of analyses. The data was screened to ensure the assumptions associated with the statistical analyses were met. First, children’s ability to tailor their language to the perspective of another person in the production task was analyzed. Second, children’s sensitivity to a speaker’s perspective when interpreting statements in the comprehension task was examined. Finally, the relations between children’s performance on the executive function tasks and their performance on the communication tasks was tested. Preliminary analyses revealed no effect of gender, sibling order, or number of siblings on the children’s performance on the communication and executive function tasks. Thus, these variables were not included in the following analyses.

Communication Tasks

Production Task

Results from the production task are displayed in Figure 2. The variable of interest was the extent to which children used an adjective to describe an object to the experimenter across the five trials of each condition. Recall that we predicted children would be more likely to use an adjective to describe the object when it was required to disambiguate the referent in the common ground condition versus in the privileged ground condition. To
Figure 2. Number of adjectives used in each condition in production task in Experiment 1.
examine this prediction, the data were subjected to a 2 (Task Order) x 3 (Condition) mixed factor ANOVA with task order as a between-subjects factor (i.e., production task first or after the comprehension task) and condition (i.e., baseline, privileged ground, common ground) as a within-subjects factor. There was a significant main effect of task order, $F(1, 59) = 10.57, \eta_p^2 = .15, p < .01$. When children were administered the production task in the first session, they were significantly more likely to produce adjectives to describe the referent object to the experimenter ($M = 39\%, SD = 29\%$) than when they had been administered the production task in the second session ($M = 17\%, SD = 24\%$), collapsed across all three conditions. There was also a main effect of condition, $F(2, 118) = 53.79, \eta_p^2 = .34, p < .001$. The interaction between the communication task order and condition was not significant.

Paired sample t-tests, with a Bonferroni correction (i.e., $0.05/3 = 0.017$) to control for Type I error, were used to follow up on the main effect of condition. Children produced more adjectives in both the privileged ground condition and the common ground condition, ($M = 31\%, SD = 36\%, M = 39\%, SD = 38\%$, respectively) than in the baseline condition ($M = 13\%, SD = 21\%$; $t(60) = 4.93, 7.24, d = .61, .93$ respectively, both $p < .001$). As predicted, children produced significantly more adjectives in the common ground condition than they did in the privileged ground condition, $t(60) = 2.59, d = .33, p < .012$. Thus, children were more likely to use an adjective to differentiate between two similar objects when the experimenter can see both objects versus when the experimenter could only see one of the pair of objects.
Comprehension Task

The variables of interest in the comprehension task were: 1) the object(s) chosen by the children, 2) the number of looks directed toward the referential alternative and target object, and 3) the duration of looking time directed toward the referential alternative and target object. Recall that we expected that children would be less likely to choose an object that was hidden from the speaker’s perspective and would consider this object less in their object choice as evidenced by fewer looks and looking for a shorter duration, at this hidden object. Results from the comprehension task are displayed in Table 2. Preliminary analyses revealed no significant effects for communication task order.

Object(s) chosen. In order to assess whether the objects chosen varied across conditions, two analyses were performed. The first analysis was a paired sample t-test wherein the number of times the referential alternative was chosen in the privileged ground condition (i.e., the object that was blocked from the second experimenter’s view) was compared to the number of times the referential alternative was chosen in the common ground condition. As there was no referential alternative within the baseline condition, this condition was not included in the analyses. Children picked the referential alternative significantly more often in the common ground condition ($M = 56\%, SD = 24\%$) than in the privileged ground condition ($M = 13\%, SD = 19\%$), $t (60) = 11.93, d = 1.53, p < .001$.

The second analysis involved a comparison of how often children chose both objects at the same time across conditions. The choice of both objects simultaneously suggests that children view both the referential alternative and target object as equally plausible selections. Children were significantly more likely to choose two objects in the common ground condition ($M = 14\%, SD = 43\%$) than in the privileged ground condition
Table 2

*Children’s Performance on the Comprehension Task Trials in Experiment 1*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Baseline</th>
<th>Privileged Ground</th>
<th>Common Ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean number of looks at target object (SD)</td>
<td>1.14 (.21)</td>
<td>1.22 (.33)</td>
<td>1.08 (.45)</td>
</tr>
<tr>
<td>Mean number of looks at related (or blocked) object (SD)</td>
<td>.40 (.24)</td>
<td>.72 (.39)</td>
<td>1.05 (.51)</td>
</tr>
<tr>
<td>Mean duration of looks, target object (SD)</td>
<td>500 ms (147)</td>
<td>578 ms (237)</td>
<td>605 ms (461)</td>
</tr>
<tr>
<td>Mean duration of looks, referential alternative (or blocked object) (SD)</td>
<td>138ms (101)</td>
<td>406 ms (307)</td>
<td>640 ms (599)</td>
</tr>
<tr>
<td>Percentage of trials target object chosen (SD)</td>
<td>100% (0)</td>
<td>92% (14%)</td>
<td>61% (24%)</td>
</tr>
<tr>
<td>Percentage of trials referential alternative chosen (SD)</td>
<td>n/a</td>
<td>13% (19%)</td>
<td>56% (24%)</td>
</tr>
<tr>
<td>Percentage of trials two objects chosen (SD)</td>
<td>n/a</td>
<td>4% (11%)</td>
<td>14% (26%)</td>
</tr>
</tbody>
</table>

Note. Percentages of trials target object and referential object were chosen in each condition sum to greater than 100% due to children being credited for picking up both objects when two objects chosen simultaneously.
Together, the results of these analyses suggest that children were less likely to consider the referential alternative to be the potential referent of the experimenter's request when it was blocked from her view, indicating that children were considering the speaker's perspective when interpreting the request.

Eye movement data. For a more sensitive measure of attention to speaker perspective, children's eye movements were recorded from the onset of the noun to the initiation of their reaching motion. To code eye movements, children's performance on the comprehension task was downloaded onto a computer and coded by a research assistant blind to the hypotheses of the study. Due to the location of the video camera (i.e., it was directed at the child's face), the assistant was also blind to the condition of each trial (i.e., placement of objects and door). Responses were analyzed on a frame-by-frame (33 ms) basis using FinalCut Pro 5.0.4, with audio and video signals fully synchronized. The number of looks (i.e., number of times child's gaze was directed towards an object) and duration of looking time (i.e., total amount of gaze toward an object) toward each object was coded. To ensure reliability of the eye movement data, a second experimenter coded data from 15 randomly chosen participants (representing 25% of the total sample). The interrater reliability for the number of looks was: target $r = .87$, referential alternative $r = .91$, blocked object in baseline condition $r = .87$; and for the duration of looking time was: target $r = .89$, referential alternative $r = .96$, blocked $r = .88$.

For analysis purposes, a measure that reflected the number of looks to both target and referential alternatives was calculated for each condition. This measure, the target advantage, was calculated by subtracting number of looks to the referential alternative from the number of looks to the target for trials in the common ground and privileged ground
conditions. For trials in the baseline condition, the number of looks to the blocked object was subtracted from the number of looks to the target, as there was no referential alternative in this condition. These calculations were repeated using the duration of looking measures as well. Thus, the key variables included in the analyses were the target advantage for the number of looks and the target advantage for the duration of looking. These measures were chosen as they reflected the degree to which the target object was considered relative to the referential alternative. That is, if children directed an equal number of looks toward, and looked for an equal duration at, each object it would suggest that they view both objects as equally possible referents of the speaker's request. Alternatively, if the children considered the target object to be the correct referent, they would look more often and longer towards the target object than the referential alternative.

Number of looks. To examine condition differences, the target look advantage variables (i.e., number of looks towards target object relative to referential alternative) were subjected to a one-way ANOVA. A significant main effect of condition was found, $F(2, 120) = 3.77$, $\eta^2_p = .52$, $p < .05$, and was followed up with paired samples t-tests with a Bonferroni correction. The target look advantage for the common ground condition ($M = .028$, $SD = .29$) was significantly less than for the privileged ground condition ($M = .50$, $SD = .40$), $t(60) = 6.84$, $d = .88$, $p < .001$. Both target look advantages for common ground and privileged ground conditions were significantly less than for the baseline condition ($M = .74$, $SD = .39$), $t_s(60) = 11.13$, $4.04$, $d_s = .143$, $.51$, $p_s < .001$, respectively.

Duration of look. A one-way ANOVA on target time advantage (i.e., duration of looks to target relative to duration of looks to related) yielded a significant effect of condition, $F(2, 120) = 33.36$, $\eta^2_p = .40$, $p < .01$. See Figure 3. Follow-up paired sample t-
Figure 3. Duration of looking time towards target object relative to the referential alternative in comprehension task (i.e., target time advantage) in Experiment 1.
tests with a Bonferroni correction indicated that the target time advantage was significantly lower in the common ground condition ($M = -34$ ms, $SD = 300$ ms) than the privileged ground condition, ($M = 171$ ms, $SD = 317$ ms, $t (60) = 3.99$, $d = .51$, $p < .001$). The target time advantage for both the common ground condition and the privileged ground condition were significantly lower than the baseline condition, ($M = 360$ ms, $SD = 173$ ms), $t_s (60) = 7.88, 4.39$, $d_s = 1.00, .56$, $p_s < .001$. Thus, children looked significantly less at the referential alternative (relative to the target object) when the speaker could not see the referential object versus when the speaker could see the referential object. That is, children were using the speaker's perspective, rather than their own privileged perspective, to guide their interpretations of the speaker's requests.

Together, the results of the production and comprehension tasks suggest that 5-year-old children can track and use the perspective of their speaking partner to guide their communicative behaviors. That is, children were more likely to use an adjective to differentiate between two similar objects when the speaker's perspective, rather than their own perspective required they do so. Similarly, children were less likely to consider an object as the correct selection for a request when this object was hidden from a speaker's perspective (but they could see it) versus when both they and the speaker could see the object.

**Executive Function Tasks**

Children were administered five measures to assess three different aspects of executive function, namely, working memory, inhibitory control, and cognitive flexibility. Mean scores on the executive function tasks are displayed in Table 3. Even within the narrow age range of the participants in this study (i.e., 4.5-5.5 years-old), performance on the executive function tasks varied as a function of age, with improvements occurring as
Table 3

*Children’s Performance on the Executive Function and Language Measure, Experiment 1*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Working Memory</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digit span forward</td>
<td>5.42</td>
<td>1.57</td>
</tr>
<tr>
<td>Object memory (/22)</td>
<td>13.07</td>
<td>3.05</td>
</tr>
<tr>
<td><strong>Inhibitory Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tapping task (/10)</td>
<td>7.72</td>
<td>2.53</td>
</tr>
<tr>
<td>Red dog / Blue dog (/28)</td>
<td>23.23</td>
<td>4.3</td>
</tr>
<tr>
<td><strong>Cognitive Flexibility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIST selection 2 (/12)</td>
<td>4.30</td>
<td>3.61</td>
</tr>
<tr>
<td><strong>Verbal Skill</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPVT raw score</td>
<td>78.82</td>
<td>15.51</td>
</tr>
<tr>
<td>PPVT age equivalent</td>
<td>5 years:11 mo.</td>
<td></td>
</tr>
</tbody>
</table>
children’s age increased. The bivariate and partial correlations (when age and verbal skills were controlled for) between measures, are presented in Table 4. One child’s data was excluded from these analyses as his score was a statistical outlier on one inhibitory control task (i.e., he received 0/28 on the Red dog / Blue dog task).

A score for each factor of executive function was compiled. For the working memory category, a composite score was constructed using digit span forward and object memory. These two measures were significantly positively correlated with each other when age and language skills, as measured by the PPVT, were controlled, \( r (60) = .51, p < .001 \). The score was calculated by taking the mean of their digit span proportion score (i.e., child’s score divided by total possible correct) and their object memory proportion scores (i.e., child’s score divided by total possible correct). For inhibitory control, the measures were the performance on the red dog/blue dog and the tapping task. The inhibitory control measures were significantly correlated with each other \( r (60) = .39, p < .05 \), when age and verbal skills was controlled. Children were close to ceiling on the tapping task as over half the children (56%) received a score of 9 or 10 correct answers out of a total possible of 10. As the lack of variability would lower the predictive power of the inhibitory control composite, the tapping task was excluded from the composite and children’s performance on the red dog/blue dog was used as the measure of inhibitory control. The cognitive flexibility measure used was the children’s performance on the second selection on the FIST task when the first selection of cards was correct.

*The Relation between Executive Function Skills and Communication*

Of particular interest in this study were the relations between the executive function measures and children’s performance on the communication tasks. Table 5 shows the
Table 4

*Bivariate and Partial Correlations between Executive Function Measures in Experiment 1*

<table>
<thead>
<tr>
<th></th>
<th>PPVT</th>
<th>Digit Span forward</th>
<th>Object Memory</th>
<th>Tapping Task</th>
<th>Red dog / Blue dog</th>
<th>FIST selection 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>.41**</td>
<td>.31*</td>
<td>.36**</td>
<td>.26*</td>
<td>.26*</td>
<td>.36**</td>
</tr>
<tr>
<td>PPVT</td>
<td></td>
<td>.35**</td>
<td>.42**</td>
<td>.28*</td>
<td>.30*</td>
<td>.36**</td>
</tr>
<tr>
<td>Digit Span</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>forward</td>
<td></td>
<td>.59** (.51**)</td>
<td>.05 (-.09)</td>
<td>.11 (-.02)</td>
<td>.32* (.18)</td>
<td></td>
</tr>
<tr>
<td>Object Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.35** (.26)</td>
<td>.24 (.13)</td>
<td>.19 (.014)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tapping Task</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.46** (.39*)</td>
<td>.18 (.04)</td>
</tr>
<tr>
<td>Red dog / Blue</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.27* (.14)</td>
</tr>
</tbody>
</table>

Note. Partial correlations controlling for age and verbal skills are shown in parentheses.

* p < .05. ** p < .01.
Table 5

*Bivariate and Partial Correlations between Executive Function Measures and Communication Measures in Experiment 1*

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Verbal Skill</th>
<th>Working Memory</th>
<th>Inhibitory Control</th>
<th>Cognitive Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production Task</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of adjectives used in common ground</td>
<td>.21</td>
<td>.25</td>
<td>.25 (.15)</td>
<td>.15 (.03)</td>
<td>.21 (.10)</td>
</tr>
<tr>
<td><strong>Comprehension Task</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Referential alternative chosen in privileged ground</td>
<td>-.18</td>
<td>-.05</td>
<td>-.11 (-.09)</td>
<td>-.43** (-.40**)</td>
<td>-.07 (.01)</td>
</tr>
<tr>
<td>Two objects chosen in privileged ground condition</td>
<td>-.16</td>
<td>-.26*</td>
<td>-.10 (-.01)</td>
<td>-.43** (-.35*)</td>
<td>-.04 (.11)</td>
</tr>
<tr>
<td>Number of Look toward referential alternative privileged ground condition</td>
<td>.002</td>
<td>-.01</td>
<td>-.05 (.02)</td>
<td>-.41** (-.45**)</td>
<td>.004 (.02)</td>
</tr>
<tr>
<td>Duration of looks at referential alternative in privileged ground condition</td>
<td>-.07</td>
<td>-.05</td>
<td>-.11 (.13)</td>
<td>-.42** (-.46**)</td>
<td>.10 (.13)</td>
</tr>
</tbody>
</table>

Note. Partial correlations controlling for age and verbal skills are shown in parentheses.

* *p < .05. ** p < .01.*
correlations between the executive function tasks and performance on the production and comprehension communication task.

Successful communication, as measured by the production task, was assessed by examining children's performance in the common ground condition. That is, in this condition children were faced with a situation in which an adjective was required to unambiguously reference the target object. When age and verbal skills were controlled for, there were no significant correlations between performance on the executive function tasks and children's use of an adjective to unambiguously identify an object.

Rather than examining successful communication per se, in the comprehension task, the lack of success was assessed. That is, the comprehension task allowed us to examine children's egocentric behaviors. In the privileged ground condition, children had visual access to the referential alternative in the display case, whereas the second experimenter was not able to see this object. As such, any behaviors directed towards the referential alternative (i.e., picking up, looking towards) in this condition reflected an egocentric interpretation of the communicative context. Correlations revealed that children's choice of the referential alternative, choosing the referential alternative and target object simultaneously, number of looks to the referential alternative, and duration of looks to the referential alternative in the privileged ground condition were all significantly negatively correlated with performance on the inhibitory control measure, $r_s(60) = -.43, -.43, -.41, -.42$ respectively, all $p_s < .01$. When age and verbal skills were controlled for, the significant relationships remained, all $p_s < .05$. Children's behaviors towards the referential alternative in other conditions (i.e., baseline and common ground) were not significantly correlated with the inhibitory control measure. Thus, children's performance on the inhibitory control measures was related specifically to the children's egocentric interpretations of the
communicative context. No other executive function measures significantly correlated with any measures of children's performance on the comprehension task. That is, all measures of objects chosen and looking behaviours in the baseline and common ground condition were not significant, all $p_s > .17$.

As a further analysis of the relation between executive function and children's communicative competence, four multiple regression analyses were conducted with the following dependent variables: 1) the number of looks children directed toward the referential alternative in the privileged ground conditions, 2) the duration of looks toward the referential alternative in the privileged ground condition, 3) the children's choice of the referential alternative in the privileged ground condition, 4) the children's choice of both the target and referential object simultaneously (i.e., both objects). The independent variables were age, PPVT-III score, the inhibitory control measure, the working memory measure, and the cognitive flexibility measure. The predictor variables together significantly predicted the number of looks to the referential alternative in the first regression, $F(5, 52) = 2.66, p < .05, R^2 = .20$. When the semi-partial correlation coefficients were examined, inhibitory control was the only independent variable that significantly accounted for unique variance in the duration of looks to the referential alternative, $t(52) = 3.6, p < .01$, accounting for 20% of the variance. In the second analysis, the independent variables significantly predicted the duration of looking time toward the referential alternative in the privileged ground condition, $F(5, 52) = 3.64, p < .05, R^2 = .26$. Again, further analyses of the individual predictors revealed that inhibitory control provided the only significant contribution to this regression, $t(52) = 3.99, p < .001$, accounting for 22% of unique variance in the duration of looks toward the referential alternative. In the third analysis, the number of times the children chose the referential alternative, $t(52) = 3.6, p < .01$, accounting for 20% of the variance.
alternative as the referent of the speaker's request was significantly predicted by the
independent variables, $F(5, 52) = 2.42, p < .05, R^2 = .18$. The inhibitory control measure
was the only independent variable that significantly accounted for unique variance in the
dependent measure, $t(52) = 3.17, p < .005$. Finally, the number of times children chose
both objects in the privileged ground condition was not significantly predicted by the
independent variables, $p > .05$.

Thus, when the influence of age, verbal skills, and other executive function skills
are controlled, inhibitory control was significantly related to children's egocentric
processing of statements from others as measured by their references toward and choice of
the referential alternative in the privileged ground condition.

Discussion

Although children demonstrate perspective-taking in theory of mind tasks around
the age of 3 to 4 years (e.g., Perner & Leekam, 1986), previous research has yielded
inconsistent results regarding children's use of another's perspective in communicative
situations (e.g., Glucksberg & Krauss, 1967; Nadig & Sedivy, 2002; O'Neill, 1996;
Pechman & Deutch, 1982). To further examine this issue, young 5-year-old children's
ability to track and make use of the perspective of their speaking partner in comprehension
and production tasks was investigated. Children's successful communicative perspective-
taking was examined in relation to higher-level cognitive skills, namely executive
functions. The results of this study yielded a number of insights into young children's
communicative perspective-taking.

First, young 5-year-old children demonstrated that they were aware of and could
tailor their verbal utterances to the perspective of their listener. That is, children were more
likely to provide an adjective in their requests for an object when an adjective would
disambiguate between two similar objects the listener could see compared with the situation where only the children could see the two objects. These findings highlight young children’s emerging sophistication in communication in that they were able to differentiate between information that was present within the shared context (i.e., common ground) versus information that was available only to them (i.e., privileged ground). Furthermore, they used this information to generate a referential description that unambiguously identified the target object. This is not to say that children were consistently effective in their production of unambiguous referential descriptions as they did not use adjectives to describe the target object on each and every common ground trial. However, of key importance was the discrepancy between how much information children provided when the situation required it from their own perspective versus when the situation required it from their communicative partner’s perspective.

The findings that young children were sensitive to another’s perspective when generating utterances are consistent with previous research which has demonstrated young children’s success in tailoring their nonverbal and basic verbal communications to the perspective of a listener (e.g., Nayer & Graham, 2006; Nadig & Sedivy, 2002; O’Neill, 1996; O’Neill & Topolovec, 2001). That is, the present results indicate that by 5 years of age, children can judge the needs of their communicative partner and use additional linguistic information (i.e., beyond gestures or object names) when required by the listener’s perspective.

Interestingly, the children provided more detailed referential descriptions when they did not first have the experience of being the listener (i.e., in the comprehension task). Previous work has demonstrated that when children are trained on describing differences between referent objects, they provide better descriptions (Whitehurst & Sonnenshein,
1981). However, when children were trained as speakers they did not generalize their skills to a later role as a listener, and vice versa (Sonnenschein & Whitehurst, 1983). Similarly, disparity between children’s referential comprehension skills and production skills (e.g., Hurewitz, Brown-Schmidt, Thorpe, Gleitman, & Trueswell, 2000) suggests these two skills do not develop together nor necessarily influence each other. Thus it is not surprising that the children in the present experiment did not perform better after having the experience of being a listener. However, it is surprising that they performed less well when they had participated in the task as a listener. This finding could be attributed to children’s modeling of adult behaviour. That is, the experimenter’s descriptions of objects (which did not include an adjective) may have influenced children’s subsequent descriptions. The effect of order was not found to interact with the conditions as children produced more adjectives in all three conditions when administered the production task first.

Second, the present findings indicate that children’s choice of objects and eye movement patterns reflected an appreciation for a speaker’s perspective when interpreting requests from others. When the speaker’s instruction matched a similar object children could see, children were less likely to look towards it and choose it when it was blocked from the speaker’s view than when it was available to both the child and the speaker. In this task, children identified whether information to which they had access was shared by the speaker and modified their responses accordingly. That is, children understood that the referential expression (e.g., the *duck*) referred to an object visible to both themselves and the speaker, rather than to the hidden object. The results indicate that this sensitivity to another’s perspective operates at an earlier age than previously found in related work (e.g., Nadig & Sedivy, 2002).
Although children were sensitive to the perspective of a speaker, they continued to be somewhat egocentric in their interpretations of requests. That is, they referenced the referential alternative in the privileged ground condition (when it was blocked from the speaker’s perspective) to a greater extent than they referenced an unrelated blocked object in the baseline condition. If children’s interpretations were guided solely by the speaker’s perspective, their performance in the privileged ground condition would be similar to that of baseline condition. Instead, children referenced the blocked object more when it was a viable match to the speaker’s description, even though the speaker could not see it, relative to how often they referenced a blocked object that was not a descriptive match. This finding is understandable, as even adults show processing of objects obscured from a speaker’s view in communicative tasks (e.g., Keysar, Barr & Horton, 1998). Thus, consistent with the findings from the production task, children do incorporate another’s perspective into their interpretations of requests but do not completely disregard their own perspective.

Third, the results offer insight into the relations between communicative perspective-taking and executive functions. As noted earlier, no research to date has examined which cognitive skills may predict performance on communicative perspective-taking tasks. In our study, the hypothesis that as children develop more advanced executive function skills, they would be more sensitive to the perspective of their conversational partner was tested. Results indicated that children’s interpretation of referential statements was related to their executive function skills; more specifically, to their inhibitory control skills. That is, children who were better able to inhibit a dominant response in order to provide a correct response on a non-linguistic task (i.e., Red dog / Blue dog) were less likely to choose the object that was hidden from the speaker’s view, and spent less time looking at this object in a communicative task. Thus, children who possessed more
developed inhibitory control skills were better able to inhibit their own perspective and adopt the perspective of their speaking partner.

Interestingly, the other executive function skills tested in this study, namely, working memory and cognitive flexibility, did not predict children’s use of another’s perspective for statement interpretation. In terms of working memory, the memory demands of this task were somewhat minimized as the contextual situation provided up-to-date information regarding the speaker’s perspective (i.e., the child was able to see that the speaker did not have visual access to the referential alternative whilst she was producing a statement, rather than having to remember her knowledge state). It may be the case that if a child had to remember a speaker’s knowledge state from a previous context (i.e., if a speaker was provided with some information the child had to keep in mind prior to hearing a statement from this person), a relation between children’s use of their communicative partner’s perspective and memory capacity would emerge.

Cognitive flexibility also did not play a role in children’s interpretation of referential statements in this study. It may be that this skill becomes increasingly important when children are required to shift their thinking about a particular object. That is, in the present study, a child was required to conceptualize the hidden object as one which was seen by him/herself, but not by the experimenter, which may not place great demands on cognitive flexibility. However, referential communication tasks which require a child to define the same object differently using different perspectives may require more flexibility in their thinking. For example, if a child was asked to pick up “the small duck” in a situation where the smallest duck was hidden from the speaker’s view, but a medium and large duck were mutually observable by the child and the listener, the child would have to represent the medium-sized duck as a “medium duck” by his or her own perspective, but as
the “small duck” by the speaker’s perspective. In this scenario, it may be that greater flexibility in representational thinking (presumably, in addition to greater inhibitory control skills) would contribute a child’s success in referential interpretations.

Finally, children’s performance on the production task did not vary with respect to their executive function skills. It may be the case that the executive function skills measured in our study do not play a dominant role in the production of unambiguous referential communications, at least at this stage in children’s development. Conversely, it may be that the measure used to assess children’s perspective-taking in the production task (i.e., number of adjectives used in the common ground condition) was not sensitive enough to show an effect. Thus, while children’s inhibitory control skills play a unique role in enabling children to interpret statements from a speaker’s perspective, different skills may support children’s ability to produce statements that address the needs of a listener.

Given the relation between inhibitory control and children’s tendency to take another’s perspective within the context of interpreting statements, one would expect that as inhibitory control skills continue to develop, children will show a greater ability to correct any initial egocentric interpretations they may have. That is, if children interpret a referential situation initially from their own perspective, their inhibitory control skills would enable them to move beyond this dominant interpretation and take into account a speaker’s view. This process of egocentric correction has been found in adult’s communicative perspective taking abilities. That is, research investigating the role of perspective taking in adult conversations suggests that mutually shared information does not play an immediate role in an individual’s interpretation. Rather, adults’ eye movements suggest that they will initially consider objects blocked from a speaker’s view as potential referents. However, they will use mutual information (i.e., which objects are jointly
observed by both listener and speaker) to adjust their initial interpretations (Keysar, Barr, Balin, & Brauner, 2000). Epley and colleagues (Epley et al., 2004) argued that both adults and children share an egocentric default in perspective taking, and that the difference between adults’ and children’s performance stems from variance in controlled process of interpretation of correction. It may be the case that development in inhibitory control allows for more successful correction of egocentric interpretations. That is, adults are able to correct their interpretation by inhibiting their initially egocentric interpretation, whereas children have more difficulty inhibiting an interpretation that stems from their own perspective. In the present study, although children were generally successful at taking into account the speaker’s perspective, children with less developed inhibitory control skills were less able to inhibit the inclination to consider an object that they alone could see.

The finding of a relation between children’s inhibitory control skills and their ability to use another’s perspective to interpret referential statements is consistent with other research which has documented the role that inhibitory control plays in children’s ability to reason about the mental state of others (e.g. Carlson & Moses, 2001; Carlson, Moses, & Hix, 1998; Hala & Russell, 2001; Leslie & Polizzi, 1998). For example, when experimenters manipulate theory of mind tasks to create more or less demand on executive function skills (i.e., more or less inhibitory control demands), children's performance changes in the predicted direction (Carlson, Moses, & Hix, 1998; Hala & Russell, 2001; Leslie & Polizzi, 1998). In addition, a correlation between executive function performance and theory of mind has been repeatedly found, even when age and verbal skills are partialled out (Carlson & Moses, 2001; Hala et al., 2003). Children who possess the ability to inhibit inappropriate, but obvious, responses were found to achieve higher performance
scores on theory of mind tasks than those children with weaker inhibitory control skills (Carlson & Moses, 2001).

To summarize, the results of this study advance the understanding of young children’s communicative perspective taking in two ways. First, new evidence is provided regarding young 5-year-old children’s emerging sophistication in using their communicative partner’s perspective to form interpretations of instructions and produce requests. Second, insight into the specific cognitive skills that underlie successful perspective-taking in communication is provided. That is, it is demonstrated that children’s inhibitory control skills contribute to their use of another’s perspective in comprehending their communicative partner’s utterances.
CHAPTER THREE: EXPERIMENT TWO

Introduction

The results of Experiment 1 demonstrated that young 5-year-olds possess an emergent ability to take into account the mental state of their speaking partner. Children used the perspective of a listener to guide their production of statements and to interpret statements produced by a speaker. Children’s performance, however, was not solely guided by the perspective of their communicative partner, as the level of information provided by children did not consistently meet the listener’s needs and children continued to reference an object blocked from a speaker’s view (albeit not to the same extent as when the speaker could see the object). Furthermore, the results demonstrated that there is a relation between children’s communicative-perspective-taking and their inhibitory control skills. That is, children who demonstrated better inhibitory control skills were less likely to interpret statements from a speaker in an egocentric fashion. The purpose of Experiment 2 was twofold: first, to examine whether younger children, namely 3- to 4-year-olds were sensitive to another’s perspective when interpreting referential statements; and second, to further explicate the relation between inhibitory control skills and children’s use of another perspective when interpreting statements.

The results from Experiment 1 demonstrated that children younger than previously demonstrated, that is, young 5-years-olds, were sensitive to another’s perspective and used this information in communicative tasks. The second experiment explored whether 3- to 4-year-old children also use this information to guide their interpretations of referential statements. Research has demonstrated that children in this age range can reason about the mental states of others (as measured by theory of mind tasks; e.g., Astington, 1991; Astington & Gopnik, 1991). Therefore, it was of interest to see whether children at this age
will use their newly acquired knowledge of another's perspective effectively in communications. To achieve this goal, children between the ages of 3.5 and 4.5 years were tested on the same comprehension task used in Experiment 1, during which they were asked by a speaker to retrieve objects from a display case. If children in this younger age range are sensitive to the perspective of their speaking partner, they would be more likely to reference the referential alternative in the common ground condition as it is visible to the speaker than in the privileged ground condition where it is blocked from the speaker’s view. Furthermore, if preschoolers consider the object hidden from the speaker’s view as a potential referent for her request (as evidenced by looking towards or picking up the referential alternative) they would be basing this interpretation on their own, rather than the speaker’s perspective.

The second goal of this experiment was to investigate whether a specific type of inhibitory control is related to communicative perspective taking. Recall that inhibitory control refers to the ability to inhibit a response to unimportant stimuli in order to advance toward a cognitively represented goal (Rothbart & Posner, 1985). Inhibitory control tasks have tended to fall into two categories: delay and conflict. Delay inhibitory control tasks require that children suppress an impulsive response for a specified amount of time. For example, a child may be asked to hold off on peeking whilst an experimenter wraps a present for them (Kochaska, Murray, Jacques, Koenig & Vandegeest, 1996). Conflict inhibitory control tasks require that children suppress a salient response and then generate a novel response. For example, a child may be asked to point to a green card when the experimenter says “snow” and a white card when the experimenter says “grass,” (Carlson & Moses, 2001). Performance on both types of inhibitory control tasks improves significantly between the ages of 3- to 5-years (Carlson, 2005). The particular type of
inhibitory control task, namely delay or conflict, has been found be important in predicting mental state reasoning. Indeed, several studies have found that children’s performance on conflict inhibition tasks (requiring both inhibition of a dominant response and elicitation of a new response) relate more strongly to their performance on false belief tasks than performance on delay tasks (that require simply inhibition of a response for a specified time; Carlson & Moses, 2001; Hala et al., 2003).

To disentangle the relationship between inhibitory control and children’s ability to suppress egocentric interpretations of statements from speakers, preschoolers in this experiment were administered four inhibitory control tasks that were chosen from amongst those that have been shown to be age-appropriate for children aged 3 and 4 years old (Carlson, 2005). Children were also were tested on the Peabody Picture Vocabulary Test – Third Edition (PPVT-III), to control for any potential influence of language skills.

Two of the inhibitory control measures administered were conflict tasks (i.e., the children had to call a card with a moon on it “day” and a card with a sun on it “night” (Day / Night task; Gerstadt, Hong, & Diamond, 1994) and follow directions from one puppet but not another (Bear / Dragon task; Reed, Pien, & Rothbart, 1984)). In a review, Carlson (2005) found that 52% of older 3-year-olds and 55% of young 4-year-olds met the pass criteria (i.e., 12/16 correct responses) on the Day/Night task. For the Bear/Dragon task, 76% of older 3-year-olds and 88% of the younger 4-year-olds met the pass criteria (i.e., 4/5 correct inhibition of responses). Both tasks load on a “Conflict” factor in a principal components analysis conducted on ten different inhibitory control measures (Carlson & Moses, 2001).

The other two inhibitory control tasks administered in this experiment were delay tasks [i.e., the children had to suppress the desire to peek whilst an experimenter wrapped a
gift for them (Gift Delay; Kochanska et al., 1996) and prevent themselves from letting go of a pinball game plunger until the experimenter specified (Pinball game; Reed et al., 1984)]. Carlson (2005) found that 48% of older 3-year-olds and 53% of young 4-year-olds met the pass criteria of the gift delay task (i.e., no peeks). Seventy-four percent of older 3-year-olds and 81% of young 4-year-olds met the pass criteria (i.e., 5/6 full wait trials) for the pinball task. Both tasks load on a “Delay” factor in a principal components analysis conducted on ten inhibitory control measures (Carlson & Moses, 2001).

The conflict inhibitory control tasks were anticipated to account for the egocentric interpretations in the comprehension task to a greater extent than the delay tasks. That is, the nature of the conflict inhibitory control tasks is such that preschoolers have to suppress a dominant response in order to provide a correct answer. Similarly, interpreting referential statements requires successful inhibition of one’s own (prepotent) perspective to allow for consideration of a speaker’s perspective. Furthermore, conflict inhibitory control tasks, like referential communication tasks, require that children mediate between two responses. In referential communication, there is the response based on a representation of the context driven from a child’s perspective, and a response derived from representation of the context based on the perspective of his or her speaking partner. It was unclear how preschoolers’ performance on the delay inhibitory control tasks would relate to their interpretations of statements, thus the predictions were more exploratory. On the one hand, delay tasks do not require the generation of an alternate response, but merely require suppression of a behavioural response. This is dissimilar to a referential communication task wherein children have to suppress a dominant interpretation and use an alternative interpretation namely one that takes into account the speaker’s perspective. This would suggest that there would be little relation between communicative perspective-taking and delay inhibition.
However, on the other hand, basic behavioural response suppression is required in the referential communication task in the sense that children are required to inhibit impulsive responding styles in their choice of objects, which would suggest that there may be a relation between children’s interpretation of statements and delay inhibition skills.

**Method**

**Participants**

The final sample consisted of 49 preschoolers ranging from 3 years: 8 months to 4 years: 6 months (32 girls, 17 boys; \( M = 3 \) years: 11 months, \( SD = 1.9 \) months). Data from five preschoolers were excluded from statistical analysis due to a) failure to complete all tasks (\( n = 2 \)); b) failure to follow directions in the tasks (\( n = 2 \)); or c) parents suspected child of having a pervasive developmental disorder (\( n = 1 \)). Preschoolers were recruited from health clinics, Welcome Wagon baby showers, and trade shows. Participants were predominantly Caucasian from varied socioeconomic backgrounds and from homes in which English was the primary language spoken. After being informed of the procedures of the study, parents provided written consent and preschoolers verbally agreed to participate. The preschoolers were given a small toy, a certificate, and a T-shirt for their participation. (See Appendix K for informational material provided to parents).

**Materials**

The materials used for the comprehension task were identical to those used in the first experiment. Materials used in the inhibitory control tasks are discussed in the procedural description of each task.

**Procedure**

During the testing session, preschoolers were tested on 1) the comprehension communication task; 2) a receptive language test; 3) two measures of conflict inhibitory
control; 4) two measures of delay inhibitory control. The comprehension task was always administered first and one of the delay tasks (i.e., one that involved giving the child a gift) was always administered last. Otherwise, the order of tasks was counterbalanced across the preschoolers. Preschoolers received stickers at set points in the procedures (e.g., after the completion of each task, after the guessing game in the comprehension task, after sitting down when they had previously stood up from their seat) to encourage participation.

Preschoolers’ performances on the tasks, with the exception of the language measure and one of the delay tasks (i.e., the pinball game), were video recorded so that their responses could be scored in a detailed fashion at a later time.

Comprehension Task

Preschoolers’ sensitivity to their partner in the context of referential communication was assessed through the comprehension task wherein preschoolers were asked to retrieve objects from a display case by a speaker. The procedure for this task was identical to that used in Experiment 1.

Language Task

In order to obtain a measure of language skills, children were administered the Peabody Picture Vocabulary Test – Third Edition (PPVT-III; Dunn & Dunn, 1997). This test was administered in the standardized fashion. The number of correct items was included as the measure of language abilities in the statistical analyses.

Inhibitory Control Tasks

Conflict inhibitory control tasks. Two measures were used to assess preschoolers’ conflict inhibitory control skills. Both tasks required that preschoolers hold task instructions in mind, withhold a prepotent response, and produce the appropriate response.
One of the tasks administered was the *Day / Night* Task (Gerstadt et al., 1994). This task began with a discussion about what is seen in the sky at night (i.e., the moon and stars), and what it is seen in the sky during the day (i.e., the sun). Preschoolers were then told they would play a “silly” game with the experimenter. She first presented a light blue card depicting a bright yellow sun and black card with a grey moon and stars on it and instructed preschoolers to say “night” when they saw the sun card and “day” when they were presented with the moon card. After two warm-up trials to ensure the preschoolers understood the task, 16 test trials were presented in a fixed, random order (eight of each card type). A response was considered incorrect if the child gave the incorrect answer or if the child did not respond within three seconds. If a child did not respond within three seconds, he or she was prompted by the experimenter who asked, “What is this one called?” This was done to ensure that the preschoolers were aware of the expectation for them to say a name for each card. The total number of correct responses (out of 16 possible correct responses) was used as the measure for this task.

The second conflict task chosen was a modified version of the *Bear / Dragon* task (Reed et al., 1984). The original version of this task used a bear puppet and a dragon puppet. In the present study, a dog puppet and a dragon puppet was used. As a warm-up for this task, preschoolers were instructed to follow a number of instructions (e.g., “Touch your nose.” “Clap your hands.”). Then preschoolers were introduced to a “nice” dog puppet (using a high-pitched voice) and a “naughty” dragon puppet (using a low-pitched voice). The experimenter explained that when the dog said something they were to listen and follow the instructions (e.g., “Touch your head.”), whereas when the dragon said something, they were not to listen and not do what he said. After 5 practice trials, during which corrective feedback was given, preschoolers were administered 12 trials without
feedback (six dragon statements, and six dog statements) in a set randomized order. Preschoolers’ responses on the dragon trials were used as the measure of inhibitory control (0 = movement as commanded, 1 = partial movement to follow command, 2 = different movement, 3 = no movement). Thus, the preschoolers’ performance was scored out of a total of 18 points (i.e., 3 possible points for each of the six dragon commands).

*Delay inhibitory control tasks.* Two measures of delay inhibitory control were administered. Both tasks required that preschoolers hold back their inclination to perform a salient action for a specified amount of time.

The first delay task administered was a *Pinball* game (Reed et al., 1984). In this task, a tabletop pinball game designed for preschoolers was installed with a digital timer. The purpose of the game (i.e., to use the levers to stop the ball from falling to the bottom of the display) was explained, the experimenter demonstrated how to play the game, and preschoolers were given a practice game. Then, preschoolers were told they could play the game, but had to hold back the plunger and wait for the experimenter to say “Go,” before they let it go. There were six test trials that had delay times of 10, 15, 25, 15, 20, 10 seconds, respectively. The digital timer recorded the length of time the preschoolers held back the plunger. The total length of time preschoolers held back the plunger (/ a total of 95 Seconds across the trials) as well as the number of correct (full wait time; /6) trials were recorded.

The second delay task administered was the *Gift Delay* Task (Kochanska et al., 1996). In this task, preschoolers were told they had done a great job on all the games and were going to receive a toy to take home. The experimenter indicated that she wanted to make the gift a surprise and therefore, was going to wrap the present. Preschoolers were asked to sit in a chair facing away from the experimenter and told to try not to peek whilst
the present was being wrapped. The experimenter then took a toy out from a box and wrapped it noisily in crinkly wrapping paper for one minute. The preschoolers’ peeking behaviors were recorded using a video camera and later scored (i.e., whether they peeked: 0 = fully turned around peek, 1 = peek over their shoulder, 2 = no peek). See Appendix L for Inhibitory Control Task Instructions.

Results

Preschoolers’ performance on the referential comprehension task, receptive vocabulary task, and the four inhibitory control tasks (two delay tasks and two conflict tasks) were examined in the following sets of analyses. Of particular interest was whether preschoolers who had better developed inhibitory control skills exhibited less egocentric interpretation and behaviour on the comprehension task.

Comprehension Task

The interactive comprehension task was used to investigate the degree to which preschoolers interpret communicative contexts from their own versus their speaking partner’s perspective. As in Experiment 1, the measures of interest in this task were: 1) the object(s) chosen by the preschoolers, 2) the number of looks directed toward the referential alternative and target object, and 3) the duration of looking time directed toward the referential alternative and target object. If preschoolers were sensitive to the speakers’ communicative perspective, it was anticipated that they would be less likely to choose an object that was hidden from the speaker’s perspective and would consider this object less in their object choice as evidenced by fewer looks, looking for a shorter duration, at this hidden object. Results from the comprehension task are displayed in Table 6. Preliminary analyses revealed no effect of gender or number of siblings on comprehension task performance.
Table 6

*Children's Performance on the Comprehension Task Trials*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
</tr>
<tr>
<td>Mean number of looks at target object (SD)</td>
<td>1.03 (.16)</td>
</tr>
<tr>
<td>Mean number of looks at referential alternative (or blocked object) (SD)</td>
<td>.37 (.26)</td>
</tr>
<tr>
<td>Mean duration of looks at target object (SD)</td>
<td>415 ms (122)</td>
</tr>
<tr>
<td>Mean duration of looks at referential alternative (or blocked object) (SD)</td>
<td>166 ms (93)</td>
</tr>
<tr>
<td>Percentage of trials target object chosen (SD)</td>
<td>100%</td>
</tr>
<tr>
<td>Percentage of trials referential alternative chosen (SD)</td>
<td>n/a</td>
</tr>
<tr>
<td>Number of times two objects chosen (SD)</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Note: Percentages of trials target object and referential object were chosen in each condition sum to greater than 100% due to children being credited for picking up both objects when two objects chosen simultaneously.
Objects chosen. In order to assess whether the objects chosen varied across conditions, two analyses were performed. The first analysis was a paired sample t-test wherein the number of times the referential alternative was chosen in the privileged ground condition (i.e., the object that was blocked from speaker’s view) was compared to the number of times the referential alternative was chosen in the common ground condition. As there was no referential alternative within the baseline condition, this condition was not included in the analyses. Results indicate that preschoolers picked the referential alternative significantly more often in the common ground condition \((M = 60\%, SD = 23\%)\) than in the privileged ground condition \((M = 30\%, SD = 29\%)\), \(t(47) = 7.20, d = 1.04, p < .001\). The second analysis involved a comparison of how often preschoolers chose both objects in the conditions. Preschoolers were significantly more likely to choose two objects in the common ground condition \((M = 19\%, SD = 34\%)\) than in the privileged ground condition \((M = 13\%, SD = 27\%)\), \(t(47) = 2.01, d = .29, p < .05\). Together, these results suggest that preschoolers are less likely to consider the referential alternative to be the potential referent of the speaker’s request when it is blocked from her view. That is, they are taking into account her perspective when choosing objects.

Eye movement data. For a more sensitive measure of attention to speaker perspective, children’s eye movements were recorded from the onset of the noun to the initiation of their reaching motion. To code eye movements, children’s performance on the comprehension task was downloaded on to a computer and coded by a research assistant blind to the hypotheses of the study. Due to the location of the video camera (i.e., it was directed at the child’s face), the assistant was also blind to the condition of each trial (i.e., placement of objects and door). Responses were analyzed on a frame-by-frame (33 ms) basis using FinalCut Pro 5.0.4, with audio and video signals fully synchronized. The
number of looks and duration of looking time toward each object was coded. To ensure reliability of the eye movement data, a second assistant coded data from 15 randomly chosen participants (representing 25% of the total sample). The interrater reliability for the number of looks was: target $r = .87$, referential alternative $r = .91$, blocked object in baseline condition, $r = .88$; and for the duration of looking time was: target $r = .95$, referential alternative, $r = .98$, blocked $r = .89$.

As in Experiment 1, a measure reflecting the number of looks to both target and referential alternatives was calculated for each condition. This measure, the *target look advantage*, was calculated by subtracting number of looks to the referential alternative from the number of looks to the target for trials in the common ground and privileged ground conditions. For trials in the baseline condition, the number of looks to the blocked object was subtracted from the number of looks to the target, as there was no referential alternative in this condition. These calculations were repeated using the duration of looking measures as well (i.e., *target time advantage*). The key variables included in the analyses, therefore, were the target advantage for the number of looks and the target advantage for the duration of looking. These measures were chosen as they reflected the degree to which the target object was considered relative to the referential alternative. That is, if children looked for an equal number and duration towards each object it would suggest they view both objects as equally possible referents of the speaker’s request. Alternatively, if the children considered the target object to be the correct referent, they would look more towards the target object than the referential alternative.

Number of looks. The target look advantage measures (i.e., number of looks toward the target object relative to the referential alternative) were subjected to a one-way ANOVA. A significant main effect of condition was found, $F (2, 96) = 37.81$, $\eta_p^2 = .45$, $p$
< .001. To follow-up on this effect, paired samples t-tests that controlled for Type I error were conducted. The target look advantage for the common ground condition \((M = - .042, SD = .42)\) was significantly smaller than for the privileged ground condition \((M = .32, SD = .44)\), \(t(47) = 4.04, d = .58, p < .001\). Both the privileged ground and common ground target look advantages were significantly smaller than in the baseline condition \((M = .65, SD = .32)\), \(t_s(47) = 4.92, 8.57, d_s = .71, 1.24, p_s < .001\), respectively.

Duration of looks. Results of a one-way ANOVA on the target time advantage measure yielded a significant effect of condition, \(F(2, 96) = 25.05, \eta^2_p = .35, p < .001\). See Figure 4. Follow-up paired sample t-tests with a Bonferroni correction indicated that the target time advantage (i.e., duration of looks to target relative to duration of looks to related) was significantly lower in the common ground condition \((M = -32 ms, SD = 289 ms)\), \(t(47) = 3.49, d = .50, p < .01\) than the privileged ground condition \((M = 139 ms, SD = 229 ms)\). Both the privileged ground and common ground condition target time advantage were significantly lower than the baseline condition \((M = 300 ms, SD = 154 ms)\) \(t_s(47) = 4.08, 6.47, d_s = .59, .93, p_s < .001\), respectively.

**Inhibitory Control Measures**

Mean scores on the IC measures are shown on Table 7 and the correlations amongst the measures are shown on Table 8. Children's age was significantly correlated with their verbal skills, but was not related to any of the inhibitory control measures. The number of siblings a child had was significantly positively correlated with their performance on one of the inhibitory control measures (i.e., Dog / Dragon, \(r = .40, p < .01\)), and gender was related to another inhibitory control measure (i.e., Day / Night, \(r = .40, p < .01\); with girls outperforming boys.
Figure 4. Preschoolers’ duration of looking time towards target object relative to the referential alternative in comprehension task (i.e., target time advantage) in Experiment 2.
Table 7

*Children’s Performance on the Inhibitory Control and Language Measures, Experiment 2*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean (SD)</th>
<th>Pass Criteria</th>
<th>% of Participants who met Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Verbal Skill</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPVT</td>
<td>56.02 (11.49)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>PPVT Age equivalent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 years: 5 mos</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Conflict Inhibitory Control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog / Dragon (/18)</td>
<td>12.19 (7.55)</td>
<td>18/18</td>
<td>50.0%</td>
</tr>
<tr>
<td>Day / Night (/16)</td>
<td>9.13 (5.21)</td>
<td>11/16</td>
<td>52.1%</td>
</tr>
<tr>
<td><strong>Delay Inhibitory Control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gift Delay (score / 2)</td>
<td>1.29 (.87)</td>
<td>2/2 (i.e., no peeks)</td>
<td>56.3%</td>
</tr>
<tr>
<td>Pinball (total wait time / 95s)</td>
<td>77.36s (25.75)</td>
<td>95s (i.e., no release before allotted time)</td>
<td>47.9%</td>
</tr>
</tbody>
</table>
Table 8

Bivariate and Partial Correlations between Inhibitory Control Measures in Experiment 2

<table>
<thead>
<tr>
<th></th>
<th>PPVT</th>
<th>Dog / Dragon</th>
<th>Day / Night</th>
<th>Gift Delay</th>
<th>Pinball</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>.29*</td>
<td>.12</td>
<td>-.05</td>
<td>.11</td>
<td>-.15</td>
</tr>
<tr>
<td>PPVT</td>
<td></td>
<td>.40**</td>
<td>.53**</td>
<td>.21</td>
<td>.16</td>
</tr>
<tr>
<td>Dog / Dragon</td>
<td>.40** (.23)</td>
<td></td>
<td>-.001 (.02)</td>
<td>.35* (.28)</td>
<td></td>
</tr>
<tr>
<td>Day / Night</td>
<td></td>
<td>.25 (.23)</td>
<td></td>
<td>.34* (.25)</td>
<td></td>
</tr>
<tr>
<td>Gift Delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.16 (.23)</td>
</tr>
</tbody>
</table>

Note. Partial correlations controlling for age and verbal skills are shown in parentheses.

* p < .05. ** p < .01.
As preschoolers’ performance on three out of the four inhibitory control tasks was close to ceiling (i.e., with roughly 50% achieving the highest possible score), preschoolers’ ability to meet a specified pass criterion for each task was used for statistical analyses rather than raw scores. The pass criterion for each of the inhibitory control tasks was determined based on whether the children successfully responded to all items of the task (i.e., for pinball, gift delay, dog/dragon tasks) or the score that roughly 50% of preschoolers achieved (i.e., for the day/night task; See Table 7).

For the dog/dragon task, successful inhibition of all the actions dictated by the dragon was determined to be the passing criterion, with 50% of preschoolers meeting this level. The pass criterion for the day/night task was providing 10 or more correct responses (out of 16), with 52% of the preschoolers meeting this criterion. A pass of the gift delay was successful inhibition of a peeking response in the allotted one minute time period and the passing criterion for the pinball game was being able to inhibit pulling the plunger before the experimenter said “Go” on all trials. Fifty-six percent of preschoolers achieved the gift delay pass criteria and 48% of preschoolers met the pinball pass criteria.

As previous research has found both the day/night and dog/dragon task load onto a “conflict” factor of inhibitory control, the preschoolers’ pass/fail scores on these tasks were summed to calculate a score reflecting their conflict inhibitory control skills (Carlson & Moses, 2001). In order to calculate the preschoolers’ delay inhibitory control skills, their pass/fail scores on the pinball and gift delay tasks were summed, as both scores have been found in previous studies to load onto a “delay” factor (Carlson & Moses, 2001). Thus, all preschoolers received a “0,” “1” (passed on one task), or “2” (passed two tasks) for both the conflict and delay inhibitory control measures.
Inhibitory Control and Communication

The privileged ground condition within the comprehension task allowed for an investigation of how well preschoolers were able to take into account the perspective of their speaking partner when they interpreted and responded to instructions. That is, if preschoolers interpreted the instructions from the speaker from an egocentric perspective, they would be just as likely to reference the referential alternative (hidden from the speaker’s view) as the target object. Thus the key measures on this task were the degree to which the preschoolers selected the referential alternative or chose both the target and referential alternative. Both actions reflect an egocentric bias as they would be indicative of preschoolers’ belief that the experimenter could be referring to the referential alternative. Preschoolers’ duration of eye gaze towards the referential alternative was also examined. If preschoolers considered the referential alternative to be a potential referent, they would be more likely to look towards it. Preschoolers’ performance on the communicative measures in the privileged ground condition were compared to their inhibitory control task performance.

The bivariate and partial correlations (when age and verbal skills were controlled) between the inhibitory control and communication measures are presented in Table 9. Preschoolers who performed better on the conflict inhibitory tasks were less likely to look at the referential alternative in the privileged ground condition, \( r (48) = -0.293, p < .05 \).

Furthermore, preschoolers with better conflict inhibitory skills demonstrated a higher target time advantage (i.e., they looked for a longer duration towards the target object than the referential alternative) in the privileged ground condition, \( r (48) = 0.347, p < .05 \). Both these correlations remained significant when age and verbal skills were partialled out of the relation, \( r_s (42) = -0.320, 0.312 \) respectively, \( p_s < .05 \). Preschoolers’ conflict inhibition
Table 9

*Bivariate and Partial Correlations between Inhibitory Control Measures and Communication Measures in Experiment 2*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Age</th>
<th>Verbal Skill</th>
<th>Conflict Inhibitory Control</th>
<th>Delay Inhibitory Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referential alternative picked in privileged ground condition</td>
<td>-.26</td>
<td>-.36*</td>
<td>-.24 (-.20)</td>
<td>-.30* (-.28)</td>
</tr>
<tr>
<td>Two objects picked in privileged ground condition</td>
<td>-.21</td>
<td>-.29</td>
<td>-.10 (-.03)</td>
<td>-.38** (-.36*)</td>
</tr>
<tr>
<td>Duration of eye gaze at referential alternative in privileged ground condition</td>
<td>-.16</td>
<td>-.16</td>
<td>-.29* (-.32*)</td>
<td>-.29* (-.28)</td>
</tr>
<tr>
<td>Target time advantage in privileged condition</td>
<td>.25</td>
<td>.20</td>
<td>.35* (.31*)</td>
<td>.08 (.06)</td>
</tr>
</tbody>
</table>

Note. Partial correlations controlling for age and verbal skills are shown in parentheses.

* p < .05. ** p < .01.
scores were not related to any other measure on the communication task. In contrast, the preschoolers’ delay inhibitory control skills were significantly related to their choice of objects in the privileged ground condition. That is, when age and verbal skills were accounted for, preschoolers who had better delay inhibitory control skills chose two objects (i.e., the target and referential alternative) less often, \( r(42) = -.363, p < .05 \). Children’s delay skills were also found to relate to their choice of two objects in the common ground condition, \( r(42) = -.31, p < .05 \), when age and verbal skills were partialled out.

As a further test of the relation between the two dimensions of inhibitory control and egocentric communicative behaviors, multiple regression analyses were conducted. The dependent variables were the egocentric behaviours in privileged ground condition, namely 1) the number of times the referential alternative was chosen, 2) the number of times both the related and target object was chosen simultaneously, 3) the duration of eye gaze toward the referential alternative, and 4) the duration of eye gaze toward the referential alternative relative to the duration of eye gaze toward the target object. In all of the regression analyses, the predictor variables were the child’s age, PPVT score, conflict inhibitory control score, and delay inhibitory control score. For the first regression analysis, the independent variables together predicted the number of times preschoolers chose the referential alternative, \( F(4, 41) = 2.82, p < .05, R^2 = .22 \). However, no predictor alone accounted for a significant amount of unique variance, \( p_s > .12 \). Thus, age and verbal skills together with the different measures of inhibitory control predict children’s choice of the referential alternative in the privileged ground condition. However, this relationship is not specific to the contribution of one independent variable.

For the second analysis, the predictor variables predicted the number of times a child picked up both the related and target object simultaneously, accounting for 22.1% of
the variance, $F(4, 41) = 2.90, p < .05, R^2 = .22$. Preschoolers’ delay inhibitory control score was the only measure that independently significantly predicted this dependent variable, accounting for 12.3% of unique variance, $t(45) = 2.54, p < .05$. Thus, when the contribution of age, verbal skills, and conflict inhibitory control are partialled out, children who had more difficulty on the delay inhibitory control tasks were significantly more likely to choose both the target and the referential alternative simultaneously in the privileged ground condition.

The duration of eye gaze toward the referential alternative was not significantly predicted by the regression equation ($p > .92$), however the duration of eye gaze towards the target object, relative to the duration of eye gaze to the referential alternative (i.e., target time advantage) was predicted by the equation, $F(4, 41) = 3.16, p < .05, R^2 = .24$. The only predictor that accounted for a unique amount of variance was conflict inhibitory control, which accounted for 8.5% of the variance, $t(45) = 2.13, p < .05$. Thus, when the contribution of age, verbal skills, and delay inhibitory control were accounted for, children who were less successful on the conflict inhibitory control measures tended to show more egocentric eye movements in that they referenced the referential alternative (relative to the target object) for a longer duration.

In sum, the results suggest that preschoolers’ conflict inhibitory control skills are related to the degree to which the referential alternative was considered, prior to initiating any behaviour, as a potential referent for the experimenter’s request. Preschoolers who performed well on the conflict inhibitory control measure looked for a shorter duration at the referential alternative relative to the time they looked at the target object. In contrast, preschoolers’ delay inhibitory control skills were related to the actual object choice. That is,
preschoolers with proficient delay inhibitory control skills were less likely to pick up both the referential alternative and target object simultaneously.

Discussion

In this second experiment, preschool-age children demonstrated sensitivity to a speaker’s perspective in their interpretations of referential statements. When children were asked to retrieve an object from a display case, their eye gaze duration towards an object that was a correct referential match, but was blocked from the speaker’s view, was shorter than when the speaker had visual access to that object. Similarly, they were less likely to choose an object when it was blocked from the speaker’s view even when it matched her description. However, similar to the performance of the older children in the first experiment, preschoolers in this experiment were not able to completely disregard their own perspective in their interpretations in that they referenced (and occasionally chose) the object blocked from the speaker’s view when it was a referential match to her description.

The present studies do not allow for a fine-grained analysis of the exact time during a communicative interaction that common ground information plays a role. That is, it is not clear from the present work whether children initially adopt an egocentric perspective and then move beyond it to take into account common ground information at a later stage of processing or whether children use common ground information from the primary stages of processing. Work with adults has demonstrated that the former hypothesis is most likely to be the case. Keysar and his colleagues argue that individuals do not restrict their search of referents to those which are contained in the common ground. Rather, the role of common ground information is to correct initially egocentric interpretations (Horton & Keysar, 1996; Keysar et al., 2000; Keysar, Barr, Balin, & Paek, 1998).
The results of the present study demonstrate that, consistent with the findings of Experiment 1, preschoolers’ egocentric behaviour was related to their inhibitory control skills. In particular, preschoolers who demonstrated better conflict inhibitory control skills had less egocentric processing. Preschoolers’ performance on two tasks that measured their ability to suppress a prepotent response in order to generate a correct response accounted for unique variance in how long they looked at an object blocked from a speaker’s view relative to an object that was available to both the speaker and the child. Furthermore, preschoolers’ delay inhibitory control skills were related to their ability to suppress incorrect and impulsive responses. That is, preschoolers who were more successful at withholding a response for a specified amount of time were less likely to choose both the mutually observable and hidden object simultaneously.

In Experiment 1, children’s conflict inhibitory control skills were predictive of both egocentric processing (i.e., the amount of time children looked at the referential alternative in the privileged ground) and egocentric choices (i.e., the number of times the referential alternative was chosen by children). In the first experiment, however, the contribution made by delay inhibitory control was not accounted for as there was no delay inhibition task included in the regression analyses. In the second experiment, preschoolers’ inhibitory control conflict composite was correlated with the preschooler’s inhibitory control delay composite. As a result, the relationship found between inhibitory control and egocentric choices in the first experiment may have been due to the variance in the conflict measure that would be shared with delay tasks. That is, in the second experiment, when the delay component is partialled out, the relationship between conflict inhibitory control and children’s egocentric interpretations relates more specifically to their looking behaviour. In contrast, the preschoolers’ delay inhibitory control skills were related to their choice of two
objects. By controlling for the shared variance between the two inhibitory control types, a
dissociation between the type of inhibitory control measure and response is elucidated.

The relation between conflict inhibition and children's consideration of the
referential alternative (relative to the target) is not surprising given the similarities in the
components of the tasks. In the conflict inhibitory control tasks, preschoolers had to both
suppress a dominant response and generate an alternative response. As well, when
interpreting statements from others, suppression and then alternate response generation is
involved. In order to be successful in their interpretations of statements from others,
children have to suppress the dominant egocentric interpretation and then generate an
interpretation that is based on the speaker's perspective. In both tasks children have to
mediate between two representations and inhibit the dominant one in order to be successful.
Another component of the conflict inhibitory control tasks is that they require a degree of
working memory load in the sense that to be successful a child has to keep in mind the
rules of the task, and the alternative answer, when generating a response (Carlson et al.,
2002). Similarly, for successful referential communication to take place, the listener must
hold in mind the intentional state of a speaker when forming an interpretation. Thus, it may
be that only when the children develop a certain level of proficiency in inhibition, and are
able to synthesize this with the ability to hold in mind information that is common ground,
will they be able to use the speaker's perspective when interpreting statements. However, it
should be noted that working memory alone was not predictive of children's
communication skills in Experiment 1. Furthermore, the memory component of the
comprehension task was minimized as the children had continual access to information
about the speaker's knowledge while they were interpreting her statements (i.e., rather than
having to recall this information from memory). Thus, it is more likely that it is the ability
to inhibit a dominant representation in order to take into account a less salient representation that is driving the relationship between conflict inhibition and communicative interpretations, rather than the added working memory component per se.

Preschoolers’ ability to suppress responses for a specified amount of time during the nonverbal inhibition delay tasks was related to their choice of both objects. This finding contrasts with results from theory of mind studies which have generally found that delay inhibition does not play a role in children’s mental state reasoning (e.g., Carlson et al., 2002; Hala et al., 2004) however some studies have found delay inhibition relates to theory of mind ability, e.g., Carlson & Moses, 2001). The relation in this study, however, likely reflects the fact that both the choice of two objects and the delay tasks reflect a basic measure of suppression. In the delay tasks, the children had to merely suppress a response, rather than generate an alternative response. In the comprehension task, to be successful overall, the preschoolers would have to form an interpretation that was in line with the perspective of the speaker, in addition to suppressing their perspective. The act of picking up two objects in the comprehension task reflects an incorrect and impulsive style of responding. For example, if we consider a child with no ability to delay responses, we could anticipate that when this child were to hear “Pick up the duck,” when there are two ducks present (with one blocked from the speaker’s view), his / her impulsive-style behavioural response could be to just to pick up everything relevant, with little consideration about what would be a correct response to the request. It was as if the children with little ability to delay their responding were unable to suppress their responses enough in the comprehension task to operate on the basis that there is even an actual correct or incorrect response. In the present study, preschoolers who had less developed delay skills were also more likely to choose two objects in the common ground condition, which
supports the notion that having problems with delay inhibition may be more related to being able to prevent down impulsive responses, than mediating between one’s own versus another’s perspective.

In sum, the findings of the second experiment demonstrate that the relationship between inhibitory control and children’s ability to take into account the perspective of the speaker is present in children as young as 4-years old. Furthermore, Experiment 2 provides more precise insight into the nature of the relation between inhibitory control and communicative perspective-taking by demonstrating that conflict inhibition was related to children’s egocentric cognitive processing while delay inhibition was related to an incorrect behavioural-style of responding.
CHAPTER FOUR: GENERAL DISCUSSION

The goals of the present studies were to examine the perspective-taking abilities of young children in referential communication tasks and to assess which cognitive skills contributed to children’s sensitivity to their speaking partner’s perspective. The results of both experiments highlighted young children’s emergent ability to use their speaking partner’s perspective during referential communications. In the role of the speaker, 5-year-old children used the listener’s perspective to dictate whether disambiguating information was required. In the role of a listener, 4- and 5-year-old children’s interpretation of messages was guided by the perspective of the speaker. Across both studies, inhibitory control contributed to children’s ability to generate interpretation from the speaker’s, rather than their own, perspective.

The results of the present studies offer insight into the developmental emergence of children’s communicative perspective-taking abilities. Previous research has found that children as young as 2-years-old have an understanding that others can possess a visual perspective that is different from their own (Masangkay, McCluskey, McIntyre, Sims-Knight, Vaughn & Flavell, 1974), and are able to use information about what another person saw to guide their use of communicative gestures (e.g., O’Neill, 1996). Results from Experiment 1 add to this line of work by demonstrating that 5-year-old children produce disambiguating verbal information when it is required by the listener’s perspective more often than when it is required by their own perspective. A comparison of the present results to those of Nadig and Sedivy (2002) indicates that this ability continues to develop between 5 and 6 years of age. That is, 6-year-old children (Nadig & Sedivy, 2002, Experiment 1) provided unambiguous descriptions to their listeners on the majority of the trials in a similar task, more than produced by the 5-year-old children in the present study (75% as
compared to 39% in our study). By adulthood, individuals produced adjectives 100% of the time when required by the listener’s perspective when tested on similar tasks (Nadig & Sedivy, 2002). Thus, children’s communicative perspective-taking appears to follow a developmental progression whereby the needs of a communicative partner are initially addressed through gestures and basic linguistic information, followed by the ability to use increasingly sophisticated language to tailor communications to the perspective of a listener.

In terms of interpreting referential messages, the results of Experiment 1 and 2 demonstrate that 4- and 5-year-olds use a speaker’s perspective as one constraint on how they interpret messages. During the comprehension task children looked toward the referential alternative much less in the privileged ground condition, when it was hidden from the speaker’s view, than in the common ground condition when it was mutually observeable. Furthermore, they chose the referential alternative as the correct referent of the speaker’s description less in the privileged ground condition than in the common ground condition. Interestingly, a developmental trend was observed in that younger children were more likely to choose the referential alternative in the privileged ground condition (i.e., reflecting an egocentric interpretation of a statement) than the older children. That is, 5-year-olds chose the referential alternative 13% of the time on the comprehension task whereas 4-year-olds chose the referential alternative 30% of the time. It therefore appears that children become better able to use a speaker’s perspective to guide their response choices during this developmental period.

How, then, does a child develop the ability to successfully incorporate another’s perspective into his or her communicative interactions? Results from Experiment 1 and 2 demonstrate the importance of inhibitory control in children’s ability to use a speaker’s
perspective to guide their interpretations. That is, as children develop the ability to inhibit their own perspective, they become better able to use another’s perspective to guide their interpretations of referential statements. Furthermore, the results of Experiment 2 demonstrate that not only must children be able to suppress responses in isolation of other activities to be successful communicators. Rather, they must be able to synthesize the suppression with an ability to generate an alternate, less salient response (i.e., one that takes into account the speaker’s perspective). The results of the present study do not directly assess the causal role that inhibitory control plays in children’s development of communicative perspective-taking. The results do, however, fit with the notion that increased sophistication of children’s executive function skills makes a child’s mental state reasoning possible (e.g., Carlson et al., 2002; Hala et al., 2002).

The role of inhibition in children’s communicative interpretations appears to be specific to their ability to take into account the perspective of the speaker. In both experiments, children’s ability to inhibit a dominant response and generate an alternate response was predictive of their egocentric processing when age and verbal skills (and other executive function skills in Experiment 1) were partialed out of the relation. Moreover, their performance on conflict inhibition tasks was related to eye gaze measures only within the privileged ground condition and only those directed towards the referential alternative. Recall that the referential alternative in the privileged ground condition was the object that was visually available only to the child. Any processing of this object would, therefore, reflect an egocentrism as the speaker would not have requested an object she could not see. Thus, within referential communication, children’s inhibitory control skills relate specifically to their ability to suppress the egocentric interpretations, rather than other aspects of communication.
Future Directions

The present findings demonstrate that young children are able to use another’s perspective in communications, and provide evidence that inhibition plays a role in allowing children to use a speaker’s perspective when interpreting statements. There are a number of ways in which this research could be extended to more fully explore children’s communicative perspective-taking and the underlying cognitive skills necessary.

In two experiments, children demonstrated sensitivity to what contextual information was mutually available versus privileged. However, in day-to-day conversations, successful communicators must take into much more than their communicative partner’s visual perspective. Inferences about mutual knowledge may be based on information that was shared between two parties days or even years prior and can be acquired through a number of avenues, including previous conversations, activities, background knowledge, and general assumptions about interpersonal exchanges (Ackerman, 1993). Thus, an important next step in this research agenda is to examine how children are able to track shared (versus privileged) information from a variety of sources, and use this information to guide the way in which they communicate with another person at a later time period. It is conceivable that because of the increased cognitive demands of tracking common ground information over time, this ability might emerge at a later developmental stage than that tested in the present studies. In addition, as this type of communicative perspective-taking involves retrieving information about a speaker’s past knowledge, memory skills may play a greater role in predicting their communicative perspective-taking than was demonstrated in the present experiment.

Another direction for future research would be to examine the role of feedback on children’s communicative perspective-taking abilities. In the present study children were
not provided with feedback regarding the accuracy of their responses. That is, during the production task (Experiment 1), the listener was told previously what the correct object was and always chose this object regardless of the clarity of the child’s message. During the comprehension task (Experiment 1 and 2), children were not told whether the object they had selected was correct or not. Previous research, however, has demonstrated that descriptions provided by speakers are affected by feedback (Krauss & Weinheimer, 1966) and that even 3-year-old children can modify initial descriptions when additional information is requested (Deutsch & Pechman, 1982). Thus, it would be of interest to assess whether children would demonstrate an increased ability to use the perspective of their communicative partner if they are provided with the feedback that their initial responses (in terms of either statement production or interpretation) were inadequate.

In a similar vein, it would be interesting to assess how a child’s home environment and interactions with caregivers play a role in the development of communicative perspective-taking skills. Certainly, within the realm of language development, parents play an important role in facilitating word learning through social means, such as their participation in joint attention episodes (e.g., Carpenter, Nagell, & Tomasello, 1998). One could conceive that children’s communicative perspective-taking skills would be substantially influenced by the communicative success of their parents. The nature of the relationship would be interesting to assess as one could argue for a number of different directions. For example, it might be the case that children model their parents’ styles in that when parents successfully incorporate their child’s perspective, children learn to do the same (similar to the modeling that was demonstrated in Experiment 1). However, it could also be the case that when children are continually communicating with a caregiver who demonstrates an ability to read the nonverbal cues of their child and respond to the child’s
needs without the child providing adequate information, the child may not have the experiences of communicative breakdowns that would allow for a learning opportunity. In a sense, the child would not need to take his or her caregiver’s perspective into account in order for the child’s communicative goals to be accomplished, and this lack of necessity could lead to slower learning.

In order to further explore the nature of children’s difficulty producing unambiguous referential statements, future research could examine the children’s performance during a production task in an on-line fashion. Although, the first experiment demonstrated that 5-year-old children used the listener’s (to a greater extent than their own) perspective to dictate whether additional information (in the form of a colour or scalar adjective) was required in their requests, they were not completely successful in their descriptions. Children regularly did not provide sufficient information to disambiguate between the target and referential alternative object in the common ground condition. There are two possible explanations for children’s difficulty with this situation. One explanation is children did not provide enough information in these situations because they did not assess the context sufficiently. That is, once they knew which object they were to describe, they did not look at any of the other objects. In their descriptions, then, an adjective was not provided because the context did not appear to require it. Alternatively, children may have reliably assessed the context (i.e., been aware that there were two similar objects that needed to be disambiguated), but were not able to incorporate this information into the production of their statements. Future research could examine these two possibilities through an analysis of children’s on-line eye movements during the course of production of referential statements. In addition, one could test the possibility that children are not successful in referential descriptions in the common ground condition because of a failure
to fully appreciate the context through an examination of performance when children have been explicitly made aware of the nature of a given context. For example, if children’s difficulty with the production of statements is due to not appreciating the context, one would expect that if they were asked acknowledge all the objects in the display case, they would provide better referential descriptions. However, if their difficulty was due to an inability to incorporate this information, one would expect that having children look at all the objects would not provide any benefit.

In addition to advances in inhibitory control skills, there are likely other factors that influence the likelihood children will take into account the perspective of a speaker when interpreting statements. An interesting direction for future research would be to examine which situational factors may play a role in determining children’s communicative perspective-taking performance. For example, research has demonstrated that adults who are successful on a noncommunicative perspective-taking task show more egocentric interpretation when they are engaged in a competing task, or if they are provided with little motivation regarding the accuracy of their judgment (Epley, Keysar, Van Boven, & Gilovich, 2004). It may be the case that children’s communicative perspective-taking shows the same malleability in particular contexts.

Conclusion

In summary, the results of these studies advance our understanding of young children’s communicative perspective taking in two ways. First, the present studies demonstrated that children as young as 4-years-old demonstrate an emergent ability to use the perspective of their speaking partner to guide their communicative behaviours. Second, the studies demonstrate that inhibitory control allows children to inhibit their own perspective so that their communicative interpretations are guided by the perspective of
their speaking partner. These results suggest that children who have deficits in inhibitory control may have corresponding difficulties with referential communication. This finding is particularly important when examining various disorders which have problems with inhibition as part of their deficits, such as attention-deficit hyperactivity disorder (Barkley, 2003) and fetal alcohol spectrum disorder (Kodituwakku, Kalberg, & May, 2001; Schonfeld, Paley, Frankel, & O'Connor, 2006) as well as disorders where communication and perspective-taking is lacking, such as autism spectrum disorder (Baron-Cohen, 1988; Baron-Cohen, Leslie, & Frith, 1985).
References


Individual Differences: A Developmental Perspective (pp.93-123). New York: Plenum.


APPENDIX A: Experiment 1 Informed Consent, Debriefing Form, and Parent Results

Letter
Informed Consent Form: Parents

Research Project Title: The Relationship between Children’s Executive Functioning and Communicative Competence

Investigators: Dr. Susan A. Graham, Liz Nilsen
Funding Agency: Social Sciences and Humanities Research Council of Canada

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, please ask. Please take the time to read this form carefully and to understand any accompanying information.

The purpose of this project is to examine communicative development in childhood. One key aspect of communicative competence is that the two persons involved in conversation (or communicative exchange) must have some understanding of the other’s mental state. For example, each person must be aware of what the other person knows and sees. This study is designed to examine children’s ability to adapt their communications based on information that is both shared and not shared by their communicative partner. In addition, we want to examine the skills that predict children’s ability to adapt their communications. The cognitive skills which we hypothesize are predictive of children’s performance in communicative tasks are their ability to hold information in mind (working memory), hold back initial responses (inhibitory control), and change their focus of attention (cognitive flexibility), as well as their language abilities. The tasks will involve asking your child to 1) remember and repeat back some numbers he/she hears, 2) label cards as they are presented, 3) sort cards based on the dimensional properties of the objects represented (e.g., by colour, size, shape, number), and 4) respond to questions assessing his/her expressive and receptive vocabulary (i.e., how many words he/she can produce/understand). The communication tasks involve a production and comprehension component. In the production task your child will be asked to instruct an experimenter to pick up various objects (e.g., cups and balls) from a display. In the comprehension task a researcher will instruct your child to pick up various objects in a display. In both tasks some objects will be visible to both the child and researcher, whereas others will be visible only to the child. We are examining how your child’s behaviour differs when key objects are visible to both the experimenter and the child versus when they are just visible to the child.

Two sessions are required in order to look at all the tasks we are interested in. Each session (scheduled approximately one week apart) will last approximately half an hour. Portions of the testing will be videotaped so that the researchers may code your child’s responses at a later time. This video tape and score sheets will be identified by participant number only and will remain confidential. Only researchers within the Language and Cognitive Development Lab will have access to the data. If you have any questions about the study, the researcher will gladly answer them.
Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have any further questions concerning matters related to this research, please contact Liz Nilsen, Department of Psychology, University of Calgary; 220-4955 or Dr. Susan Graham, Associate Professor of Psychology, University of Calgary; 220-7188.

If you have any concerns about the way you’ve been treated as a participant, please contact Bonnie Scherrer, Research Services Office, University of Calgary at (403) 220-3782; email bonnie.scherrer@ucalgary.ca.

A copy of this consent form has been given to you to keep for your records and reference. This research has the ethical approval of the Conjoint Faculties Research Ethics Board.

Parent (Guardian): ___________________ Date: ______________

Investigator: _____________________ Date: ______________
My signature below certifies that I consent to my child's participation in the project entitled "The Relationship between Children’s Executive Functioning and Communicative Competence" and have received a copy of the consent form describing this research:

Child's name: ___________________________  PLEASE Circle: Male  
Female

Child's birth date: ___________________  
Year/Month/Day  Child's Age (in months) ____________

Child’s siblings and date of birth:
Male  Female  birth date: ___________ (Year/Month/Day)
Male  Female  birth date: ___________ (Year/Month/Day)
Male  Female  birth date: ___________ (Year/Month/Day)

Parent/Guardian name (print):
____________________________________

Parent/Guardian signature:
____________________________________

Date: __________________

Please fill out your name and address below if you would like to receive a copy of the results of the study:

Name: _____________________________
Address: ___________________________
Dear parents:

We would like to thank you very much for allowing your child to participate in our research study on early communication and cognitive development. We very much appreciate your willingness to come to our laboratory at the University of Calgary.

This research is being conducted in order to better understand communicative development in early childhood. We are interested in looking at how well children take into account what information is common to themselves and their communicative partner. We hypothesize that children’s performance on various cognitive tasks will be related to their communicative competence.

The cognitive skills that were measured were working memory, inhibitory control, cognitive flexibility, and language. The working memory tests examined how long your child could hold in memory and repeat back a string of digits or objects. The task measuring mental flexibility involved having your child sort cards based on their dimensions (size, colour, number, shape). Language skills were assessed using a standard language test where your child had to respond to questions (e.g., pointing to pictures that corresponded with the verbal label). Inhibitory control (i.e., your child’s ability to inhibit an original response to make the correct response) was tested through 1) a test that involved showing your child pictures dogs of and were asked to call the dog by a name that was different to the colour that the dog was (i.e., they had to inhibit the natural response of saying the colour of the dog when providing the name) and 2) a test that involved having to tap a different number of taps than the experimenter had demonstrated (i.e., inhibiting the response to imitate the experimenter’s actions).

Communicative competence is measured by investigating how well children take into account information that is common to themselves and their communicative partner. In the production task we were looking at whether children were more likely to use scalar or colour adjectives (e.g., big and small; red and green) in a situation where they need to distinguish between two similar objects that are both visible to the experimenter, compared to a situation where the experimenter can only see one object. In the comprehension task, we are interested in whether children’s eye movement pattern is different in a situation where all the objects are viewed by both the children and the experimenter compared to a situation where one object is obscured from the experimenter’s point of view. That is, do they look to both objects or just to the object that the experimenter can see?

The main purpose is to investigate whether children’s performance on the cognitive tasks predict their performance on the communication tasks. When the study has been completed, we will send a copy of our group results to those of you who have requested them.

Once again, thank you for your interest and participating in our studies. Much of what we know about how children’s cognitive abilities and communicative understanding develop has come from studies such as the ones that we are conducting. This research would not be possible without the generous contribution of time and effort by families such as yours. If you would like further information about the results of this study or have any questions about issues concerning language or cognitive development, please do not hesitate to contact Liz Nilsen at 220-4955. You can also contact Dr. Susan Graham at 220-7188.
Dear Parent(s),

We would like to thank you and your child very much for participating in our research study on The Relationship between Executive Functions and Children’s Communicative Competence. We greatly appreciated your willingness to come with your child to our laboratory at the University of Calgary. Findings from this study were presented at the Biannual Cognitive Development Society Meeting in San Diego, California this past fall and will be submitted for presentation to the Society for Research in Child Development Biennial Meeting in Boston, Massachusetts, in the spring of 2007. Findings from this study will be submitted as partial fulfillment for a doctoral thesis. We would like to take this opportunity to share our results with you. The results letter consists of findings from the study your child participated in which is the first of two studies for this project.

One key aspect of successful communication is the ability to identify the information that is/is not shared by the hearer and speaker. Past research has demonstrated that children often do not use this information in referential communicative contexts, as indicated by their tendency to use terms that are unfamiliar to their listener, and not provide adequate information when referring to specific objects (e.g., asking for “the red one” when there is both a red car and a red ball visible). However, other studies have found that children at a young age are sensitive to the knowledge state of others. Thus, the purpose of this study was to examine the discrepancy between the two findings. That is the overall goal of this study was to examine what skills enable children to be successful communicators. More specifically we were interested in investigating 1) children’s sensitivity to, and use of, the perspective of another person, and 2) what skills are related to children’s ability to tailor their communication to the perspective of the other person?

In this study, your child was asked to do a number of tasks over two sessions. At the beginning of each session, your child took part in the communication tasks. One communication task identified children’s comprehension skills, and the other highlighted the children’s production skills. Both tasks involved placing four objects on a display case and using sliding doors at the back of the display case to block off specific objects from the experimenter’s view. In the comprehension task, your child was asked to pick up an object by the experimenter. We were interested in whether children in this age group would consider objects that were hidden from the experimenter’s view and be more confused in the condition where there were two objects that fit the description given by the experimenter. In the condition where there were two objects that fit the description given by the experimenter. In the condition where there were two objects that fit the description given by the experimenter. In this task, we were interested in whether children would be more likely to provide an adjective (e.g., “the big duck”) in the condition where there were two similar objects visible to the experimenter (e.g., a duck that differed in size) than when one of the objects was blocked from the experimenter’s view.
Following the communication tasks, children took part in a number of tasks that measured their executive function skills. That is, their working memory (i.e., ability to hold information in mind – as measured by two tasks one that measured memory for objects, the other memory for a string of digits), inhibitory control (i.e., ability to prevent themselves from making an obvious response to make the correct response – as measured by a task that required them to tap a wand differently than the experimenter, and another where they were asked to call a blue dog “red” and a red dog “blue”), and their cognitive flexibility (i.e., their ability to switch their focus – as measured by a card sorting task where they were asked to make judgments on how to group cards depicting different objects together based on different properties of the objects). Your child’s language skills were assessed using a standard language test where your child had to respond to questions (e.g., pointing to pictures that corresponded with the verbal label).

The findings of the communication tasks indicated that, as a group, children between the ages of four and six are sensitive to the perspective of their speaking partner. That is, in the comprehension task, they were more likely to look longer between objects when two potential objects were visible to the experimenter, than when one object was hidden from the experimenter’s view. That is, they appeared to have an understanding that the experimenter cannot be asking for something they are not able to see, therefore, the object they want must be the visible one. This finding demonstrates that, at this stage of development, children do not operate from a completely egocentric perspective. In the production task children demonstrated the same sensitivity in that they provided an adjective when describing an object significantly more when there were two similar objects on the display case compared to when there was just one. Furthermore, children provided an adjective significantly more when the experimenter had visual access to both objects, than when she was only able to see one object. Thus, the children were able to tailor their communication to the listener’s perspective.

To address the second purpose of the study – that is investigating the skills required for successful communication – the children’s performance on the communication tasks were examined in relation to their executive function skills. We found that children who performed well on the inhibitory control tasks (i.e., red dog / blue dog task) were less likely to reference the objects hidden from the experimenter’s view in the comprehension communication task. Thus, it appears that children who have stronger inhibitory control skills are better able to inhibit their own perspective as reflected by less egocentric communicative behaviour in the comprehension task.

These findings are important because they demonstrate the sensitivities that children have to the perspective of another person at this stage of their development. In addition, they highlight skills that children might require prior to developing successful communication skills, namely inhibitory control.

Once again, thank you so much for your interest and participation in our studies. This research would not be possible without the generous contribution of time and effort by families such as yours. If you would like further information about the results of this study
or have any questions about issues concerning cognitive and language development, please do not hesitate to contact Dr. Graham at 220-7188 or Liz Nilsen at 220-4955.

Sincerely,

Susan Graham, Ph.D., C. Psych.
Associate Professor and
Canada Research Chair

Liz Nilsen, M.Sc.
Ph.D. Clinical Psychology Student
APPENDIX B: Communication Task Stimuli
### Object Pairs for Communication Tasks

<table>
<thead>
<tr>
<th>Target / Referential Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big / Small Duck</td>
</tr>
<tr>
<td>Big / Small Elephant</td>
</tr>
<tr>
<td>Big / Small Glass</td>
</tr>
<tr>
<td>Big / Small Star</td>
</tr>
<tr>
<td>Big / Small Hat</td>
</tr>
<tr>
<td>Big / Small Flower</td>
</tr>
<tr>
<td>Big / Small Glass</td>
</tr>
<tr>
<td>Blue / Red Ball</td>
</tr>
<tr>
<td>Green / Yellow Apple</td>
</tr>
<tr>
<td>Red / Grey Car</td>
</tr>
<tr>
<td>Brown / White Bear</td>
</tr>
<tr>
<td>Green / Purple Grapes</td>
</tr>
<tr>
<td>Blue / Red Cup</td>
</tr>
<tr>
<td>Pink / Green Frog</td>
</tr>
<tr>
<td>Brown / Black Horse</td>
</tr>
</tbody>
</table>

*Note 1.* The order of objects was counterbalanced across participants.

*Note 2.* For each object pair, the target / referential alternative distinction was counterbalanced across participants (i.e., the big duck was the target object for roughly half the participants and the small duck was the target object for half the participants).

*Note 3.* Unrelated objects were chosen from an array of toys of similar interest that did not match the test objects on form (i.e., there was no other glass, flower, horse etc.). For example, a whale, a football, a plate, a bottle, etc.
APPENDIX C: Production Task Instructions and Response Sheet
Instructions for Production Task: (note – instructions modified if this task follows the comprehension task)

Okay (child’s name) we are going to play a fun game with (Experimenter’s name). Now I’ll explain what this is here. I am going to be putting some toys in these boxes here. When this door is open, (Experimenter’s name) can see what is there. When this door is closed, she can’t see. (Demonstrate sliding doors) So sometimes we have to give her some clues as to what it behind this door.

First (Experimenter’s name) needs to put on her blindfold so she can’t see what we are doing. Does she have her blindfold on? Okay, I’ll put this here, and this here, and this here – and we’ll close up this door (put object in all four quadrants, close door on bottom right which is holding a banana).

Okay, we’re ready (Experimenter’s name). (Experimenter takes off blindfold) What can you see?

Experimenter: I can see (object 1), (object 2), and a (object 3). I don’t know what’s behind there. Can you give me some hints?

Okay, let’s give her some hints. Hmmm... what would be a good hint...

You can eat it – “is it a cookie?”
No... it’s shaped long - “is it a hot dog?”
No... it’s yellow – “is it a sucker?”
Hey... I know a good hint... what do you have to do to eat it? You have to... peel it
- “is it a banana” Yes!

Now, (Experimenter’s name) is going to put on her blindfold again. This time, before we play the guessing game, YOUR job is to ask (Experimenter’s name) to pick something up. But this is a tricky game in that you have to keep you hands tucked down here like this (demonstrate hands on lap), so you have to use your words to get her to pick it up.

I’m going to put this here, and here, and here and close up this door here so she can’t see (put objects in all four quadrants of display).

This time I want you to pick up this thing right here (point to predetermined target object).

Okay, we’re ready (Experimenter’s name)

(If child is not responding: Go ahead.).

(Experimenter has list of correct objects in her lap, hidden from child’s view, and always picks up correct object regardless of child’s description)

Good playing!

(Experimenter puts on her blindfold. Process is repeated for all 15 trials – with intermittent guessing games).
### Coding Sheet – Production Task

<table>
<thead>
<tr>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition:</td>
<td>Condition:</td>
<td>Condition:</td>
<td>Condition:</td>
</tr>
<tr>
<td>Use of adj: Y N</td>
<td>Use of adj: Y N</td>
<td>Use of adj: Y N</td>
<td>Use of adj: Y N</td>
</tr>
<tr>
<td>Scalar or colour</td>
<td>Scalar or colour</td>
<td>Scalar or colour</td>
<td>Scalar or colour</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trial 5</th>
<th>Trial 6</th>
<th>Trial 7</th>
<th>Trial 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition:</td>
<td>Condition:</td>
<td>Condition:</td>
<td>Condition:</td>
</tr>
<tr>
<td>Use of adj: Y N</td>
<td>Use of adj: Y N</td>
<td>Use of adj: Y N</td>
<td>Use of adj: Y N</td>
</tr>
<tr>
<td>Scalar or colour</td>
<td>Scalar or colour</td>
<td>Scalar or colour</td>
<td>Scalar or colour</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trial 9</th>
<th>Trial 10</th>
<th>Trial 11</th>
<th>Trial 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition:</td>
<td>Condition:</td>
<td>Condition:</td>
<td>Condition:</td>
</tr>
<tr>
<td>Use of adj: Y N</td>
<td>Use of adj: Y N</td>
<td>Use of adj: Y N</td>
<td>Use of adj: Y N</td>
</tr>
<tr>
<td>Scalar or colour</td>
<td>Scalar or colour</td>
<td>Scalar or colour</td>
<td>Scalar or colour</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trial 13</th>
<th>Trial 14</th>
<th>Trial 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition:</td>
<td>Condition:</td>
<td>Condition:</td>
</tr>
<tr>
<td>Use of adj: Y N</td>
<td>Use of adj: Y N</td>
<td>Use of adj: Y N</td>
</tr>
<tr>
<td>Scalar or colour</td>
<td>Scalar or colour</td>
<td>Scalar or colour</td>
</tr>
</tbody>
</table>

Baseline number of adjectives (/5): ____

Privileged number of adjectives (/5): ____

Common ground number of adjectives (/5): ____

Number of scalar: ____ number of colour: ____ other? ____
APPENDIX D: Experiments 1 and 2 Comprehension Task Instructions and Response

Sheets
Instructions for comprehension task: (note – initial instructions modified if this task follows the production task)

(Child’s name) I’m going to explain a couple things to you. First of all, I’ll explain what this is here. This is your sticker page. So as we go through this game you have a chance to get lots of stickers. You get stickers for doing really good stuff like listening well… for example when we came in here I said “you can sit down on the blue chair” and what did you do? You sat right down on the chair. Good work. (give sticker). So, how many stickers do you think you can get?

Now I’ll explain what this is here. This is a video camera that is taking pictures of what you do, so make sure you sit pretty still. You are doing great sitting still right now.

Now I’ll explain what this is here. I am going to be putting some toys in these boxes here. When this door is open, (Experimenter’s name) can see what is there. When this door is closed, she can’t see. (Demonstrate sliding doors) So sometimes we have to give her some clues as to what it behind this door.

First (Experimenter’s name) needs to put on her blindfold so she can’t see what we are doing. Does she have her blindfold on? Okay, I’ll put this here, and this here, and this here – and we’ll close up this door (put object in all four quadrants, close door on bottom right which is holding a banana).

Okay, we’re ready (Experimenter’s name). (Experimenter takes off blindfold) What can you see?

Experimenter: I can see (object 1), (object 2), and a (object 3). I don’t know what’s behind there. Can you give me some hints?

Okay, let’s give her some hints. Hmmm... what would be a good hint...

You can eat it – “is it a cookie?”
No... it’s shaped long - “is it a hot dog?”
No... it’s yellow – “is it a sucker?”
Hey... I know a good hint... what do you have to do to eat it? You have to... peel it
- “is it a banana” Yes!

Great hints!

Now, (Experimenter’s name) is going to put on her blindfold again. I’m going to put this here, and here, and here and close up this door here so she can’t see (put objects in all four quadrants of display). Now, before we play the guessing game, (Experimenter’s name) is going to ask you to pick something up. What you need to do is pick up whatever she asks for and give it to me. Got it?
Okay, we’re ready (Experimenter’s name).

Experimenter: “pick up the: _____” (eyes looking at centre)

Okay!, or Alright!

(Guessing game – after the first trial and then every 3 trials). Sticker after every guessing game. Can give praise for good hints, good sitting etc.

**Guessing game:** (Experimenter’s name), What do you think is behind this door?
Experimenter: “I don’t know, can I have a hint?” (guesses wrong first couple hints, then can guess right if really obvious
Coding for Comprehension Task

TR=top right; TL=top left; BR=bottom right; BL=bottom left
Note: record time for each saccade
Note: record if clarification on target object was requested
Note: start coding at “the”, stop coding when child retracts from the display (i.e., object in hand, eyes off the display)

Trial 1: Condition: 

Verbal utterance/queries: 
Object(s) picked up: 
Number of looks at each quadrant: TL: , TR: , BL: , BR: 
Total time on each quadrant: TL: , TR: , BL: , BR: 
Any other behaviour?: 

Trial 2: Condition: 

Verbal utterance/queries: 
Object(s) picked up: 
Number of looks at each quadrant: TL: , TR: , BL: , BR: 
Total time on each quadrant: TL: , TR: , BL: , BR: 
Any other behaviour?: 

Trial 3: Condition: 

Verbal utterance/queries: 
Object(s) picked up: 
Number of looks at each quadrant: TL: , TR: , BL: , BR: 
Total time on each quadrant: TL: , TR: , BL: , BR: 
Any other behaviour?:
Trial 4: Condition:

Verbal utterance/queries:

Object(s) picked up:

Number of looks at each quadrant: TL: , TR: , BL: , BR:

Total time on each quadrant: TL: , TR: , BL: , BR:

Any other behaviour?:

Start of Reaching:

END:

Trial 5: Condition:

Verbal utterance/queries:

Object(s) picked up:

Number of looks at each quadrant: TL: , TR: , BL: , BR:

Total time on each quadrant: TL: , TR: , BL: , BR:

Any other behaviour?:

Start of Reaching:

END:

Trial 6: Condition:

Verbal utterance/queries:

Object(s) picked up:

Number of looks at each quadrant: TL: , TR: , BL: , BR:

Total time on each quadrant: TL: , TR: , BL: , BR:

Any other behaviour?:

Start of Reaching:

END:
<table>
<thead>
<tr>
<th>Trial 7: Condition:</th>
<th>Verbal utterance/queries:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Object(s) picked up:</td>
</tr>
<tr>
<td></td>
<td>Number of looks at each quadrant: TL: , TR: , BL: , BR:</td>
</tr>
<tr>
<td>Start of Reaching:</td>
<td>Total time on each quadrant: TL: , TR: , BL: , BR:</td>
</tr>
<tr>
<td>END:</td>
<td>Any other behaviour?:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trial 8: Condition:</th>
<th>Verbal utterance/queries:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Object(s) picked up:</td>
</tr>
<tr>
<td></td>
<td>Number of looks at each quadrant: TL: , TR: , BL: , BR:</td>
</tr>
<tr>
<td>Start of Reaching:</td>
<td>Total time on each quadrant: TL: , TR: , BL: , BR:</td>
</tr>
<tr>
<td>END:</td>
<td>Any other behaviour?:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trial 9: Condition:</th>
<th>Verbal utterance/queries:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Object(s) picked up:</td>
</tr>
<tr>
<td></td>
<td>Number of looks at each quadrant: TL: , TR: , BL: , BR:</td>
</tr>
<tr>
<td>Start of Reaching:</td>
<td>Total time on each quadrant: TL: , TR: , BL: , BR:</td>
</tr>
<tr>
<td>END:</td>
<td>Any other behaviour?:</td>
</tr>
</tbody>
</table>
Trial 10: Condition: ________________

Verbal utterance/queries: __________________________

Object(s) picked up: __________________________

Number of looks at each quadrant: TL: __________, TR: __________, BL: __________, BR: __________

Start of Reaching: ________________

Total time on each quadrant: TL: __________, TR: __________, BL: __________, BR: __________

END: ________________

Any other behaviour?: __________________________

Trial 11: Condition: ________________

Verbal utterance/queries: __________________________

Object(s) picked up: __________________________

Number of looks at each quadrant: TL: __________, TR: __________, BL: __________, BR: __________

Start of Reaching: ________________

Total time on each quadrant: TL: __________, TR: __________, BL: __________, BR: __________

END: ________________

Any other behaviour?: __________________________

Trial 12: Condition: ________________

Verbal utterance/queries: __________________________

Object(s) picked up: __________________________

Number of looks at each quadrant: TL: __________, TR: __________, BL: __________, BR: __________

Start of Reaching: ________________

Total time on each quadrant: TL: __________, TR: __________, BL: __________, BR: __________

END: ________________

Any other behaviour?: __________________________
Trial 13: Condition: 

Verbal utterance/queries: 

Object(s) picked up: 

Number of looks at each quadrant: TL: , TR: , BL: , BR: 

Total time on each quadrant: TL: , TR: , BL: , BR: 

Any other behaviour?: 

Start of Reaching: 

END: 

Trial 14: Condition: 

Verbal utterance/queries: 

Object(s) picked up: 

Number of looks at each quadrant: TL: , TR: , BL: , BR: 

Total time on each quadrant: TL: , TR: , BL: , BR: 

Any other behaviour?: 

Start of Reaching: 

END: 

Trial 15: Condition: 

Verbal utterance/queries: 

Object(s) picked up: 

Number of looks at each quadrant: TL: , TR: , BL: , BR: 

Total time on each quadrant: TL: , TR: , BL: , BR: 

Any other behaviour?: 

Start of Reaching: 

END: 

APPENDIX E: Instructions for Coding the Comprehension Task
**Comprehension Coding Instructions:**

**Eye gaze:**
- Begin coding eye movement at the “the” – record where eyes are looking at this point and continue from there:
  - e.g., (1st fixation)
    - TR →
    - 2:26
    - (onset of “the”)
- code based on point of view (note sides are backwards to account for child’s point of view):
  
<table>
<thead>
<tr>
<th>TR</th>
<th>TL</th>
</tr>
</thead>
<tbody>
<tr>
<td>BR</td>
<td>BL</td>
</tr>
</tbody>
</table>

- eye movement is coded at point of initiation – so, as soon as eye starts to move it is considered to be time at the quadrant it is moving towards.

**Eye gaze to centre / exp:**
- If child looks at centre with somewhat of a pause – this would be coded as centre
- If child looks at centre, but it is part of the fluid movement to some other quadrant (e.g., BL to TR) then the centre spot would not be coded, rather it would be considered the move to TR.
- If child looks at experimenter – code EXP

**Beginning of words:**
- words are coded at the very first onset of the noun (e.g., the “duh” of duck)

**Coding movement to pick up object:**
- beginning of reach is point at which the movement is initiated. If a child stands up to pick something up (in a smooth movement), the beginning of the reach would be at the point of standing up – however if the child stands up to look around and then picks something up – the reach would be coded at the arm movement.
- If they lean: code as part of the reach if it is part of the fluid movement. If they are leaning in to get a better look then initiate a movement the lean would not get coded – the actual reach would.

**Time calculation:**
- Time calculation is for the time between the onset of noun and beginning of reach (note: however, coding starts at the onset of “the” and continues until the retraction from the display case.

**Picking up two objects:**
- If a child picks up two objects, the time calculation is to the reach for the first object (however code the reaches to both)
I am considering that they picked up two objects if the objects were reached for almost simultaneously – not if they picked up on and handed it to me and then picked up another (to err on side of caution if in doubt code both reaches).

Verbal utterances:
- occasionally a child might say something like “which one” or “I’ll pick the red one” – these comments should be recorded and the onset at which they happened indicated.
APPENDIX F: Experiment 1 Working Memory Task 1: Digit Span Instructions and Response Sheets
Digit Span Task: (Wechsler, 1991)

NOTE: Actual material not included due to protection of test material

An example task (i.e., with different numbers) is provided.

Forward:

<table>
<thead>
<tr>
<th>Item</th>
<th>Trial</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 - 8</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5 - 1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4 - 2 - 5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2 - 1 - 5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3 - 4 - 7 - 2</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6 - 2 - 8 - 9</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>5 - 8 - 6 - 7 - 3</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8 - 1 - 6 - 7 - 6</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>8 - 9 - 4 - 7 - 3 - 2</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>6 - 7 - 8 - 9 - 4 - 2</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>8 - 8 - 5 - 1 - 3 - 4 - 6</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1 - 7 - 2 - 1 - 4 - 7 - 2</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1 - 5 - 1 - 7 - 3 - 1 - 5 - 2</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>1 - 8 - 5 - 2 - 2 - 7 - 3 - 2</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>2 - 7 - 3 - 2 - 7 - 3 - 7 - 2 - 1</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>3 - 7 - 5 - 1 - 5 - 6 - 8 - 3 - 5</td>
<td></td>
</tr>
</tbody>
</table>

Total Number of Correct Trials: ________

Backwards:

<table>
<thead>
<tr>
<th>Item</th>
<th>Trial</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4 - 5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5 - 1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1 - 7</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3 - 9</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3 - 7 - 4</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>8 - 7 - 6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1 - 8 - 9 - 2</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>4 - 4 - 5 - 3</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>6 - 5 - 1 - 9 - 7</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>9 - 7 - 6 - 7 - 4</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>3 - 9 - 7 - 2 - 4 - 8</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1 - 6 - 8 - 5 - 3 - 6</td>
<td></td>
</tr>
</tbody>
</table>

Total Score Digit Backward: ________
APPENDIX G: Experiment 1 Working Memory Task 2: Object Memory Instructions and Response Sheets
Participant Number: ______

Instructions:

Okay ______ For this next game I am going to show you some pictures, I want you to say
aloud what the pictures are and try to remember the last picture you see. So after you say
the pictures I will ask you to tell me what the last picture in each row is, the one in the
yellow square.

Let’s try this one. What are these pictures here (leaf, frog, shoe) – okay, now what was the
picture in the yellow square? (shoe) – very good.

This one’s a little trickier, let’s try it. What are the pictures here (sock, ball, cake – and –
leaf, sun, pig) – so what were the last pictures of each row (cake, pig)

(if correct) – very good – you told me pictures in the yellow box
(if not correct) – that’s not quite right, in this example you saw sock, ball, cake and leaf,
sun, pig (show full view of card) – so the last picture in the rows would be cake and pig.

Okay, now we are going to try the real game.
You are to say the pictures aloud and then tell me the last picture on each row that are in the
yellow square.

<table>
<thead>
<tr>
<th>Working Memory Task Response Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (ball) ______</td>
</tr>
<tr>
<td>2. (sock) ______</td>
</tr>
<tr>
<td>3. (fork) ______</td>
</tr>
<tr>
<td>4. (frog, shoe) ______</td>
</tr>
<tr>
<td>5. (pig, leaf) ______</td>
</tr>
<tr>
<td>6. (pig, cake) ______</td>
</tr>
</tbody>
</table>

Items correct (i.e., in correct order; /8 (not including one item trials): ______

Total numbers correct (/22): ___
APPENDIX H: Experiment 1 Inhibitory Control Task 1: Red dog / Blue dog Instructions and Response Sheets
**Participant Number: ____**

**Instructions:**
In this game I am going to show you pictures of some dogs. Your job is to tell me the name of the dog on the card I show you. This dog here is called “RED” so when you see this card you will say “RED”. This dog here is called “BLUE” so when you see this dog you will say “BLUE”. So when you see this dog (show blue dog) you will say _____ (RED) and when you see this dog (show red dog) you will say ___(BLUE).
(Correct any mistakes)
Okay, now you’ve got it.

**Red Dog / Blue Dog Inhibitory Control Task Response Sheet**

<table>
<thead>
<tr>
<th>1. I</th>
<th>2. I</th>
<th>3. I</th>
<th>4. (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. (B)</td>
<td>6. I</td>
<td>7. (B)</td>
<td>8. I</td>
</tr>
<tr>
<td>9. I</td>
<td>10. (B)</td>
<td>11. (B)</td>
<td>12. I</td>
</tr>
<tr>
<td>13. (B)</td>
<td>14. (B)</td>
<td>15. I</td>
<td>16. I</td>
</tr>
<tr>
<td>17. (B)</td>
<td>18. I</td>
<td>19. (B)</td>
<td>20. (B)</td>
</tr>
<tr>
<td>21. I</td>
<td>22. (B)</td>
<td>23. I</td>
<td>24. (B)</td>
</tr>
<tr>
<td>25. (B)</td>
<td>26. (B)</td>
<td>27. I</td>
<td>28. (B)</td>
</tr>
</tbody>
</table>

**Total Number correct (/28): ____**

**Total Number incorrect: ____ Total number no response: ____**
APPENDIX I: Experiment 1 Inhibitory Control Task 2: Tapping Task Instructions and Response Sheets
Tapping Task

Okay ______, now we are going to play a different game. For this game, I am going to get you to use this pencil like a drumstick. For the first game I am going to get you to:

**Tap twice when I tap once** – so like this (demonstrate) – now you try: (tap once, three times, child should tap twice after each time)

Also, **you have to tap once when I tap twice** – like this (demonstrate) – now you try (tap twice three times, child should tap once after each time).

(correct any mistakes with an explanation)

Now we can start the game – remember **when I tap once, you tap twice and when I tap twice you tap once**.

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

*Number of correct tapping responses: ______*
APPENDIX J: Experiment 1 Cognitive Flexibility Task Instructions and Response Sheet
Instructions – FIST task (Note: Instructions from Jacques & Zelazo 2001, p. 580)

Ok _______ We are going to play another game now.

Demonstration Trial:

<table>
<thead>
<tr>
<th>2 big orange fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 little pink T-shirt</td>
</tr>
<tr>
<td>1 little pink T-shirt</td>
</tr>
<tr>
<td>2 big orange fish</td>
</tr>
</tbody>
</table>

Look! Here's a card, here's another card, here's another card, and here's another card. I'm going to pick two cards that are the same in one way. So I'll pick these two cards (pointing simultaneously to cards 1 and 4). These two cards are the same because they both have two big orange fish on each card. So they're the same. Now I'm going to pick two cards that are the same but in a different way. So I'll pick these two cards (simultaneously pointing to cards 2 and 3). These two cards are the same because they both have one little pink T-shirt on each card. That's why they are the same. So these two cards are the same (first pair) and these two cards are the same (second pair), but see, these two cards here are different from those two cards. You know what? Now it's your turn to show me some cards.

Lay out cards for criterion 1:

<table>
<thead>
<tr>
<th>3 medium blue phones</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 medium blue phones</td>
</tr>
<tr>
<td>2 little pink fish</td>
</tr>
<tr>
<td>2 little pink fish</td>
</tr>
</tbody>
</table>

Show me (put your fingers on) two cards that are the same in one way (Selection 1)
Show me (put your fingers on) two cards that are the same but in a different way (Selection 2)

Lay out cards for criterion 2:

<table>
<thead>
<tr>
<th>1 big blue T-shirt</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 medium orange phones</td>
</tr>
<tr>
<td>1 big blue T-shirt</td>
</tr>
<tr>
<td>3 medium orange phones</td>
</tr>
</tbody>
</table>

Same instructions as above: (Selection 3 and 4)
No feedback given – if child erred on any of the selections, he/she does not continue with task.
Test Trials (12):

Lay out three cards

*Show me (put your fingers on) two cards that are the same in one way (Test Selection 1)*

*Show me (put your fingers on) two cards that are the same, but in a different way (Test Selection 2)*

**Layout of Trials:** (test item in bold)

<table>
<thead>
<tr>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
<th>Trial 5</th>
<th>Trial 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 medium orange T-shirt</td>
<td>1 large purple T-shirt</td>
<td>One small orange T-shirt</td>
<td>Two medium pink fish</td>
<td>Two large pink fish</td>
<td>Three small pink phones</td>
</tr>
<tr>
<td>3 medium orange T-shirts</td>
<td>2 large purple T-shirts</td>
<td>One small orange fish</td>
<td>Three medium purple fish</td>
<td>Two medium pink phones</td>
<td>Three large pink phones</td>
</tr>
<tr>
<td>3 small orange T-shirts</td>
<td>1 large purple phone</td>
<td>One small purple fish</td>
<td>Two medium pink fish</td>
<td>Two large pink phones</td>
<td>Three small orange phones</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trial 7</th>
<th>Trial 8</th>
<th>Trial 9</th>
<th>Trial 10</th>
<th>Trial 11</th>
<th>Trial 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two medium orange fish</td>
<td>One small purple T-shirt</td>
<td>One small orange phone</td>
<td>Two large purple T-shirts</td>
<td>Two small pink fish</td>
<td>Three large purple phones</td>
</tr>
<tr>
<td>Three medium orange fish</td>
<td>One medium purple T-shirt</td>
<td>One small pink phone</td>
<td>Two medium purple T-shirts</td>
<td>One large pink fish</td>
<td>Three large pink T-shirts</td>
</tr>
<tr>
<td>Three medium orange phones</td>
<td>One small purple fish</td>
<td>Three small orange phones</td>
<td>Two medium orange T-shirts</td>
<td>Two large pink fish</td>
<td>Three large pink phones</td>
</tr>
</tbody>
</table>
Participant Number: ____

Performance on FIST trials

<table>
<thead>
<tr>
<th>Criterion 1:</th>
<th>Criterion 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection 1 successful: YES</td>
<td>Selection 1 successful: YES</td>
</tr>
<tr>
<td>Selection 2 successful: YES</td>
<td>Selection 2 successful: YES</td>
</tr>
<tr>
<td>Selection 1 successful: NO</td>
<td>Selection 1 successful: NO</td>
</tr>
<tr>
<td>Selection 2 successful: YES</td>
<td>Selection 2 successful: YES</td>
</tr>
</tbody>
</table>

Criterion total score: (/4) _____

Test Trials

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection 1:</td>
<td>Selection 1:</td>
<td>Selection 1:</td>
</tr>
<tr>
<td>Selection 2:</td>
<td>Selection 2:</td>
<td>Selection 2:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection 1:</td>
<td>Selection 1:</td>
<td>Selection 1:</td>
</tr>
<tr>
<td>Selection 2:</td>
<td>Selection 2:</td>
<td>Selection 2:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection 1:</td>
<td>Selection 1:</td>
<td>Selection 1:</td>
</tr>
<tr>
<td>Selection 2:</td>
<td>Selection 2:</td>
<td>Selection 2:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection 1:</td>
<td>Selection 1:</td>
<td>Selection 1:</td>
</tr>
<tr>
<td>Selection 2:</td>
<td>Selection 2:</td>
<td>Selection 2:</td>
</tr>
</tbody>
</table>

Total score: (/24) _____

Total selection 1 score: (/12) _____

Total selection 2 score: (/12) _____ Total selection 2 score when 1 correct: (/12) _____
APPENDIX K: Experiment 2 Informed Consent, Debriefing Form, and Parents Results

Letter
UNIVERSITY OF CALGARY
INFORMED CONSENT FORM

Research Project Title: The Relationship between Children’s Executive Functioning and Communicative Competence

Investigators: Liz Nilsen, Dr. Susan Graham
Department of Psychology
Funding Agency: Social Sciences and Humanities Research Council of Canada

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you a basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, please ask. Please take the time to read this form carefully and understand any accompanying information.

Purpose of the Study:
The purpose of this project is to examine communicative development in childhood. One key aspect of communicative competence is that the two persons involved in conversation (or communicative exchange) must have some understanding of the other’s mental state. For example, each person must be aware of what the other person knows and sees. This study is designed to examine children’s sensitivity to information that is both shared and not shared by their communicative partner. In addition, we want to examine the skills that predict children’s sensitivity to this information. The cognitive skill that we expect is predictive of children’s performance in communicative tasks is inhibitory control – i.e., their ability hold back initial responses. One type of inhibitory control task involves a delay in a response, whereas another type involves having to mediate between conflicting information. We anticipate that children who have better inhibitory control skills, as evidenced by their performance on the inhibitory control tasks involving a conflict, will be better able to inhibit their own perspective and take into account the perspective of their speaking partner.

What Will I Be Asked to Do?
The testing session will last approximately half an hour. The tasks that will be used to measure your child’s inhibitory control skills will involve your child 1) naming cards, 2) following instructions from a puppet, 3) waiting to play a pinball game, and 4) waiting for a gift to be wrapped. In the communication task, a researcher will instruct your child to pick up various objects in a display. In this task, some objects will be visible to both the child and researcher, whereas others will be visible only to the child. We are examining how your child’s behaviour differs when key objects are visible to both the experimenter and the child versus when they are just visible to the child. Your child’s receptive vocabulary will be tested using a standardized measure of language skills.

Are there Risks or Benefits if my child Participates?
You and your child’s participation in this study are voluntary, and you may refuse to participate or withdraw from the study at any time. The tasks that will be administered to
your child are not deemed to involve procedures that he/she would not encounter in his/her daily life. As such, there are not foreseeable risks or harms to you or your child. After the testing session, your child will receive a certificate and a small toy as a token of our appreciation.

**What Personal Information will be Collected? What Happens to the Information?**

Should you agree to have your child participate, you will be asked to provide information on his/her gender, date of birth, and birth order. Portions of the cognitive testing will be videotaped so that the researchers may code your child’s responses at a later time. The videotapes and score sheets will be identified by participant number only and will remain confidential. Only researchers within the Language and Cognitive Development Lab will have access to the data. Only group information will be summarized for any presentation or publication of results. The data will be stored for five years after publication of the results, at which time it will be disposed of in a secure fashion. If you have any questions about the study, the researcher will gladly answer them.

**Signatures:**

Your signature on this form indicates you have understood to your satisfaction the information regarding participation in the research project and agree to have your child participate. In no way does this waive your legal rights not release investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from this research project at any time. You should feel free to ask for clarification or new information throughout your child’s participation. If you have further questions concerning matters related to this research, please contact:

**Liz Nilsen:** Graduate Student, Department of Psychology  
The University of Calgary; 220-4955

**Dr. Susan Graham:** Associate Professor of Psychology  
The University of Calgary; 220-7188

If you have any concerns about the way you’ve been treated as a participant, please contact Bonnie Scherrer, Research Services Office, University of Calgary at (403) 220-3782; email bonnie.scherrer@ucalgary.ca.

Parent (Guardian): ___________________________ Date: ___________________________

Investigator: ___________________________ Date: ___________________________

A copy of this consent form has been given to you to keep for your records and reference. This research has the ethical approval of the Conjoint Faculties Research Ethics Board.
My signature below certifies that I consent to my child’s participation in the project entitled “The Relationship between Children’s Executive Functioning and Communicative Competence” and have received a copy of the consent form describing this research:

Child’s name: ______________________  PLEASE Circle:  Male  Female

Child’s birth date: __________
Year/Month/Day

Child’s siblings and date of birth:

Male  Female  birth date: _________ (Year/Month/Day)
Male  Female  birth date: _________ (Year/Month/Day)
Male  Female  birth date: _________ (Year/Month/Day)

Parent/Guardian name (print):

______________________________

Parent/Guardian signature:

______________________________

Date:

______________________________

Please fill out your name and address below if you would like to receive a copy of the results of the study:

Name:

__________________________________________

Address:

__________________________________________
Dear parent(s):

We would like to thank you very much for allowing your child to participate in our research study on early communication and cognitive development. We very much appreciate your willingness to come to our laboratory at the University of Calgary.

This research is being conducted in order to better understand communicative development in early childhood. We are interested in how well children understand what information is shared between themselves and their communicative partner and which information only they know. We are also interested in whether children’s inhibitory control abilities (which are—try to give a more everyday like explanation of this) predicts their understanding of what is shared between them and their communicative partner.

Communicative competence is measured by investigating how well children take into account information that is shared between them and their communicative partner. In the communication task, we are interested in whether children’s eye movement pattern is different in a situation where all the objects are viewed by both the children and the experimenter compared to a situation where one object is obscured from the experimenter’s point of view. That is, when your child was asked to pick up an object in a situation in which there were two possible objects (one that was blocked from the experimenter’s view, and one that was visible to the experimenter) does he/she look to both objects or just to the object that the experimenter can see? Furthermore, do children of this age pick up objects that are obstructed from the experimenter’s view?

Your child’s inhibitory control skills (i.e., his/her ability to prevent themselves from giving the most obvious or dominant response in order to follow the instructions) were tested through tasks that involved either a delay of response or a conflict. In the delay tasks, your child was asked to wait for a gift to be wrapped before looking at it, and he/she had to refrain from pulling pinball lever until told to do so by the experimenter. In the conflict tasks, your child was asked to 1) only follow instructions from one puppet, but not the other, and 2) name a card depicting a sun “night” and a card depicting the moon and stars “night” (i.e., he/she had to inhibit the natural response of saying “day” when they see the sun, and “night” when they see the stars).

We expect that children’s performance on inhibitory control tasks that involve a conflict will be related to their communicative competence to a greater extent than the inhibitory control measures that involve a delay. That is, the conflict tasks require that the children both suppress a response and generate a new response, whereas the delay tasks require only the suppression of a response. Thus, the conflict task requires more memory demands (i.e., they must hold in mind the alternative response). The greater memory demands are thought to relate more to children’s communication skills in that the communication task requires that they hold in mind the perspective of the speaker as well as inhibiting their own perspective in order to be successful. Furthermore, the relationship between inhibitory control and communication will be independent of the language skills that the children demonstrate. When the study has been completed, we will send a copy of our group results to those of you who have requested them.

Once again, thank you for your interest and participating in our studies. Much of what we know about how children’s cognitive abilities and communicative understanding develop has been generated through studies such as the ones that we are conducting. This research would not be possible without the generous contribution of time and effort by families such as yours. If you would like further information about the results of this study or have any questions about issues concerning language or cognitive development, please do not hesitate to contact Liz Nilsen at 220-4955. You can also contact Dr. Susan Graham at 220-7188.

Thank you,

Liz Nilsen
Results Letter

July 10, 2006
Dear Parent(s),

We would like to thank you and your child very much for participating in our research study on The Relationship between Executive Functions and Children’s Communicative Competence. We greatly appreciated your willingness to come with your child to our laboratory at the University of Calgary. Findings from this study will be submitted for presentation to the Society for Research in Child Development Biennial Meeting in Boston, Massachusetts, in the spring of 2007 and will be submitted for publication in a psychology journal. Findings from this study will be put forward as partial fulfillment for a doctoral thesis. We would like to take this opportunity to share our results with you. This results letter consists of findings from the study your child participated in, which is the second of two studies for this project.

One key aspect of successful communication is the ability to identify the information that is/is not shared by the hearer and speaker. Past research has demonstrated that children often do not use this information in communicative contexts, as indicated by their tendency to use terms that are unfamiliar to their listener, and to not provide adequate information when referring to specific objects (e.g., asking for “the red one” when there is both a red car and a red ball visible). In addition, children have been found to interpret communicative statements from others based on their own, rather than the speaker’s perspective. The goal of this study was to investigate how sensitive children between the ages of 3.5 years and 4.5 years were to the perspective of their speaking partner. Furthermore, we were interested in assessing whether the egocentric (i.e., derived from their own perspective) behaviours children demonstrated were related to their inhibitory control skills (i.e., their ability to suppress a dominant response).

In this study, your child was asked to do a number of tasks over the session. At the beginning the session, your child took part in the communication task. This task involved placing four objects on a display case and using sliding doors at the back of the display case to block off specific objects from the experimenter’s view. Your child was asked to pick up an object by the experimenter. We were interested in whether children in this age group would consider objects that were hidden from the experimenter’s view as the possible object the experimenter could be referring to. That is, if a child was asked to pick up “a duck” when there was a big duck the experimenter could see, and a small duck he or she could see (but was blocked off from the experimenter’s view), which duck would they choose? If the child had difficulty inhibiting his/her own perspective, he/she would be just as likely to choose the big or small duck. However, if the child was sensitive to the experimenter’s perspective, he/she would always choose the object the experimenter could see, namely, the big duck.

Following the communication task, your child was administered four measures of inhibitory control. The two measures of “conflict” inhibitory control assessed how well you child could prevent themselves from giving a dominant response to give a correct response (i.e., following direction from a dog puppet, but not a dragon puppet; calling a card with a moon on it “day” and a card with a sun on it “night”). Whereas the two
measures of “delay” inhibitory control assessed how well your child could postpone a salient response (i.e., not peeking whilst a gift was wrapped, not letting go of a pinball plunger until the allotted time). Your child’s language skills were assessed using a standard language test where your child had to point to pictures that corresponded with a verbal label.

The findings of the communication tasks indicated that, as a group, children between the ages of 3.5 and 4.5 years are sensitive to the perspective of their speaking partner. That is, in the comprehension task, they were more likely to look longer between objects when two potential objects were visible to the experimenter, than when one object was hidden from the experimenter’s view. They appeared to have an understanding that the experimenter cannot be asking for something she is not able to see, therefore, the object she wants must be the visible one. This finding demonstrates that, at this stage of development, children do not operate from a completely egocentric perspective.

To address the second purpose of the study – that is investigating the skills required for successful communication – the children’s performance on the communication task were examined in relation to their inhibitory control skills. We found that children who performed well on the “conflict” inhibitory control tasks were less likely to reference (i.e., look at) the objects hidden from the experimenter’s view in the comprehension communication task. In contrast, children who performed well on the “delay” inhibitory control tasks were likely to choose the object hidden from the experimenter’s view. Thus, it appears that children who have stronger inhibitory control skills are better able to inhibit their own perspective as reflected by less egocentric communicative behaviour in the comprehension task.

These findings are important because they demonstrate the sensitives that children have to the perspective of another person at this stage of their development. In addition, they highlight skills that children might require prior to developing successful communication skills, namely inhibitory control.

Once again, thank you so much for your interest and participation in our studies. This research would not be possible without the generous contribution of time and effort by families such as yours. If you would like further information about the results of this study or have any questions about issues concerning cognitive and language development, please do not hesitate to contact Dr. Graham at 220-7188 or Liz Nilsen at 220-4955.

Sincerely,

Liz Nilsen, M.Sc.  
Ph.D. Candidate  
Clinical Psychology Student

Susan Graham, Ph.D., R. Psych  
Associate Professor and  
Canada Research Chair
INHIBITORY CONTROL SCORE SHEET (tasks from Carlson, 2005)

Participant Number: ______________________

Bear / Dragon Task
Task Order:

"Let's see if you can do some things... 1) stick out your tongue, 2) touch your ears, 3) touch your teeth, 4) touch your eyes, 5) clap your hands, 6) touch your feet, 7) touch your head, 8) touch your tummy, 9) touch your nose, and 10) wave your hand"

"I'm going to introduce you to two animals...

"This is a nice dog, so when he talks to us, we will do what he tells us to do"

"This is a naughty dragon, so when he talks to us, we won't listen to him. If he tells us to do something we won't do it"

Practice trials: (feedback given)

<table>
<thead>
<tr>
<th>Who says it</th>
<th>Action</th>
<th>Score</th>
<th>Notes on what child did</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog</td>
<td>Show me thumbs up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dragon</td>
<td>Touch your leg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dragon</td>
<td>Shake your head</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog</td>
<td>Close your eyes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog</td>
<td>Touch your hair</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reminder of rules: "remember we will do what the dog tells us, but we won't do what the dragon tells us"

Test trials (12) (no feedback)

<table>
<thead>
<tr>
<th>Who says it</th>
<th>Action</th>
<th>Score</th>
<th>Notes on what child did</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog</td>
<td>Touch your ears</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dragon</td>
<td>Touch your head</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog</td>
<td>Touch your leg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog</td>
<td>Stick out your tongue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dragon</td>
<td>Touch your feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dragon</td>
<td>Touch your teeth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog</td>
<td>Touch your nose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dragon</td>
<td>Clap your hands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dragon</td>
<td>Touch your eyes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog</td>
<td>Wave your hand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog</td>
<td>Touch your tummy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dragon</td>
<td>Show me thumbs up</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring - On each dragon trials:
0=full command movement; 1=partial commanded movement; 2=wrong movement; 3=no movement

Practice Trials: _______ Total Score (/18): _______
Day / Night Task
Task order:

“What is it that we see in the sky at night? That’s right there are stars and a moon at night. And what is it that we see in the sky during the day that is very bright? That’s right, the sun is out during the day”

“Now we are going to play a game. I am going to show you some cards. When you see this card, you will say “day” and when I show you this card, you will say “night”

“Let’s practice”
put card down: “that’s right” or “remember, when you see this card, you say _____”
put card down: “that’s right” or “remember, when you see this card, you say _____”

<table>
<thead>
<tr>
<th>1 Night</th>
<th>2 Day</th>
<th>3 Day</th>
<th>4 Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Night</td>
<td>6 Night</td>
<td>7 Day</td>
<td>8 Night</td>
</tr>
<tr>
<td>9 Night</td>
<td>10 Day</td>
<td>11 Day</td>
<td>12 Day</td>
</tr>
<tr>
<td>13 Night</td>
<td>14 Day</td>
<td>15 Night</td>
<td>16 Night</td>
</tr>
</tbody>
</table>

Scoring:
1=each correct item (/16)
0=wrong answer or more than 3 second delay to answer

Total Score (/16): _______

Pinball Game
Task Order:

“Now we are going to play a fun game. You are trying to get the ball into these holes here. See when I pull this handle out and let go – I can start to play”
demonstrate game
“Now you try to make the ball go”
Let child try game.
“This time, I want you to hold the handle out until I tell you to GO – Only when I say GO can you let go”
“Okay pull the handle out and wait until I say GO”

(repeat instruction before each trial)

<table>
<thead>
<tr>
<th>Time delay before “go”</th>
<th>Child wait time</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Total wait time across trials: _______
Gift Delay

"Now, I have a present for you, but I want it to be a BIG surprise" “You can sit over there (point to chair turned other direction) and try not to look while I wrap your present”

Noisily wrap gift for one minute

“Okay, I’m all finished you can come and get your present now”

<table>
<thead>
<tr>
<th>Measure</th>
<th>Child’s Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peeking Score:</td>
<td></td>
</tr>
<tr>
<td>0=turning fully to peek</td>
<td></td>
</tr>
<tr>
<td>1=peeking over shoulder</td>
<td></td>
</tr>
<tr>
<td>2=no attempt to peek</td>
<td></td>
</tr>
<tr>
<td>Total Number of Peeks</td>
<td></td>
</tr>
<tr>
<td>Latency to peek over their shoulder or fully turn around</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX I: Ethics Approval Form
CERTIFICATION OF INSTITUTIONAL ETHICS REVIEW

This is to certify that the Conjoint Faculties Research Ethics Board at the University of Calgary has examined the following research proposal and found the proposed research involving human subjects to be in accordance with University of Calgary Guidelines and the Tri-Council Policy Statement on "Ethical Conduct in Research Using Human Subjects". This form and accompanying letter constitute the Certification of Institutional Ethics Review.

File no: 4109
Applicant(s): Elizabeth S. Nilsen
Department: Psychology
Project Title: The Relationship Between Childrens' Executive Functioning and Communicative Competence
Sponsor (if applicable):

Restrictions:

This Certification is subject to the following conditions:

1. Approval is granted only for the project and purposes described in the application.
2. Any modifications to the authorized protocol must be submitted to the Chair, Conjoint Faculties Research Ethics Board for approval.
3. A progress report must be submitted 12 months from the date of this Certification, and should provide the expected completion date for the project.
4. Written notification must be sent to the Board when the project is complete or terminated.

Janice Dickin, Ph.D., LLB,
Chair
Conjoint Faculties Research Ethics Board

2004/09/23
Date:

Distribution: (1) Applicant, (2) Supervisor (if applicable), (3) Chair, Department/Faculty Research Ethics Committee, (4) Sponsor, (5) Conjoint Faculties Research Ethics Board (6) Research Services.