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### Theory Of Mind And Negation

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ABSTRACT

THEORY OF MIND AND NEGATION

by

Jasmine Buckins

Chair: Dr. D'Jaris Coles-White

## ABSTRACT OF GRADUATE RESEARCH

Thesis

Andrews University

School of Health Professionals

Title: THEORY OF MIND AND NEGATION

Name of researcher: Jasmine M. Buckins

Name and degree of faculty chair: Dr. D'Jaris Coles-White PhD, CCC-SLP

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### Problem

There is an extensive amount of research on theory of mind, which is the ability to attribute mental states (e.g., beliefs, intents, desires, knowledge, etc.) to oneself and others and to comprehend that others have beliefs, desires, intentions and perspectives that may be different from one's own. Some researchers have investigated the potential prerequisites or developmental milestones that may be required in order for a theory of mind to be developed in young children. Some researchers have concluded that certain factors play a role in theory of mind development. These factors include environmental, cognitive and linguistic components.

However, in the area of linguistics few studies have been able to find a direct link to how language interconnects with theory of mind acquisition. More so, little research

has been conducted on grammatical negation, also called syntactic negation and a possible link to theory of mind development. This thesis attempts to add to the body of research on how theory of mind and negation are connected.

## Method

The participants in this study were comprised of 22, monolingual, English speaking children 3 to 7 years of age who presented with typically developing language skills. These participants were recruited from both public and private schools located in Southwest Michigan. Recruitment strategies included, sending Andrews University Institutional Review Board approved consent forms to the parents of children who were enrolled in Preschool through 1<sup>st</sup> grade in the Southwest Michigan locations mentioned above. The participants were randomly selected from those consent forms that were returned from parents who gave signed consent to allow their children to participate. The Peabody Picture Vocabulary Test, 4<sup>th</sup> Edition (PPVT-IV) was given to all participants. The PPVT-IV is a standardized test of receptive vocabulary knowledge that is highly correlated with other standardized tests of language and cognitive skills. All participants were required to achieve a standard score of 85 or above in order to satisfy inclusionary criteria for this study. Two participants were excluded from the study because they did not meet the inclusionary criteria for participation.

## Results

The results yielded no significant statistical evidence between the negation tasks and theory of mind tasks. However, negation was shown to develop on a developmental trajectory with older children performing better than their younger counterparts on the

sentence picture verification tasks used to investigate syntactic negation.

### Conclusion

Implication for these findings propose that different kinds of negation should be analyzed in regards to theory of mind acquisition. For further study, language impaired children and a specific types of negation should be investigated over a larger sample size of children.

Andrews University  
School of Health Professionals

THEORY OF MIND AND NEGATION

A Thesis  
Presented in Partial Fulfillment  
of the Requirements for the Degree  
Masters of Science

by  
Jasmine Buckins

2017

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# THEORY OF MIND AND NEGATION

A thesis  
presented in partial fulfillment  
of the requirements for the degree  
Masters of Science

by  
Jasmine Buckins

APPROVAL BY THE COMMITTEE:

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Date Approved



## DEDICATION

This this is dedicated to my mother, Sheryl A. Buckins. Thanks for being a key component to my success!

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## LIST OF ABBREVIATIONS

|         |  |
|---------|--|
| CELF-IV | Clinical Evaluation of Language, Fourth Edition          |
| F       | False Statement  |
| FN      | False Negative Statement                                 |
| NEG     | Syntactic Negation                                       |
| PPVT-IV | Peabody Picture Vocabulary Test, 4 <sup>th</sup> Edition |
| T       | True Statement   |
| TN      | True Negative Statement                                  |
| ToM     | Theory of Mind   |
| ToMk    | Theory of Mind “know”                                    |
| ToMt    | Theory of Mind “think”                                   |

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I would like to acknowledge the faculty and staff of Andrews University, Dr. D'Jaris Coles- White, Tammy Shilling and Heather Ferguson for being apart of my thesis committee. Thank you for all your time and hard work. Also I would like to thank the faculty and staff of the Southwest Michigan school districts that allowed research to be conducted at their schools.

## CHAPTER 1

### INTRODUCTION

The way in which people have come to understand or learn that other's beliefs, desires, thoughts, and intentions may be different from their own mental states (e.g., beliefs, intents, desires, knowledge, etc.) is a concept known as a "theory of mind." There has been an extensive amount of research on a theory of mind investigating mental states using false-belief tasks, such as the classic Sally-Anne Test. The Sally-Anne Test is known in the literature as a social cognitive task measuring one's knowledge of other's beliefs. Some researchers have used false-belief tasks to investigate one's knowledge of mental states by using certain verbs, such as "think" and "know". These certain verbs, known as mental state verbs have been seen as major predictors on how a child will perform on false belief tasks (de Villiers, 2007). Some researchers have investigated the potential prerequisites or developmental milestones that may be required in order for a theory of mind to be developed in young children. Researchers have concluded that certain factors play a role in theory of mind development. These factors include environmental (Stanzione, & Schick, 2014), cognitive (Ensor, Devine, Marks, & Hughes, 2014), and linguistic components (de Villiers, 2007). Some studies have focused on the environmental and cognitive factors. However, few studies have focused on the linguistic components because of the complexities involved in language, specifically grammatical negation. For this proposed research, the focus will be on the linguistic component in the area of negation. The questions and hypotheses for this research study are as followed:

Question 1: Is there a difference between the performance of younger and older groups of children on the theory of mind (ToM) and syntactic negation (NEG) tasks?

Hypotheses

H<sub>0</sub>: There is no difference between the performance of younger and older groups of children on ToM and NEG tasks.

H<sub>1</sub>: There is a difference between the performance of younger and older groups of children on ToM and NEG tasks.

Question 2. Is there a relationship between age and performance on ToM, and NEG tasks?

Hypotheses

H<sub>0</sub>: There is no relationship between age and performance on ToM and NEG tasks.

H<sub>1</sub>: There is a relationship between age and performance on ToM and NEG tasks

Question 3: Can age predict performance on ToM and NEG tasks?

Hypotheses

H<sub>0</sub>: Performance on ToM and NEG tasks cannot be predicted by age.

H<sub>1</sub>: Performance on ToM and NEG tasks cannot be predicted by age.

These questions will help expand the understanding of the key elements necessary to recognize predetermining linguistic factors that could be associated with theory of mind development. The avenues of study on language and theory of mind are important because they will expand the knowledge of what developmental language components precede a child's ability to understand the mental states of others.



## CHAPTER 2

### LITERATURE REVIEW

#### **Theory of Mind**

“Theory of mind is a folk physiological theory that we use to predict and explain others behavior on the basis of their internal workings: their feelings, intentions, desires, attitudes, beliefs, knowledge and point of view” (de Villiers, 2007). To fully understand theory of mind, it is best described through an example. Let’s meet Maxi, Maxi is a young girl who loves chocolate. Maxi devours half of her candy bar and decides that she wants to save the other half for later. She stores the left over candy bar in the kitchen cupboard. Then she decides to go outside and play. A little later Maxi’s mother comes in, opens the cupboard and sees the candy bar, to keep it from melting she moves it to the refrigerator. When Maxi comes in from playing outside where will she look first when in search of her candy bar? (Frith & Frith, 2005).

In order to make sense of the sequence of events in the example highlighted above to explain what is a “theory of mind,” one must be flexible in their thinking. That is, one must be able to shift their thinking from one perspective to another. According to Frith and Frith (2005), we naturally explain a person’s behavior based on their mind or mental processes that enables them to: know, think, believe and desire. When there is a conflict between belief and reality, the persons’ belief, not the reality determines the persons’ behavior (Frith & Frith, 2005). In the example given above of Maxi, the answer to the

question of the location of the candy bar seems simple. Since Maxi was playing outside, she will have no idea that her mother moved her candy bar to the refrigerator. Even though it is a false presumption, Maxi still believes that her candy bar is where she left it, in the cupboard, and that is where she will look for it. If a person hearing this story is able to come up with the conclusion that the candy bar is in the cupboard, then they would have a “theory of mind” (Frith & Frith, 2005).

The concept of theory of mind has been debated throughout history. As a result of the debates many theories attesting to the concept of a ToM has been espoused over the years. Some theorists proposed a theory-theory account, while others believed that the concept of a ToM could best be explained by a simulation approach (Gordon, 1992; Hale & Tager-Flusberg, 2003; Jha & Singh, 2009). Still others thought that a ToM should be conceptualized under a nativist viewpoint (Hale & Tager-Flusberg, 2003). It was hypothesized by Lewis (1966), that the ToM is acquired through a person’s mental state (Ensink & Mayes, 2010). Others hypothesized that it was a person’s innate capabilities that were fostered by the “process of maturation” (Fodor, 1987; Ensink & Mayes, 2010). In 1992, R.M Gordon proposed that by trying to imagine and imitate what the world looks like from other’s perspective is how one makes sense of the actions of others (Ensink & Mayes, 2010).

Two theories eventually dominated the literature, the theory-theory and the performance-based theory (Hale & Tager-Flusberg, 2003). Theory-theory takes the stance that essential conceptual changes are the driving force for developing a ToM. That is, a child builds upon their preexisting views and rearranges his or her current theory of mind in order to add new “evidence” from the environment (Astington & Gopnik, 1991;

Ensink & Mayes, 2010). This theory proposes that “success on the false belief task coexist with the recognition of false belief in oneself and the recognition of the distinction between appearance and reality” (Astington & Gopnik, 1991; Ensink & Mayes, 2010). The theory-theory account also believed that exposure to new evidence in the environment takes repeated occurrences in order to accept the counterfactual evidence that leads to a shift in thinking (Ensink & Mayes, 2010).

On the other hand, the performance-based theory believes that in order to understand the mind of others a broad-spectrum of cognitive factors are involved. Contrary to the theory-theory account, the performance-based theory suggest that theory of mind development is more widespread and covers other avenues that are not based on one specific domain (Hale & Tager-Flusberg, 2003). Two domains or subdivisions make up the performance-based theory, the nativist modular theories and the executive function theories (Hale & Tager-Flusberg, 2003). The nativist modular theory states that children at a very young age “have a metapresentational concept of belief” but due to his or her underdeveloped cognition, there performance on the false belief task is guarded (Fodor, 1992; Hale & Tager-Flusberg, 2003). According to the executive function theories, age four is a pivotal time for children. During this period a child undergoes cognitive changes in the ToM. As a result of these cognitive changes a child experiences around the age of four in executive functioning, such as inhibitory control and working memory due to maturation, conceptual changes began to evolve in their ToM (Hale & Tager-Flusberg, 2003). A full account of the historical perspective of the concept of “theory of mind” is beyond the scope of this thesis. However, what is pertinent to the research of this thesis is that a more in-depth presupposition of how the ToM is acquired

emerged from years of debate and is the catalyst for much of the research done today investigating a ToM in children.

Much of the current research done to investigate a ToM focuses on the prerequisite or innate capabilities a child must have prior to the acquisition of a theory of mind. According to Ylvisaker, Hibbar, and Feeney (2006), ToM is slow to mature in a child's early years. Starting in infancy, one can become aware of the fact that there is value in sending messages to people (Ylvisaker et al., 2006). Some investigators have shown that "infants have flexible expectations on the behaviors of those they interact with" (Liszowski, 2013). For example, from several objects, one object is ambiguously requested by an adult. The child has a predetermined expectation that the adult will request the object that they have not had a previous encounter with, this is the object that the child offers to the adult. When an interaction has occurred with all of the objects, but the adult shows a special interest in one object in particular, the child then expects the adults ambiguous request to refer to the object that is most familiar to the adult (Moll & Tomasello, 2007). These expectations depend on the situation and/or the other person's intention of the message (Liszowski, 2013).

Other researchers have debated that between the ages of one year, two months to one year, six months, babies can understand intention and comprehend basic information that others are trying to portray (Jha & Singh, 2009). For example, an adult has the intention of turning on a light, the adult attempts to complete this task, but an error is made before the task is complete. After viewing the adults example of attempting to turn off the light the child must imitate the intended action of turning off the light without replicating the mistake that was made by the adult. In the study replicated by Moll &

Tomasello (2007), the children “interpret the adult’s overall behavior as intentional and reproduce only the adults intended actions without mimicking the adults surface behaviors” (Moll & Tomasello, 2007). According to Moll & Tomasello (2007), between the ages of 14 to 18 months a child can “screen out” whether a person’s actions are meaningless or unintentional, this is one of the first steps needed for a child to acquire the theory of mind (Moll & Tomasello, 2007).

Researchers have also conducted longitudinal studies that found that the development of joint attention was a precursor to children’s performance on the ToM tasks. Children that displayed a high rate of joint attention acquisition at one year, eight months performed better on the theory of mind tasks at three years, six months than other same age peers (Jha & Singh, 2009). Researchers have also found links to animate and inanimate identification of objects as being a skill that bridges a child’s ability to become aware of intentional agents (Jha & Singh, 2009). Once intentional agents, which is an “object that acts in a goal-directed manner, essentially planning to carry out an intended action in the most efficient way to attend some end” are understood the theory of mind should develop soon thereafter (Jha & Singh, 2009).

The findings of the longitudinal studies on joint attention and the ability to distinguish between human and inanimate objects are shared among researchers. According to Ylvisaker et al. (2006), the following pragmatic language indicators; joint attention, animate and inanimate object recognition, facial expressions tie to emotions, and mimicked behaviors of others, have all been labeled as early prerequisites of developing theory of mind.

Research has shown that the false belief task has successfully been used to explore the language prerequisites that are necessary to indicate a developing theory of mind. During the early years of development, children are acquiring language skills that are necessary to understand the false belief task (Ensink et al., 2010). This false belief task is the objective that is presented to the child to determine if the theory of mind is present (Fodor, 1992). According to Liu, Sabbagh, Gehring, & Wellman (2009), a false belief task gives a child different scenarios such as: the story about Maxi stated above. A brief recap of the story is that Maxi placed a candy bar in the cupboard and left the room. While Maxi was gone, her mother took the candy bar from the cupboard and moved it to the refrigerator. When Maxi returns where will she look for her candy bar? These tasks make it possible for children to realize that a person's actions are controlled by their own opinions and beliefs and not always reality itself (Wellman, 2012). Although this task is just a precursor to a grander phenomenon, hundreds of studies have proven that the method of the false belief task aids in understanding the theory of mind. (Wellman, 2012).

### **Language and Theory of Mind**

Jha & Singh (2009), discussed that children's ability to understand the false belief task has a component that encompasses their language abilities. According to Keceli, Kaysili, & Acarlar (2011), there is a correlation between language and false belief understanding. While many investigators have hypothesized that there is a link between language measures and knowledge of false belief (e.g., Astington, 1994; Cutting & Dunn, 1999), there is uncertainty on exactly what aspects of language relate to the theory of mind. Some researchers have investigated aspects of semantic factors in the area of

acquiring new words (Bloom, 1999). Other researchers have hypothesized a direct correlation with different aspects of syntactic development and its contribution on theory of mind acquisition (de Villiers, 1995; 2000; de Villiers & Pyers, 1997; Hresko, Reid, & Hammill, 1981). However, little information is given on acquisition of the syntactic form of negation in relation to the process of developing ToM. Researchers have investigated possible links between negation and the ToM but successful findings have been limited.

### **Negation**

Negation is a process of language development where a child is able to understand negative utterances. According to Brown (1973), children utterances grow in accordance with stages where they acquire different syntactic (grammar) components as they evolve in their language development. During these phases of growth, a child learns how to negate a referent. These include non-existence (there's no juice), rejection (I don't want juice) and denial (that's not juice) (Bloom, 1970). Other researchers also agreed with this pattern of acquisition (Choi, 1988; Pea, 1978). Choi (1988), investigated more in-depth stages of negation. She believed that negation developed in three phases and had nine functions that develop during these phases. Phase one includes "non-existence, prohibition, rejection and failure"; Stage two includes "denial, inability, and epistemic negation"; and Stage three consist of "normative negation and inferential negation". Pea (1978), examined several studies of negation acquisition and discussed many different aspects of it. He concluded that the concept of denial could be theorized and divided into three subcategories (motivation dependent, truth-functional and perspective dependent). In describing his findings, it was clear that "Like many words, 'negation' does not have

any one central or defining essence, but a number of meanings that partake of familiar resemblances to one another” (Wittgenstein, 1958). All forms of negation will not be explained in this thesis. The many different forms are beyond the scope of this desired research. Nevertheless, this thesis will seek to investigate negation tasks with the theory of mind, false belief task to explore possible developmental trajectory correlations.

### **Negation and the Theory of Mind**

Müller, Sokol, & Overton (1998), conducted a study that compared the sentence verification task with the false belief task. A sentence verification task is a skill that displays how children understand negation. This is done by indicating whether a statement made corroborates with a picture. This study was conducted using three and five-year-old children. The results yielded that successful completion of the true negative sentence verification task was not a predictor on how one would do on the false belief assessment. According to Müller, Sokol, & Overton (1998), the propositional negation theory (the ability to use higher order rules) was not closely linked to understanding false belief. He also states that in order to understand true negatives it requires a unique set of skills that are not required for false belief acquisition. However, Müller, Sokol, & Overton did find a correlation between true negative items and age (Müller et. al., 1998). According to Dummett (1973), Kant (1963) and Marshall (1970), “propositional negation operates on sentences as part of a metalanguage and is, therefore, of higher logical type than the language it operates on” (Pea, 1978).

Other researchers found that false belief understanding precedes denial, which is a form of negation, concluding that one develops before the other (Cuccio, 2011).



According to Cuccio (2011), he concluded that false belief understanding is essential to understanding denial. Müller, Sokol, & Overton's research depicted no correlation between prepositional negation and the false belief task, and Cuccio (2011), hypothesized that theory of mind acquisition precedes linguistic negation. Limited research has been done on negation in association with false belief tasks, to attempt to see if there is any overlap in development based on age and/or academic grade. To date, many contradictory theories on negation and ToM have been investigated. The current research will attempt to expand upon negation and its possible links to the ToM acquisition.

## CHAPTER 3

### METHODOLOGY

#### **Participants**

The participants in this study were comprised of 22, monolingual, English speaking children three to seven years of age who presented with typically developing language skills. These participants were recruited from both public and private schools located in Southwest Michigan. Recruitment strategies included, sending Andrews University Institutional Review Board approved consent forms to the parents of children who were enrolled in Preschool through 1<sup>st</sup> grade in the Southwest Michigan locations mentioned above. The participants were randomly selected from those consent forms that were returned from parents who gave signed consent to allow their children to participate. The Peabody Picture Vocabulary Test, 4<sup>th</sup> Edition (PPVT-IV) was given to all participants because it is considered to be a valid and reliable measure of language skills and is highly correlated with several standardized tests of language and cognition. The PPVT-IV is one of the most commonly used assessment tests that measure verbal ability in Standard American English vocabulary and is intended to provide a quick estimate of verbal ability and scholastic aptitude. It measures the receptive processing of examinees from two years, six months to over 90+ years old. This measurement can estimate the child's scholastic aptitude. The test can reveal high or low verbal abilities,

identifying possible learning disabilities. The PPVT-IV may also be used to identify language disorders of children. The PPVT-IV is correlated with nonverbal intelligence.

The PPVT-IV, provides one total standard score (mean = 100, *SD* = 15), and can be used as an estimate of general verbal ability in persons aged 2.6 years to 90 + years (Dunn & Dunn, 2007). It has two parallel forms for repeat testing. It usually takes 10–15 minutes to administer. The individual must select one picture from among four to match a word orally presented by the examiner, and only one answer per item is correct. For example, the stimulus word is laughing. The child must choose between the following pictures; a boy sleeping, a man walking a dog, a woman hugging a baby, or a girl laughing. The respondent can acknowledge their choice by the number (1–4) associated with the frame, or by pointing to the picture. Accordingly, subjective judgment is not required and examiner training requirements are minimal.

According to Dunn and Dunn (2007) “split-half reliability is based on a correlation of each examinees total score on the numbered items with his or her score on the even numbered items.” The mean split-half reliability consistency is .94, which is good to excellent across all age groups (Dunn & Dunn, 2007). Construct validity for the PPVT-IV shows a strong correlation with the Expressive Vocabulary Test Second Edition (.82), this is an assessment that test the child’s expressive language skills. A moderate to high correlation was found with the Clinical Evaluation of Language, Fourth Edition (CELF-IV) (.67-.75) dependent upon age. The CELF-IV is an assessment that gives an overall core language score along with an expressive and receptive language score. There was a poor to high correlation with the Comprehensive Assessment of Spoken Language (CASL) (.41-.79) dependent upon age and category type. The CASL

tests the following areas: basic concepts, antonyms, synonyms, sentence completion and lexical/semantic composites. Special populations were also assessed using the PPVT-IV. Clinical samples were drawn for speech impairment, language delayed, language disordered, hearing impairment, special learning disability, mental retardation, giftedness, emotional/behavioral disturbed and Attention Deficit/Hyperactivity Disorder children. After analyzing the tests construct it was determined that the PPVT-IV was a good measure for determining typically developing children's language skills.

All potential participants achieving a standard score of 85 and above on the PPVT-IV, and reported by teacher to be free from hearing, vision, cognitive and language impairment were included in the study. After confirming eligibility, participants were asked to provide information related to gender, age, and grade. These demographic and language assessment data are provided in Table 1 as summary data.

Table 1

*Demographic and Language Assessment Data*

| Gender | Age | Grade     | PPVT-IV Score |
|--------|-----|-----------|---------------|
| M      | 3   | Preschool | 99            |
| M      | 3   | Preschool | 128           |
| M      | 4   | Preschool | 92            |
| M      | 4   | Preschool | 89            |
| F      | 4   | Preschool | 102           |
| F      | 4   | Preschool | 117           |
| M      | 4   | Pre-K     | 118           |

Table 1 — *Continued*

| Gender | Age | Grade        | PPVT-IV Score |
|--------|-----|--------------|---------------|
| M      | 5   | Pre-K        | 130           |
| M      | 5   | Pre-K        | 121           |
| M      | 5   | Pre-K        | 107           |
| M      | 5   | Kindergarten | 92            |
| F      | 5   | Kindergarten | 117           |
| F      | 6   | First Grade  | 100           |
| F      | 6   | Kindergarten | 114           |
| F      | 6   | Kindergarten | 114           |
| F      | 6   | Kindergarten | 110           |
| M      | 6   | Kindergarten | 108           |
| F      | 7   | First Grade  | 93            |
| M      | 7   | First Grade  | 106           |
| F      | 7   | First Grade  | 112           |
| F      | 7   | First Grade  | 111           |
| F      | 7   | First Grade  | 108           |

## Procedures

### False Belief Task Testing Theory of Mind

A false belief task was administered to all of the participants to assess ToM. This task was done using a similar model adjacent to the Sally-Anne model (Frith & Frith, 1999) with a few modifications to incorporate important linguistic verb markers. Two

additional questions were added to test the children’s understanding of “think and know”. These two extra questions were added to test the child’s ability to demonstrate an understanding of intentional (mental state) verbs. According to earlier theorist Frege (1892) and Quine (1960), intentional verb markers are essential to understanding the mental state of others. The children were presented with an iPad that displayed a single page, black and white comic strip that showed two girls Kim and Molly. The two girls in the comic strip demonstrated a specific scenario that tested their ability to understand the basic components of the ToM. After the comic strip was shown and then read aloud to each participant was asked three questions related to a ToM. The questions are shown in Table 2.

Table 2

*False-Belief Picture/Question Sequence*

---

*Question 1: ToM*

1. Where will Kim look for her baseball

*Question 2: Theory of Mind-Think (ToMt)*

2. Do you think Mooly knows where to look for Kim’s baseball? (ToMt)

*Question 3: Theory of Mind-Know (ToMk)*

3. Do you know if the baseball is where Kim left it? (ToMk)
- 

Picture Sentence Verification Task Testing Negation

A picture sentence verification task was also administered to assess the participants understanding of aspects of negation. This task was completed by showing

the child a picture of an object on the iPad (e.g. cup). The child was then prompted to conclude the true or false aspects of the statement based on the image (Kim, 1985). Four different kinds of sentence types were asked per picture, this included two assertive forms and two negative forms. The assertive forms either affirmed a true statement (e.g. This is a cup) which is true or affirm a negative statement (e.g. this is an apple), which is false. The two negative forms either denies a true statement (e.g. this is not a cup), which is false or denies a false statement correctly (e.g. this is not an apple), which is true. This task was presented by “cross-classifying two assertive forms (affirmative/ negative) and two truth values (true/false)” (Müller, Zelazo, & Imrisek, 2005), to test a child’s understanding of negation. It is important to know that in order to process the negative sentence, the understanding of the truth sentence must take place (Tian & Breheny, 2016).

A hand puppet was used; the puppet acted as a child who doesn’t know a lot of object names. The child acted as the instructor towards the puppet, and told him (the puppet) the names of the objects pictured. The label was provided for the child if they did not know the name of the object. The unknown pictures were set aside and presented later during this task. When completion of the labels had been established the child began the testing trials. The clinician prompted the child by telling them that “now they are going to see if the puppet knows all of the target words”. This task was done by the clinician talking through the puppet about characteristics of the picture for the child to answer “right or wrong”. For each trial the four sentence types were used, this continued until all the pictures were assessed and answered with a “right or wrong” response. There were 10 trials for each of the four sentence types. The question format is shown in Table 3.

Table 3

*Picture Verification Task/Question Sequence*

---

*Question 1*

1. This is a \_\_\_\_ (truth statement) Answer (right)

*Question 2*

2. This is a \_\_\_\_ (false statement) Answer (wrong)

*Question 3*

3. This is not a \_\_\_\_ (false negative) Answer (wrong)

*Question 4*

4. This is not a \_\_\_\_ (truth negative) Answer (right)
- 

**Data Analysis**

All answers were scored. Each right answer was marked with a check on a hand written score sheet, each wrong answer was marked with a negative sign on the same sheet. Data was then coded and entered in to an excel spreadsheet that displayed the participants age and individual correct responses to each question asked. All non-responses were removed for the purpose of the statistical analysis where those null scores would have skewed data. The data are further defined in Table 4.

In order to compare the results of each participants' performance on tasks, ToM and NEG, statistical analyses were completed using the Statistical Package for Social Science (IBM Corp., 2016). Correlation analyses were run to determine the relationship between age and the dependent variables of ToM and NEG. A regression analysis was



Table 4

*Dependent Variables, Their Definition and What was Being Assessed (Measurement)*

| Dependent Variable | Operational Definition  | Measurement                 |
|--------------------|---|-----------------------------|
| T                  | True or affirmative item on the sentence verification task                        | Number of correct responses |
| TN                 | Denies a false statement correctly on the sentence verification task              | Number of correct responses |
| F                  | False or affirming a negative statement on the sentence verification task         | Number of correct responses |
| FN                 | False or denies a true statement on the sentence verification task                | Number of correct responses |
| ToM                | Assessing Theory of Mind on the false belief task                                 | Number of correct responses |
| ToMt               | Assessing Theory of Mind with an additional verb “think” on the false belief task | Number of correct responses |
| ToMk               | Assessment Theory of Mind with an additional verb “know” on the false belief task | Number of correct responses |

then run to determine the ability of the independent variable age to predict the dependent variables of ToM and NEG. A repeated measures ANOVA was run to determine if there was a difference between participant groups. All statistical tests were based on a .05 level of significance.

## CHAPTER 4

### RESULTS

#### **Differences in Performance on ToM and NEG**

Repeated Measures ANOVA was run to determine if there were differences in the performance of participants on ToM and NEG tasks. Table 5 shows the descriptive statistics for the groups of participants for the experimental variables. There were significant main effects for the performance on NEG tasks by age group  $F(1, 20) = 9.535, p < .006$ . Figure 1 confirms that the older age group obtained more correct responses to the NEG tasks than the younger age group.

#### **Relationships Between ToM, NEG and Age**

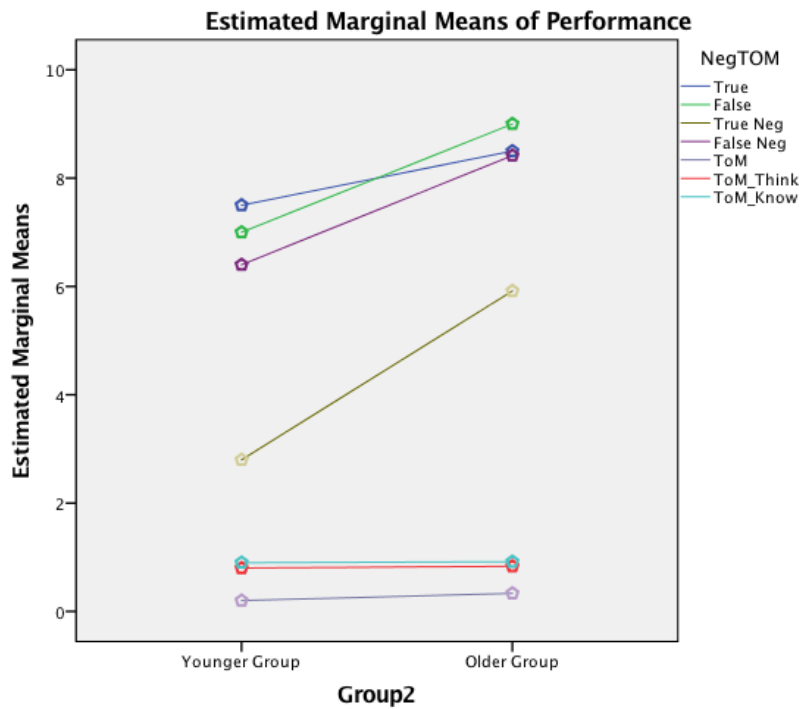
To examine the relationship between age and ToM and NEG, the dependent variables of T, TN, F, FN, ToM, ToMt, and ToMk were compared to the independent variable of age. Descriptive statistics in Table 6 provide mean, standard deviation, and the number of participants by group for each dependent variable.

A Pearson product-moment correlation analysis was run to determine the relationship between age and performance on the NEG and ToM tasks. Specifically, age was compared to the following dependent variables: T, TN, F, FN, ToM, ToMt, and ToMk. These data are presented in Table 7. As hypothesized, significant correlations were observed between age and several of the dependent variables. It was determined

Table 5

*Descriptive Statistics Including Mean, Standard Deviation, and Number of Participants for Experimental Variables*

|      | Group   | Mean | Std. Deviation | N  |
|------|---------|------|----------------|----|
| T    | Younger | 7.50 | 1.841          | 10 |
|      | Older   | 8.50 | 1.567          | 12 |
| F    | Younger | 7.00 | 3.197          | 10 |
|      | Older   | 9.00 | 1.348          | 12 |
| TN   | Younger | 2.80 | 3.553          | 10 |
|      | Older   | 5.92 | 4.231          | 12 |
| FN   | Younger | 6.40 | 3.273          | 10 |
|      | Older   | 8.42 | 2.193          | 12 |
| ToM  | Younger | .20  | .422           | 10 |
|      | Older   | .33  | .492           | 12 |
| ToMt | Younger | .80  | 4.22           | 10 |
|      | Older   | .83  | .398           | 12 |
| ToMk | Younger | .90  | .316           | 10 |
|      | Older   | .92  | .289           | 12 |



*Figure 1. Estimated Marginal Means of Performance*

Table 6

*Descriptive Statistics Including Mean, Standard Deviation, and Number of Participants*

|             | <i>N</i> | Mean  | St. Deviation |
|-------------|----------|-------|---------------|
| Age         | 22       | 5.27  | 1.316         |
| T           | 22       | 8.05  | 1.731         |
| Tn          | 22       | 4.50  | 4.160         |
| F           | 22       | 8.09  | 2.524         |
| FN          | 22       | 7.50  | 2.858         |
| ToM         | 22       | .27   | .456          |
| ToMt        | 22       | .82   | .395          |
| ToMk        | 22       | .91   | .294          |
| Overall NEG | 22       | 28.14 | 7.402         |
| Overall ToM | 22       | 2.00  | .617          |

Table 7

*Correlations Between Independent Variable Age and Dependent Variables*

|             | Pearson Correlation (AGE) | Sig(1-tailed) |
|-------------|---------------------------|---------------|
| Age         | 1                         |               |
| T           | .600**                    | .002          |
| TN          | .487*                     | .011          |
| F           | .652**                    | .001          |
| FN          | .329                      | .067          |
| ToM         | .108                      | .316          |
| ToMt        | -.083                     | .356          |
| ToMk        | .067                      | .383          |
| Overall NEG | .764**                    | .000          |
| Overall ToM | .059                      | .398          |

\*\* Correlation is significant at the 0.01 level (1-tailed)

\* Correlation is significant at the 0.05 level (1-tailed)

that as age increases, the following variables also increased: T ( $r = .600$ ,  $N = 22$ ,  $p < .002$ ), TN ( $r = .487$ ,  $N = 22$ ,  $p < .011$ ), F ( $r = .652$ ,  $N = 22$ ,  $p < .001$ ), and Overall NEG task ( $r = .764$ ,  $N = 22$ ,  $p < .000$ ). No significant correlations were observed between age

and FN ( $r = .329$ ,  $N = 22$ ,  $p < .067$ ), ToM ( $r = .108$ ,  $N = 22$ ,  $p < .316$ ), ToMt ( $r = -.083$ ,  $N = 22$ ,  $p < .356$ ), ToMk ( $r = .067$ ,  $N = 22$ ,  $p < .383$ ), and Overall ToM tasks ( $r = .059$ ,  $N = 22$ ,  $p < .398$ ).

### Predicting Theory of Mind Success

A multiple regression analysis was run to predict performance on the ToM tasks given age. Table 8 shows that .3% of the variability in the dependent variable, Overall ToM tasks can be accounted for by age in Model 1. In addition, there was no predictive power added to Model 2 by the addition of variable, Overall NEG. Consequently, neither the first model (age) nor the second model (age and overall NEG) predicted performance on ToM tasks to a statistically significant degree.

Table 8

*Regression Analysis Used to Determine the Significance of Age as a Predictor of Change for Dependent Variables Listed*

|             | Variable<br>Significance | Model 1 $R^2$ | $R^2$ change | Model 2 $R^2$ | $R^2$ change |
|-------------|--------------------------|---------------|--------------|---------------|--------------|
| Overall ToM | .59 (.003)               | .003          | .60(.004)    | .000          | NS           |

*Note.* Model 1 = Age; Model 2 = Age; Overall NEG Task

## CHAPTER 5

### DISCUSSION

Previous research conducted by Müller et al. (1998), attempted to link propositional negation to false belief understanding. He theorized that propositional negation, which encompasses the ability to understand true negative sentences, is the precursor of understanding false belief. This research replicates Müller, Sokol, & Overton's study in the sense that the picture verification task and the false belief task were used to find potential links between theory of mind and negation. According to de Villiers (1999; 2000) there are intentional verb markers that can be syntactic indicators for a child's later false belief understanding. This thesis also used the verbs "think and know" to find a potential link to the theory of mind. This current research included children ages three to seven, versus the previous research conducted by Müller et al. (1998), that studied children ages three to five. The additional years were included to see if acquisition of NEG and ToM crossed in a child's later years. This research also intended to focus on all questions of the picture verification task instead of one (true negative) as investigated by Müller, Sokol, & Overton (1998). Denial (negative sentence) and propositional negation (true negative sentence) were analyzed.

Many theorists have discussed the difficulty of NEG and how children acquire different aspects of NEG at different times. According to Nordmeyer and Frank (2013)

age is a significant predictor of understanding negative sentences. “A study of children’s comprehension of negation, examining negative sentences found that 3-year-olds were faster and more successful than 2-year-olds at correctly identifying the referent of the negative sentences” (Nrdmeyer & Frank, 2013). Kim (1985) states that “between the ages of 3 and 5, there is a tremendous change in children’s understanding of negation and usage of the words “no” and “not” and by age 5, children are able to correctly identify a negated statement as true or false”. Following this trajectory of age according to previous researchers the prediction is that as typically developing children continue to age, their ability to understand NEG will also expand. The research findings that state the NEG improves with age was also proven during this research study, which found that older children perform better on NEG task than younger ones.

The results of this study yielded no statistical evidence between the ToM task and the NEG task as a whole. However, the data from this research did find that NEG developed on a trajectory and that older children performed better on the picture verification task than younger children on each of the questions presented. Although the findings of NEG were proven to develop together, no direct link was found between NEG and the false belief task performance. Between these tasks age did not hold any significant findings. Based on the results of this study, one can conclude that the skills required to complete the false belief task and the picture verification task are not acquired on the same trajectory. The addition of the intentional verbs to the false belief task did not show any significant results in trying to understand ToM acquisition.

However, limitations were present during this research study. Some of the limitations of this study were based on the visual aids that accompanied a few of the

pictures from the NEG task. Based on the black and white digital pictures the children were not able to recognize some of the objects even when they were later told to them (See appendix B). Negation task stimulus questions were also presented in the same order, this could have caused the children to give an answer based on the pattern of the question and not actual understanding of the task. The false belief task was presented in comic strip form (See Appendix A). The child had to focus only on the line that was being read to them and try not to be distracted by the other stimuli on the page. This could have posed a distraction for the child. The length of the study could have also cause test deviations. The entire task took approximately 10 minutes, causing fatigue to occur on the children, resulting in questions not being answered to their greatest ability. There was also a limited number of subjects, if the number increased this could bring more significance to the study.

### **Conclusion**

It is an unknown fact as to what age a child develops language or cognitive criteria that intertwine, therefore the hypothesis that stated that the ToM and NEG develop on the same trajectory at some point did not hold true. This body of research attempted to expand the understanding of the trajectory of linguistic components and their relation to theory of mind acquisition. Although the findings were not significant, information can still be used from this research. Previous researchers (de Villiers, 2000; Müller et. al., 1998) have began to analyze the connection between language and ToM. This was done by matching different linguistic tasks together that potentially represent the start of the ToM acquirement. However, few studies have gone in depth on how and



when these connections interface. This study shed a little more insight on a direct language NEG task and ToM acquisition. Further research is still required in teasing apart the different kinds of NEG to see if a link exists, also research on the language impaired population is warranted.

## APPENDICES

APPENDIX A

FALSE BELIEF TASK COMIC STRIP

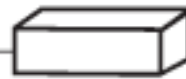
This is Kim.  
Kim has a bucket.



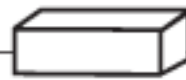
This is Molly.  
Molly has a toy box.



Kim has a baseball. She puts the baseball into her bucket.



Kim leaves the room.



Molly takes the baseball out of the bucket and puts it into the toy box.



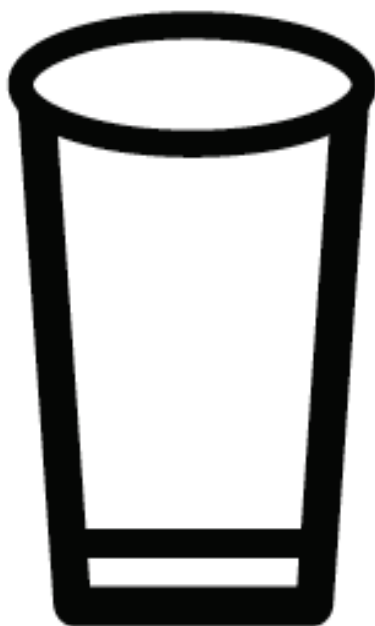
Now Kim comes back.  
She wants to play with her baseball.  
Where will Kim look for her baseball?



## APPENDIX B

### PICTURE VERIFICATION TASK DIGITAL ILLUSTRATIONS

1.



2.



3.





4.



5.



6.



7.



8.



9.



10.



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## REFERENCE LIST

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