PERSPECTIVE-TAKING AS RELATIONAL RESPONDING: A DEVELOPMENTAL PROFILE

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Developmental psychologists have been interested in the cognitive ability of perspective-taking for a number of years due to the apparent link between perspective-taking deficits and Autistic Spectrum Disorder. Most of the research in this area has employed the concepts and techniques of the approach commonly referred to as "Theory of Mind." The current paper is concerned with an alternative operant account of perspective-taking based on a modern behavioral approach to human language and cognition called Relational Frame Theory. According to this approach, the relational frames of I-YOU, HERE-THERE, and NOW-THEN are central to the development of complex perspective-taking. The present paper reports 3 studies that investigate the development of perspective-taking in terms of these 3 relational frames. In Study 1, 5 age groups of participants ranging from early childhood to adulthood were exposed to a protocol assessing their abilities to respond to relational perspective-taking tasks. A developmental profile was then constructed from the relative performances of the different age groups on this protocol. The findings from Study 1 overall indicated that accuracy increased as a function of age. Studies 2 and 3 were subsequently conducted as controls. Specifically, Study 2 was employed to determine whether the low rates of accuracy recorded with the youngest group of participants in Study 1 was simply a function of the length of the statements contained within some of the tasks. The results from Study 2 suggested that this was not the case. In Study 3 an automated version of the protocol was employed to determine whether the high rates of accuracy recorded with the adult participants in Study 1 was a function of cueing. The results from this study similarly indicated that this was not the case. Overall, the findings from the 3 studies lend support to the Relational Frame approach to the development of perspective-taking as generalized operant behavior.

Perspective-taking has attracted the attention of mainstream developmental psychologists for a number of years. For example, a growing number of researchers have attempted to understand and remediate perspective-taking deficits found in autistic populations. Most of this research has employed the concepts and techniques of the approach commonly referred to as "Theory of Mind" (Baron-Cohen, 1995; Baron-Cohen & Hammer, 1997; Baron-Cohen, Tager-Flusberg, & Cohen, 2000).

In one recent publication, leading Theory of Mind researchers described five levels of understanding of informational states involved in teaching autistic individuals to take the perspective of another (Howlin, Baron-Cohen, & Hadwin, 1999). According to this view, the simplest form of perspective-taking (*simple visual perspective-taking*) is largely visual and merely involves the fact that different people can see *different* things. For example, if a two-sided card (with a lion on one side and a car on the other) is held up between two individuals, each can see only the side in front of him or her (i.e., either the lion or the car, but not both). Once this type of simple visual perspective-taking has been taught, children are then taught a more complex form of visual perspective-taking based on the fact that people can see the *same* things differently (*complex visual perspective-taking*). For example, two individuals seated opposite each other have alternative perspectives on the same picture (e.g., of an elephant) placed in front of them. One individual will see the elephant the right way up, whereas the other (seated opposite) will see the elephant upside down.

According to Howlin et al., complex visual perspective-taking is followed by the development of a largely cognitive skill in which visual features play a less salient role in perspective-taking. That is, the third level of perspective-taking involves teaching "seeing leads to knowing" (understanding the principle that "*seeing leads to knowing*"). Imagine, for example, that a key is placed inside a box in the presence of a young girl who has been asked to close her eyes. If the girl is then asked "What is inside the box?", she might correctly suggest that she cannot know what was placed inside because she had her eyes closed (and thus did not see). If the child is then allowed to see inside the box, and is asked "How do you know what is inside?" she might correctly suggest that she now knows because she now sees.

The fourth level of informational state understanding involves teaching children to predict actions on the basis of knowledge—that is, to hold true beliefs (*predicting actions on the basis of a person's knowledge*). An example of a commonly used task for assessing this type of skill might be described as follows. Two similar play scenes are presented to a young girl. In one scene, a doll is placed beside a doll's bed and in the other scene an identical doll is placed beside a doll's pram. The girl is then told the following true belief story. "This morning, you saw the doll beside the bed but you did *not* see the doll beside the pram." The child is then asked, "Where do you think the doll is?" to which she may correctly respond that the doll is beside the bed. She is then asked "Why do you think the doll is beside the bed?" to which she may correctly reply

that she saw the doll beside the bed this morning. If she is then asked "Where will you go to get the doll?" she may reply that she would go to the bed. If the child is finally asked "Why will you go to the bed?" she might correctly reply "Because that's where I saw the doll this morning." The child's correct responses to these questions indicate the knowledge that one will only know what one has seen and will act on this basis.

The fifth and most complex level of knowledge of informational states involves teaching the principle that one can predict actions even when beliefs are false rather than true (*understanding false beliefs*). An example of a commonly used task for assessing this type of skill might be described as follows. A young boy is presented with a candy box and asked, "What do you think is inside the candy box?" to which the child is likely to reply "candy." Unbeknownst to the boy, however, the box contains pencils rather than candies. The box is then opened and the child is shown the pencils inside. He is then asked, "Before we opened the candy box, what did you think was inside?" to which he may suggest that he thought there were candies inside. If the child is then asked "What was really inside?" he might correctly reply "pencils." The child's correct responses to these questions indicate the knowledge that one can act on the basis of beliefs even when they are false. In summary, therefore, according to Theory of Mind, as articulated by Howlin et al. (1999), perspective-taking skills may be taught across increasingly complex levels of informational states that progress from simple visual perspective-taking to acting on the basis of false belief.

A very different approach to perspective-taking has recently been adopted by researchers in the field of behavior analysis. Specifically, proponents of a modern behavioral account of human language and cognition known as Relational Frame Theory (RFT) have been concerned with perspective-taking as a form of generalized operant responding (for a book-length account of RFT, see Hayes, Barnes-Holmes, & Roche, 2001; see also Barnes-Holmes, Barnes-Holmes, & Cullinan, 2001).

According to RFT, perspective-taking skills involve a family of *deictic* frames that specify a stimulus relation in terms of the perspective of the speaker. The three relational frames that appear to be critical for the development of perspective-taking skills are the frames of I and YOU, HERE and THERE, and NOW and THEN. According to this view, deictic relations emerge in part through a history of responding to questions such as " What am I doing here?" or "What are you doing now?" Although the form of these questions may often be identical, the physical environment is likely to be different each time one of these questions is asked or answered. What remains constant across these events are the relational properties of I versus You, Here versus There, and Now versus Then. In the course of language and cognitive development, these relational properties are said to be abstracted through learning to talk about one's perspective in relation to the perspective of others (Hayes, 1984). For example, *I* is always from this perspective *here*, but not from the perspective of another person *there*. Consider the following example

taken from Barnes-Holmes, Hayes, and Dymond (2001). Imagine two children facing each other when their teacher asks "Which way is left?" Both children will point in opposite directions because 'my' left is not necessarily 'your' left. What makes sense of this behavior, according to RFT, is perspective-taking.

Many phrases common to our daily discourse provide exemplars of the relevant relational properties of I-you, here-there, and now-then (e.g., "*I* am *here now*, but *you* were *here then*"). However, these perspective-taking properties may be present even when the actual words "I," "you," "here," "there," "now," and "then" are absent. That is, phrases often include or substitute words coordinated with particular individuals, places, and times (e.g., "It is 1 o'clock and I am at work [here and now], but Joanne [you] is still in the restaurant" [there and now]). These alternative or substituted words serve the same contextual functions that would otherwise be provided by the actual words themselves. For example, "Joanne" or "her" may be functionally equivalent to "you" and "the restaurant" may be functionally equivalent to "there." What is important, from an RFT point of view, is the generalized relational activity and not the actual words themselves (as is the case for all relational framing).

Similar to proponents of Theory of Mind, relational frame researchers have also been concerned with designing intervention programs for establishing perspective-taking in individuals for whom these skills appear to be absent (e.g., autistic populations). Although these two traditions have similar pragmatic goals, they differ notably with regard to what they suggest is the most effective way to establish perspective-taking skills when they are found to be absent. According to RFT, the most effective means of establishing perspective-taking would be to target the relational frames directly, rather than attempting to teach children to understand informational states as defined within Theory of Mind training programs. In a recent preliminary study conducted by Yvonne Barnes-Holmes, which hereafter will be referred to as the Barnes-Holmes protocol, an extensive protocol for analyzing perspective-taking performances in terms of the three deictic relational frames was employed (this extensive protocol is available on request from her).

Consider for example one of the simple tasks from the protocol employed by Barnes-Holmes, "If I (researcher) have a red brick and you (participant) have a green brick. Which brick do I have? Which brick do you have?" In this task, responding that "You (researcher) have a red brick and I (participant) have a green brick," involves responding in accordance with the I-you deictic relational frame, under the contextual control of the if-then relational frame. In effect, the if-then frame determines what functions (i.e., red and green bricks) become attached to the I and you relata in the deictic frame. The reversed version of this task may be interpreted in similar terms. If the participant was asked "If I have a red brick and you have a green brick and if I was you and you were me. Which brick would I have? Which brick would you have?" In effect, the if-then frame determines, via a transformation of functions in

accordance with a mutually entailed deictic relation between I and you, that I have the green brick and you have the red brick.

Consider finally for illustrative purposes a double reversed relation from the Barnes-Holmes protocol, "Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. If here was there and there was here and if now was then and then was now. Where would you be sitting now? Where would I be sitting then?" In this trial, contextual control over the combinatorially entailed transformation of functions with respect to the I-you frame is provided by if-then relational control over the here-there and now-then frames. In effect, the here-there reversal followed by the now-then reversal controls two mutually entailed relations between I and you (i.e., combinatorial entailment), thus reversing the initially reversed relation. In simple terms, the participant deriving these relations ends up in the chair in which they started.

The current study involved developing a protocol for analyzing perspective-taking in terms of the three deictic relational frames (based on the work of Barnes-Holmes) and conducting a developmental profile of these relational skills. The key aims of the current research were as follows. First, we attempted to develop a perspective-taking protocol that can be used with both adults and young children (the protocol originally developed by Barnes-Holmes involved 256 test trials and proved to be rather cumbersome). Second, we attempted to use the protocol to conduct a developmental profile of the three deictic relational frames. Third, we hoped to determine whether the outcomes obtained from the developmental profile would be broadly consistent with the simpler forms of perspective-taking suggested by the Theory of Mind literature (i.e., the protocol was not designed to analyze the more complex forms of false belief or deception). If an RFT perspective-taking protocol can be constructed, and a developmental trend observed, this would provide evidence to support the RFT approach to perspective-taking.

The protocol used in the current study consists of a battery of 62 questions based on the three deictic relational frames and combinations thereof. Furthermore, the protocol was also designed to examine different levels of relational complexity within the context of these three relational frames. Specifically, the protocol presented *simple* relations, *reversed* relations, and *double reversed* relations. The current protocol allowed us to analyze the effects of both relation type (i.e., the three relational frames of I-you, here-there, and now-then) and relational complexity (i.e., simple, reversed, and double reversed relations) across adults, adolescents, and participants from late, middle, and early childhood.

STUDY 1

Method

Participants
Forty participants from five different age ranges participated in the current study. The participants' age bands were as follows: 18–30 years

(adulthood); 12-14 years (adolescence); 9-11 years (late childhood); 6-8 years (middle childhood); and 3-5 years (early childhood). All of the adult participants were recruited through faculty board announcements from within the Department of Psychology at the National University of Ireland, Maynooth. The adolescents and children who participated were selected from volunteers following classroom announcements made in various schools within the Dublin area, and were chosen on the basis that neither their mainstream schoolteachers nor parents had identified them as presenting a learning difficulty. The consent of parents and teachers was obtained prior to each adolescent's and child's participation. None of the participants received remuneration for taking part in the study.

Setting and Materials
      The study was conducted in a quiet room free from distraction. The adult participants were exposed to the procedure in an experimental room located in the Department of Psychology. The adolescents and children were exposed to the procedure in a quiet empty classroom in their respective schools. Each participant was exposed to the protocol individually. The researcher and participant were seated adjacent to one another in the experimental room on identical chairs (the purpose of this will become clear subsequently).
      The protocol used in the current study consisted of 62 trials, typed across eight one-sided sheets of A4 paper. These were retained by the researcher throughout the study and participants were never given the sheets containing the tasks. The participants could not see what was written on the typed sheets. The sheets did not contain the answers to any of the trials. At no time during the study were the items referred to in the tasks present (i.e., the bricks, television, and radio were not present in the experimental room), obviously there was a door and chairs present in the experimental room, however at no time during the protocol were they manipulated.

General Procedure
      All five age groups were exposed to the same procedure. All participants were exposed to the protocol as a test, and no feedback was provided for any response across any of the trials. It required approximately 20 minutes for a participant to complete the protocol once. Each participant was exposed to the protocol twice (i.e., 30 minutes experimental time for each participant). The two sessions to which each participant was exposed to the protocol were conducted on consecutive days, availability permitting. The first exposure to the protocol was considered a practice exposure, and thus only the results of the second exposure are presented in the current report. (As an aside, statistical analyses of the differences between the results obtained from the first and second exposures proved to be nonsignificant. These data are not reported.) Each participant was taken to the experimental room and when he or she indicated readiness to begin, the experimenter provided a brief set of instructions regarding the procedure. These instructions were as

follows: "I will ask you a number of questions, your job is to listen to each task and tell me what you think is the correct answer to the question." If the participant had any difficulty understanding these instructions, the experimenter explained more explicitly what was involved.

Each of the 62 trials in the protocol consisted of two questions (e.g., "Where am I sitting? Where are you sitting?"). The actual questions depended on the type of relation being tested, and these will be described in greater detail subsequently. A correct response to a trial required that the participant answer aloud *both* questions correctly. If a participant (especially one of the children) indicated a response choice by means of an alternative response (e.g., by pointing) the researcher immediately asked "Please tell me what your answer is." After answering the first question, participants were asked the second question immediately. No programmed differential consequences followed any test trial. If a participant (especially a child) made any comment during a trial, the researcher simply replied "We can talk after we have finished our work." Each test exposure lasted approximately 20 minutes. Each participant was exposed twice to the same procedure and he or she thereafter was thanked for participating, and was debriefed.

The protocol employed in the current study consisted of three types of relational tasks, involving responding to the three perspective-taking frames of I-you, here-there, and now-then, and three levels of complexity involving, single relations, reversed relations, and double reversed relations. All trials were randomized such that trials assessing responding to a particular relational frame or a particular type of relational complexity were presented in random order. Examples of each of the tasks contained within the current protocol are presented in Table 1. The reader is strongly advised to study this table before proceeding.

Table 1

The Full Perspective-Taking Protocol Employed in Studies 1 and 3

SIMPLE RELATIONS
Simple I-YOU:
I have a red brick and you have a green brick.
Which brick do I have?
Which brick do YOU have?

I have a green brick and you have a red brick.
Which brick do YOU have?
Which brick do I have?

Simple HERE-THERE:
I am sitting here on the blue chair and you are sitting there on the black chair.
Where am I sitting?
Where are YOU sitting?

I am sitting here on the black chair and you are sitting there on the blue chair.
Where are YOU sitting?
Where am I sitting?

Simple NOW-THEN:
Yesterday I was watching television, today I am reading.
What am I doing now?
What was I doing then?

Yesterday I was reading, today I am watching television.
What was I doing then?
What am I doing now?

Yesterday you were reading, today you are watching television.
What are YOU doing now?
What were YOU doing then?

Yesterday you were watching television, today you are reading.
What were YOU doing then?
What are YOU doing now?

REVERSED RELATIONS
Reversed I-YOU:
I have a red brick and you have a green brick. If I was you and you were me.
Which brick would I have?
Which brick would YOU have?

I have a green brick and you have a red brick. If I was you and you were me
Which brick would YOU have?
Which brick would I have?

I have a red brick and you have a green brick. If I was you and you were me.
Which brick would YOU have?
Which brick would I have?

I have a green brick and you have a red brick. If I was you and you were me
Which brick would I have?
Which brick would YOU have?

I am sitting here on the black chair and you are sitting there on the blue chair. If I was you
and you were me.
Where would YOU be sitting?
Where would I be sitting?

I am sitting here on the black chair and you are sitting there on the blue chair. If I was you
and you were me.
Where would I be sitting?
Where would YOU be sitting?

I am sitting here on the blue chair and you are sitting there on the black chair. If I was you
and you were me.
Where would I be sitting?
Where would YOU be sitting?

I am sitting here on the blue chair and you are sitting there on the black chair. If I was you
and you were me.
Where would YOU be sitting?
Where would I be sitting?

Reversed HERE-THERE:
I am sitting here on the blue chair and you are sitting there on the black chair. If here was
there and there was here.

Where would YOU be sitting?

Where would I be sitting?

I am sitting here on the black chair and you are sitting there on the blue chair. If here was there and there was here.
Where would I be sitting?
Where would YOU be sitting?

I am sitting here on the blue chair and you are sitting there on the black chair. If here was there and there was here.
Where would I be sitting?
Where would YOU be sitting?

I am sitting here on the black chair and you are sitting there on the blue chair. If here was there and there was here.
Where would YOU be sitting?
Where would I be sitting?

Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. If here was there and there was here.
Where would I be sitting now?
Where was I sitting then?

Yesterday I was sitting there on the black chair, today I am sitting here on the blue chair. If here was there and there was here.
Where was I sitting then?
Where would I be sitting now?

Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. If here was there and there was here.
Where was I sitting then?
Where would I be sitting now?

Yesterday I was sitting there on the black chair, today I am sitting here on the blue chair. If here was there and there was here.
Where would I be sitting now?
Where was I sitting then?

Yesterday you were sitting there on the blue chair, today you are sitting here on the black chair. If here was there and there was here.
Where would you be sitting now?
Where were you sitting then?

Yesterday you were sitting there on the blue chair, today you are sitting here on the black chair. If here was there and there was here.
Where were you sitting then?
Where would you sitting now?

Yesterday you were sitting there on the black chair, today you are sitting here on the blue chair. If here was there and there was here.
Where would you be sitting now?
Where were you sitting then?

Yesterday you were sitting there on the black chair, today you are sitting here on the blue chair. If here was there and there was here.
Where were you sitting then?
Where would you be sitting now?

Reversed NOW-THEN:
Yesterday I was watching television, today I am reading. If now was then and then was now.
What was I doing then?
What would I be doing now?

Yesterday I was reading, today I am watching television. If now was then and then was now.
What would I be doing now?
What was I be doing then?

Yesterday I was watching television, today I am reading. If now was then and then was now.
What was I doing now?
What would I be doing then?

Yesterday I was reading, today I am watching television. If now was then and then was now.
What was I doing then?
What would I be doing now?

Yesterday you were watching television, today you are reading. If now was then and then was now.
What were you doing then?
What would you be doing now?

Yesterday you were reading, today you are watching television. If now was then and then was now.
What were you be doing then?
What would you be doing now?

Yesterday you were watching television, today you are reading. If now was then and then was now.
What would you be doing now?
What were you doing then?

Yesterday you were reading, today you are watching television. If now was then and then was now.
What would you be doing now?
What were you doing then?

Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. If now was then and then was now.
Where would I be sitting now?
Where was I sitting then?

Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. If now was then and then was now.
Where was I sitting then?
Where would I be sitting now?

Yesterday I was sitting there on the black chair, today I am sitting here on the blue chair. If now was then and then was now.
Where would I be sitting now?
Where was I sitting then?

Yesterday I was sitting there on the black chair, today I am sitting here on the blue chair. If now was then and then was now.
Where was I sitting then?
Where would I be sitting now?

Yesterday you were sitting there on the blue chair, today you are sitting here on the black chair. If now was then and then was now.
Where were you sitting then?
Where would you be sitting now?

Yesterday you were sitting there on the blue chair, today you are sitting here on the black chair. If now was then and then was now.
Where would you be sitting now?
Where were you sitting then?

Yesterday you were sitting there on the black chair, today you are sitting here on the blue chair. If now was then and then was now.
Where were you sitting then?
Where would you be sitting now?

Yesterday you were sitting there on the black chair, today you are sitting here on the blue chair. If now was then and then was now.
Where would you be sitting now?
Where were you sitting then?

DOUBLE REVERSED RELATIONS
I-YOU/HERE-THERE:
I am sitting here on the blue chair and you are sitting there on the black chair. If I was you and you were me and if here was there and there was here.
Where would I be sitting?
Where would YOU be sitting?

I am sitting here on the blue chair and you are sitting there on the black chair. If I was you and you were me and if here was there and there was here.
Where would I be sitting?
Where would YOU be sitting?

I am sitting here on the black chair and you are sitting there on the blue chair. If I was you and you were me and if here was there and there was here.
Where would I be sitting?
Where would YOU be sitting?

I am sitting here on the blue chair and you are sitting there on the black chair. If I was you and you were me and if here was there and there was here.
Where would YOU be sitting?
Where would I be sitting?

I am sitting here on the black chair and you are sitting there on the blue chair. If I was you and you were me and if here was there and there was here.
Where would YOU be sitting?
Where would I be sitting?

I am sitting here on the black chair and you are sitting there on the blue chair. If I was you and you were me and if here was there and there was here.
Where would YOU be sitting?
Where would I be sitting?

HERE-THERE/NOW-THEN:
Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. If here was there and there was here and if now was then and then was now.
Where would I be sitting then?
Where would I be sitting now?

Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. If here was there and there was here and if now was then and then was now.
Where would I be sitting then?
Where would I be sitting now?

Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. If here was there and there was here and if now was then and then was now.
Where would I be sitting now?
Where would I be sitting then?

Yesterday I was sitting there on the black chair, today I am sitting here on the blue chair. If here was there and there was here and if now was then and then was now.
Where would I be sitting then?
Where would I be sitting now?

Yesterday I was sitting there on the black chair, today I am sitting here on the blue chair. If here was there and there was here and if now was then and then was now.
Where would I be sitting then?
Where would I be sitting now?

Yesterday I was sitting there on the black chair, today I am sitting here on the blue chair. If here was there and there was here and if now was then and then was now.
Where would I be sitting now?
Where would I be sitting then?

Yesterday you were sitting there on the blue chair, today you are sitting here on the black chair. If here was there and there was here and if now was then and then was now.
Where would you be sitting then?
Where would you be sitting now?

Yesterday you were sitting there on the blue chair, today you are sitting here on the black chair. If here was there and there was here and if now was then and then was now.
Where would you be sitting then?
Where would you be sitting now?

Yesterday you were sitting there on the blue chair, today you are sitting here on the black chair. If here was there and there was here and if now was then and then was now.
Where would be you sitting now?
Where would you be sitting then?

Yesterday you were sitting there on the black chair, today you are sitting here on the blue chair. If here was there and there was here and if now was then and then was now.
Where would you be sitting then?
Where would you be sitting now?

Yesterday you were sitting there on the black chair, today you are sitting here on the blue chair. If here was there and there was here and if now was then and then was now.
Where would be you sitting now?
Where would you be sitting then?

Yesterday you were sitting there on the black chair, today you are sitting here on the blue chair. If here was there and there was here and if now was then and then was now.
Where would be you sitting now?
Where would you be sitting then?

Description of Protocol

The current protocol consisted of 62 trials assessing responding to the three perspective-taking frames (I-you, here-there, and now-then) and the three levels of relational complexity (simple, reversed, and double reversed relations). These combinations were presented across eight trial-types. Specifically, there were three trial-types assessing simple relations presented across eight trials (two trials for I-you and here-there respectively, and four trials for now-then). There were three trial-types assessing reversed relations presented across 36 trials (8 I-you trials, 12 here-there trials, and 16 now-then trials). There were two trial-types assessing double reversed relations presented across 18 trials (6 I-you/here-there trials and 12 here-there/now-then trials). Across all three levels of complexity, trials also assessed responding to the three perspective-taking frames.

Simple Relations

There were three trial-types assessing simple relations. These trial-types can be described as simple I-you relations; simple here-there relations; and simple now-then relations. The current protocol contained eight trials of simple relations. The order in which these eight trials were presented within the protocol was randomized. An example of a trial-type involving simple I-you relations was as follows. The subject was asked "If I (experimenter) have a red brick and you (participant) have a green brick. Which brick do I have? Which brick do you have?" (As noted previously, no actual bricks were present). The correct answers to all trials involving simple relations required responses that are identical to the arrangements specified in the experimenter's instructions. In this case, the correct response was "You (experimenter) have a red brick and I (participant) have a green brick" or words to that effect. (Most participants simply stated the color names in the appropriate order). The protocol contained two exposures to this particular trial-type. On each of these trials the order in which the two I and you questions were presented was alternated. That is, on one trial the participant was asked "Which brick do I have?" followed by "Which brick do you have?" On the other exposure the order of the questions was reversed (i.e., the participant was asked "Which brick do you have?" followed by "Which brick do I have?"). It is important to note that the simple here-there tasks involved responding to I-you differentially. For example a here-there trial-type involves a statement such as "I am sitting here on the blue chair and you are sitting there on the black chair." On such a trial-type participants are required to respond to questions involving "I" and "you" respectively, that is; "Where am I sitting / Where are you sitting?" *All* of the simple trial-types contained within the protocol were each presented twice, ensuring that the order of the questions was counterbalanced in this way.

As well as simple I-you and simple here-there, the protocol also contained two exposures to trial-types involving simple now-then relations. This trial-type differed somewhat from the other two simple

relations just described in that, although the relational frame of I-you was present, it did not involve responding to I and you *simultaneously* (only I was involved in the previous example). This procedural modification was necessary because in the perspective-taking frame of now-then, the target relations become unspecified when I and you relations are combined. For example, if a participant is instructed "Yesterday I was watching television, today you are reading," this leaves unspecified what I am doing today and what you did yesterday. A corollary, of course, is that when dealing with the now-then frame, I-you relations cannot be reversed if all relations are to be specified. The trials presented for all now-then relations, therefore, specified what only one person (i.e., the experimenter *or* the participant) was doing. Given this modification, all now-then trials in the protocol contained two I questions or two you questions (rather than one of each). For illustrative purposes, an example of a simple now-then relations trial-type was as follows. The subject was asked, "Yesterday I was watching television, today I am reading. What was I doing then? What am I doing now?" Once again, the order of the questions was randomized. In this case, one trial presented the now question first, followed by the then question, whereas on the other trial this order was reversed. Once again, no visual aids were present and these two trials could have been presented at any point in the protocol.

Reversed Relations
There were three trial-types assessing reversed relations: I-you reversed; here-there reversed; and now-then reversed relations. The current protocol contained 36 of reversed relations, 8 I-you trials, 12 here-there trials, and 16 now-then trials. Given the number of trial-types and the constraints imposed by the higher level of complexity involved in dealing with reversed relations it was necessary to present more trials of reversed rather than simple relations. All of the trial-types involving reversed relations are presented in Table 1, and a number of examples are also provided below.

An example of a trial involving a reversed I-you relation is as follows. The participant was asked "If I have a red brick and you have a green brick. If I was you and you were me. Which brick would I have? Which brick would you have?" In the statement "If I was you and you were me" the I-you relation is explicitly reversed. Correct responses to these questions were based on the I-you reversal specified by the experimenter (again no visual prompts were actually present). That is, the correct answer in this case would be "You (experimenter) would have the green brick and I (participant) would have the red brick" or words to that effect. This type of reverse answer constituted the correct response in all trials in which one of the relations was reversed. There were four trials in which this trial-type was presented and the order of the questions was counterbalanced and randomized across these trials.

The protocol contained eight exposures to a trial-type involving now-then reversals. A participant may be instructed, for example, "Yesterday you

were sitting there on the black chair, today you are sitting here on the blue chair. If now was then and then was now. Where were you sitting then? Where would you be sitting now?" Once again, the correct answer was the reverse of the experimenter's instructions, and the order of the questions was counterbalanced and randomized across the four exposures.

Double Reversals

There were two trial-types assessing double reversed relations. These are: I-you/here-there double reversals; and here-there/now-then double reversals (see Table 1). In these trial-types two relations were reversed simultaneously, either I-you and here-there or here-there and now-then. (I-you and now-then could not be reversed simultaneously because, as mentioned previously, I and you cannot be specified together when now-then is also present).

The protocol contained 18 trials of double reversed relations, 6 I-you/here-there double reversals and 12 here-there/now-then double reversals (see Table 1). An example of a trial involving here-there/now-then double reversals was as follows. "Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. If here was there and there was here and if now was then and then was now. Where would I be sitting now? Where would I be sitting then?" In this trial both the here-there and now-then relations are reversed simultaneously and correct responses to these questions are based on this double reversal. In this example, the correct response would be "Now you (experimenter) would be sitting on the black chair, yesterday you would have been sitting on the blue chair" or words to that effect. There were six exposures to each of the three double reversal trial-types, across which the two questions contained within each trial were counterbalanced and randomized.

Results and Discussion

The percentage of errors produced across the entire protocol by each participant during the second exposure was calculated. These results were then grouped by age category and trial-type and are presented in Figure 1. The data indicate that, in general, errors decreased within trial-type as a function of age. Adults produced the lowest number of errors across six of the eight trial-types and the early childhood group produced the highest number of errors across seven of the trial-types. For five of the eight trial-types, the adolescent group produced fewer errors than late and middle childhood, and it was the only group to perform better than the adults on any of the eight trial-types, although the differences were marginal. The differences between late and middle childhood were relatively small and not particularly consistent across the six simple and reversed trial-types, although the middle childhood group produced slightly fewer errors than the late childhood group. However, for the two double reversed trial-types the middle childhood group produced at least 20% more errors than the late childhood group.
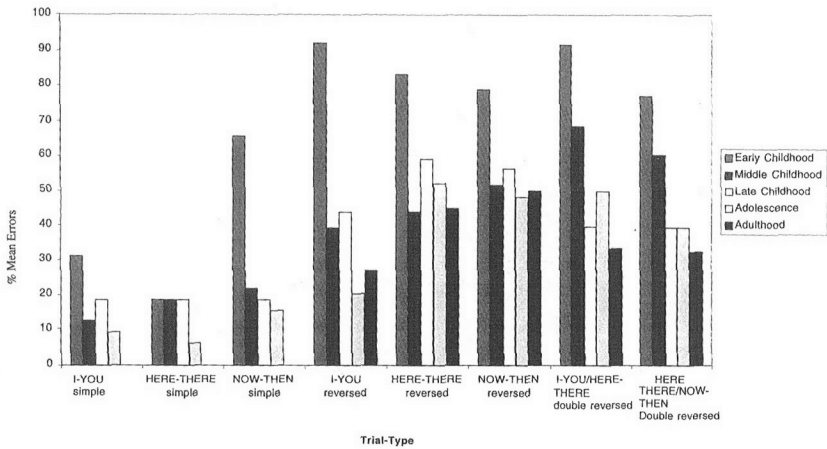
Figure 1. The overall mean percentage of errors recorded in the performances of participants from the five age groups in Study 1.

The error data obtained from the five groups of participants were analyzed using a 5 x 8 mixed repeated measures ANOVA with age as the between subject variable and trial-type as the within subject variable (see

Table 2

Planned Comparisons for Age, Relation Type, and Relational Complexity Presented in Study 1

Age Comparisons	Statistical Significance
Adulthood vs. Adolescence	.287
Adulthood vs. Late childhood	.039*
Adulthood vs. Middle childhood	.014*
Adulthood vs. Early childhood	.000*
Adolescence vs. Late childhood	.295
Adolescence vs. Middle childhood	.143
Adolescence vs. Early childhood	.000*
Late childhood vs. Middle childhood	.665
Late childhood vs. Early childhood	.000*
Middle childhood vs. Early childhood	.000*
Relation Type Comparisons	
I-YOU simple vs. HERE-THERE simple	.722
I-YOU simple vs. NOW-THEN simple	.058
HERE-THERE simple vs. NOW-THEN simple	.025*
I-YOU reversed vs. HERE-THERE reversed	.023*
I-YOU reversed vs. NOW-THEN reversed	.018*
HERE-THERE reversed vs. NOW-THEN reversed	.924
I-YOU/ HERE-THERE double reversed vs. HERE-THERE/NOW-THEN double reversed	.197
Relational Complexity Comparisons	
I-YOU simple vs. I-YOU reversed	.000*
HERE-THERE simple vs. HERE-THERE reversed	.000*
NOW-THEN simple vs. NOW-THEN reversed	.000*

Note. * Denotes that there was statistical significance between the two groups.

Table 2). The effect of age proved to be significant $F(4, 7) = 14.4$, $p = .000$, as did the effect of trial-type, $F(4, 7) = 27.1$, $p = .000$. The interaction between age and trial-type was nonsignificant at the .05 level. Post hoc tests (Fishers PLSD) were used to make a series of planned comparisons amongst the different age groups, among the different relation types, and among the different levels of relational complexity (see Table 2).

Age Comparisons

In the planned comparisons between age groups, the early childhood group produced significantly more errors than each of the other four groups, $p = .000$. Furthermore, the middle and late childhood groups produced significantly more errors than the adults, $p = .039$, and $p = .014$, respectively. The four remaining planned age comparisons were nonsignificant at the .05 level. These statistical analyses indicated a general developmental trend in terms of the errors produced by participants on the current perspective-taking protocol.

Relation Type Comparisons

Comparisons between relation type revealed significantly more errors on the now-then simple trial-type than on the here-there simple trial-type, $p = .025$, on the here-there reversed trial-type than on the I-you reversed trial-type, $p = .023$, and on the now-then reversed trial-type than on the I-you reversed trial-type, $p = .018$. The remaining four comparisons were nonsignificant at the .05 level, although the greater number of errors produced on the now-then simple trial-type, relative to the I-you simple trial-type, approached significance, $p = . 058$. These data indicate that responding in accordance with the now-then frame produced the greatest difficulty for the participants in the current study. Furthermore, responding in accordance with either the here-there or now-then frame, when deriving a reversed relation, was more difficult than deriving a reversed relation within the I-you frame.

Relational Complexity Comparisons

Relational complexity yielded three significant differences between the I-you simple and the I-you reversed trial-types, $p = .000$, the here-there simple and the here-there reversed trial-types, $p = .000$, and the now-then simple and the now-then reversed trial-types, $p = .000$). In each case, participants produced significantly more errors on reversed trial-types than on simple trial-types, which indicates that errors increased as a function of relational complexity. Planned comparisons were not conducted between the double reversed versus simple and between the double reversed versus reversed trial-types because such analyses do not separate relational complexity from relation type. For example, in comparing the I-you/here-there double reversed trial-type with the I-you reversed trial-type, any significant difference that emerged could be due either to relational complexity (i.e., double reversed versus reversed) or to the different relation type involved (i.e., I-you combined with here-there versus I-you alone).

As stated previously, the ANOVA yielded no significant interaction effect between age category and trial-type, and thus it was not appropriate to conduct further statistical analyses of within trial-type differences across age groups, relation type, or relational complexity.

Many of the performances produced by the various age groups demonstrated error rates in the region of 50% (these scores are located in the middle of the range in Figure 1), which could be interpreted as chance level responding. Specifically, such scores might be unrelated to those features of the questions that were relevant to the study. In order to determine whether this was the case the number of participants whose scores were over 67% correct was calculated and the results are presented in Figure 2. If these performances increased as a function of age then the general trend of a larger number of older participants performing at an accuracy level higher than 67% would be evident. This type of age trend is clearly apparent from Figure 2, thus indicating that appropriate stimulus control by the questions increased with age.
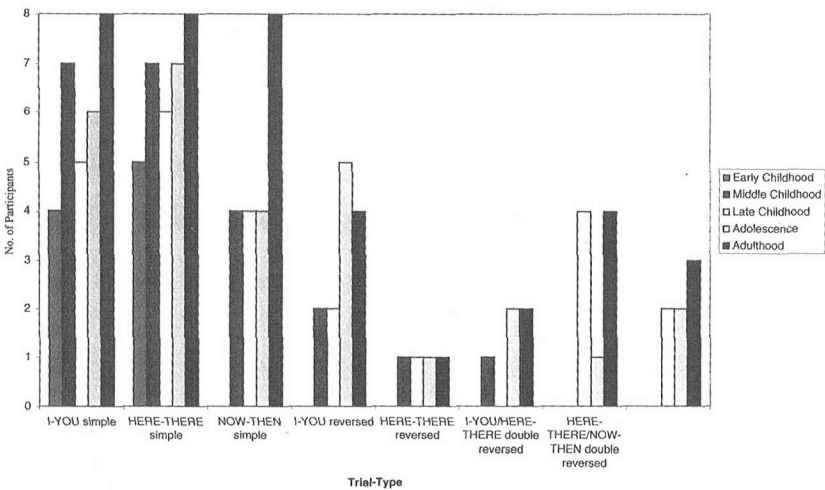

Figure 2. The number of participants over 67% correct in each trial-type for each age group in Study 1.

The results from the current study can be summarized as follows. Errors decreased as a function of age. In general, adults produced the lowest number of errors and the early childhood group produced the highest number of errors across trial-types. A larger number of the older participants performed at an accuracy level higher than 67% across trial-types, which indicated that appropriate stimulus control on these perspective-taking tasks increased as a function of age. Broadly speaking, participants in the four oldest age categories produced the fewest number of errors on trial-types involving the deictic frame of I-you

while producing most errors on the now-then trial-types. Furthermore, participants produced more errors on reversed trial-types than on simple trial-types, thereby demonstrating that relational complexity, as defined within the current protocol, affected participants' performances.

One pattern that clearly emerged from the current data is that the early childhood group produced large numbers of errors relative to the other age groups, particularly on reversed and double reversed trial-types. This difference could be interpreted in two broad ways. On the one hand, perhaps the verbal or relational repertoires of the youngest age group were not sufficiently developed to allow them to demonstrate reversed or double reversed relational responding. On the other hand, perhaps the questions that were presented to the participants for the reversed and double reversed trial-types were simply too long for this particular age group and this factor alone accounted for the differences observed. In other words, the extremely poor performances of the youngest age group may have arisen purely from an inability to understand the long questions as opposed to difficulties in deriving the correct relational responses. To test this suggestion, Study 2 involved replicating Study 1 with new groups of children in their early and middle childhood, except that the long reversed and double reversed questions were replaced with questions of the *same length* that did not require the child to derive reversed and double reversed relations. That is, if word length, rather than relational complexity was the key factor in producing the poor performances of the younger children in Study 1, no significant differences should emerge between the data obtained in Studies 1 and 2. If, however, the poor performances of the children in Study 1 were due, to some degree, to relational complexity, rather than to word length, the performances of the children in Study 2 should be better than in Study 1 (because in the former the children were not required to derive reversed and double reversed relations).

STUDY 2

Study 2 was designed to control for the possible effects of word length in accounting for the errors made by the youngest groups of children in responding to reversed and double reversed trial-types. This was achieved by holding word length constant while removing the need to derive the relations in order to produce a correct response. If no differences emerge in the results obtained from this procedure and that of Study 1, this would indicate that word length alone was responsible for the performances observed with the younger children. If, however, children in Study 2 perform better than those in Study 1, this would indicate that the requirement to derive perspective-taking relations was, at least in part, responsible for the poorer performances observed on the more complex trial-types.

Method

Participants

Sixteen new children participated in Study 2. Eight of these children were in their early childhood (aged 3-5 years), and 8 were in their middle childhood (aged 6-8 years). All 16 participants were selected from volunteers following classroom announcements made in various schools within the Dublin area, and were chosen on the basis that neither their mainstream schoolteachers nor parents had identified them as presenting a learning difficulty. The consent of parents and teachers was obtained prior to each child's participation. None of the participants received remuneration for taking part in the study.

Setting and Materials

The setting in Study 2 was identical to that in Study 1. The materials (i.e., the protocol) used in the current study were identical to those used in Study 1, except that a number of trials contained within the protocol were altered (these alterations are described below).

General Procedure

Both age groups in Study 2 were exposed to the same protocol.

Table 3

Foiled Reversed and Double Reversed Trial-Types

Reversed I-YOU
I have a red brick and you have a green brick. If I am me and you are you.
Which brick would I have?
Which brick would YOU have?

Reversed HERE-THERE
Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. If here is here and there is there.
Where would I be sitting now?
Where was I sitting then?

Reversed NOW-THEN
Yesterday you were watching television, today you are reading. If now is now and then was then.
What were you doing then?
What are you doing now?

Double Reversed I-YOU/HERE-THERE
I am sitting here on the blue chair and you are sitting there on the black chair. If here is here and there is there and now is now and then is then.
Where would you be sitting then?
Where would you be sitting now?

Double Reversal HERE-THERE/NOW-THEN
Yesterday you were sitting there on the black chair, today you are sitting here on the blue chair. If here is here and there is there and now is now and then was then.
Where would you be sitting then?
Where would you be sitting now?

Again the protocol was carried out with each participant across two exposures. This protocol contained identical simple trial-types to those presented in Study 1. However, all of the reversed and double reversed trials were modified. These modifications to both reversed and double reversed trials involved the introduction of what were referred to as "foils." A foil trial is identical in length to an original (reversed or double reversed) trial, but no derivation is required to produce a correct response. For example, the instructions in an original I-you reversed trial contained the words; "If I was you and you were me," but in a foil trial, this statement was converted to " If I am me and you are you." Thus, during a foiled I-you reversed trial in Study 2, a participant may have been instructed as follows: "I am sitting here on the blue chair and you are sitting there on the black chair. If I am me and you are you. Where are you sitting? Where am I sitting?" All reversed and double reversed trial-types were modified with foils in this way. That is, the three types of reversed relations (I-you, here-there, and now-then) and the two types of double reversals (I-you/here-there and here-there/now-then) were presented as foils. These five modified trial-types with foils are presented in Table 3.

Results and Discussion

The combined error rates for each participant across the second test exposure were analyzed to produce a mean error rate for each participant in each of the two age groups. The two age groups were then analyzed separately and the performance of each was compared to the performance obtained with the participants of the same age in Study 1 (i.e., those participants exposed to the original trial-types).

Early Childhood Comparisons

The overall mean error rates for participants in the 3-5 age group are presented in Figure 3. The participants who were exposed to the foils produced fewer errors than children of the same age exposed to the original trials in Study 1. The largest difference between these groups was recorded on the reversed relations. The error data were analyzed using a 2 x 3 mixed repeated measures ANOVA with study (1 & 2) as the between subject variable and complexity as the within subject variable. The effect of study (i.e., original trial-types versus foils) proved to be significant, $F(46, 1) = 30.93$, $p = .000$, as did the effect of complexity, $F(2, 1) = 4.626$, $p = .000$. The interaction between study and complexity was nonsignificant at the .05 level. Post hoc analyses (Fishers PDSL) indicated that there was no significant difference, at the .05 level, in the number of errors produced by the 3- to 5-year-old children on the simple trial-types across Studies 1 and 2. However, this age group did produce significantly lower numbers of errors on the reversed, $p = .000$, and double reversed relations, $p = .000$, in Study 2 relative to Study 1. The fact that no difference emerged for the simple trial-types simply replicates the findings of Study 1 because the trial-types were identical across both studies. However, the fact that differences emerged for

the reversed and double reversed trial-types supports the conclusion that the errors produced by the young children in Study 1 were due, at least in part, to the requirement that a deictic relation be derived in order to produce the correct response.
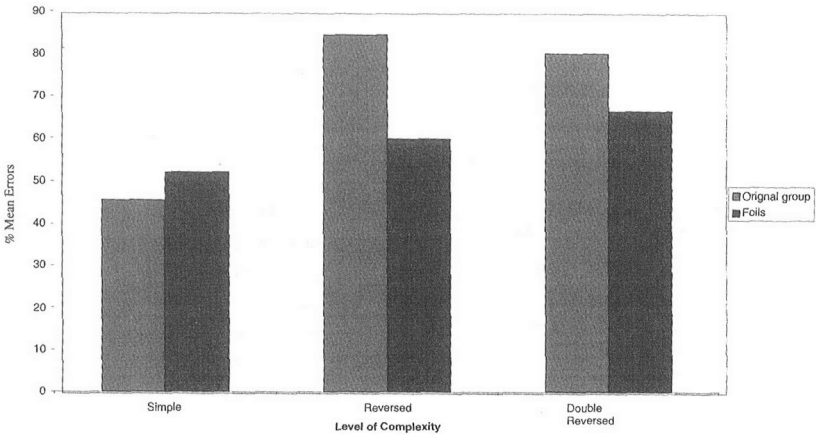

Figure 3. The overall mean percentage of errors recorded in the performances of participants in the early childhood group in Study 1 compared to the performances of age-similar controls responding to foiled trial-types in Study 2.

Middle Childhood Comparisons

Similar analyses to those conducted with the young children were also conducted with the 6- to 8-year-olds. The overall mean error rates for these participants are presented in Figure 4. The participants who were exposed to the foils produced fewer errors than children of the same age exposed to the original trials in Study 1. The largest difference between these groups was recorded on the double reversed relations (for the younger children the largest difference was on the reversed relations). The error data were analyzed using a 2 x 3 mixed repeated measures ANOVA with study (1 & 2) as the between subject variable and complexity as the within subject variable. The effect of study (i.e., original trial-types versus foils) proved to be significant, $F(1, 43) = 8.274$, $p = .006$, as did the effect of complexity, $F(2, 1) = 2.821$, $p = .013$. The interaction between study and complexity was nonsignificant at the .05 level. Post hoc analyses (Fishers PDSL) indicated that there was no significant difference, at the .05 level, in the number of errors produced by the 6- to 8-year-old children on the simple trial-types across Studies 1 and 2. However, this age group did produce significantly lower numbers of errors on the reversed, $p = .002$, and double reversed relations, $p = .000$, in Study 2 relative to Study 1. The fact that no difference emerged for the simple trial-types once again replicates the findings of Study 1 because the trial-types were identical across both studies. However, the fact that differences emerged for the reversed and double reversed trial-types

again supports the conclusion that the errors produced by the 6- to 8-year-old children in Study 1 were due, at least in part, to the derived properties of the correct responses rather than word length per se.
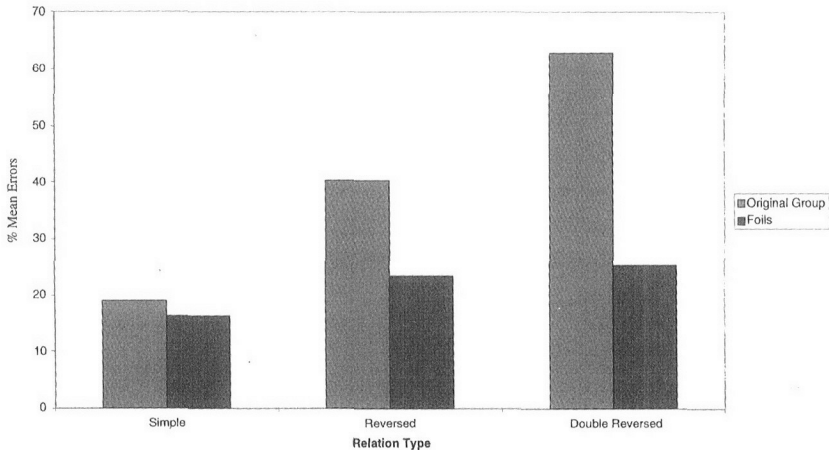

Figure 4. The overall mean percentage of errors recorded in the performances of participants in the middle childhood group in Study 1 compared to the performances of age-similar controls responding to foiled trial-types in Study 2.

STUDY 3

One issue that might be raised, with regard to the performances observed in Studies 1 and 2, is the possibility of the researcher cueing because the procedure involved the experimenter and participant interacting throughout each study. Study 3 was designed, therefore, as a control study to determine whether an automated procedure, for which no researcher was present, would significantly alter the performances of a group of new adult participants relative to those in Study 1. If the findings from this final study are similar to those in Study 1, this would indicate that the table-top procedure used in Studies 1 and 2 had little impact on the participants' performances. If, however, significant differences emerged from the automated procedure, involving identical trial-types, this would suggest that the presence of the researcher was an important controlling variable in the two previous studies.

Method

Participants
Eight adult participants aged between 18 and 30 years old participated in Study 3. All of the participants were recruited through personal contacts. None of the participants received remuneration for taking part in the study.

Setting and Apparatus

Participants were seated in a small experimental room (6' x 6') located in the Department of Psychology. The room contained only a desk, a chair, and a personal computer with a 550 MHz processor, a 14-inch color monitor, and a standard computer mouse. The study was conducted entirely by means of the computer. All trial presentations and response recordings were controlled by programs written in Visual Basic 6.0. All participants were exposed to the procedure individually.

General Procedure

The automated protocol employed in Study 3 was identical to that used in Study 1, except that the computer presented the whole procedure. The automated procedure, therefore, contained original rather than foiled trial-types. Each of the 62 trials of the original protocol was presented one at a time, in a random order, on the computer screen. Once again, participants were exposed to two tests across two consecutive days. While each test was being conducted, the participant was alone in the experimental room and the experimenter remained seated outside.

Each participant was taken to the experimental room and when he or she indicated readiness to begin, the experimenter instructed the participant to simply follow the instructions that appeared on the screen. Participants were assured that all of the information they required to conduct the study would be presented by the computer, but if additional assistance was needed, the experimenter's attention could be sought. At the beginning of the study, the experimenter provided a brief set of instructions regarding the procedure. These instructions were as follows: "Each computer screen presents a task. Your job is to look at the details of each task and to try to make the correct choices from those made available to you on the screen. You should use the mouse to click on what you think are the correct choices on each task. The computer will then present the next task immediately. The computer will let you know when the study is over." After answering any further questions, the experimenter instructed the participant to attend to the screen.

The automated procedure commenced automatically with an introductory screen. This consisted of a blue background that filled the entire screen and a single gray button box located in the middle of the screen. The gray box contained the word "Start" written in black letters, font size 20. All of the text contained within the procedure was of this format. When the subject was ready to continue, the experimenter instructed him or her to use the mouse to locate the cursor on the screen, position the cursor on the gray box and click. All operations conducted by the participants during the automated procedure involved using the mouse in this way. A brief delay occurred before the presentation of the next screen, during which time the experimenter ensured that the participant was aware of what was required to interact with the program. The experimenter then left the room. Participants were asked not to leave the experimental room until the computer instructed them to do so.

The next screen was an intermediate screen that ensured once again that participants were able to interact correctly with the program. The intermediate screen consisted of a gray background, in the middle of which was located a dark gray rectangular button box containing the words "Click To Continue." When participants clicked correctly on this box, the first of the 62 randomized test trials appeared immediately.

Each test screen followed the same format. For illustrative purposes, one of the test screens of a reversed now-then trial-type is presented in Figure 5.
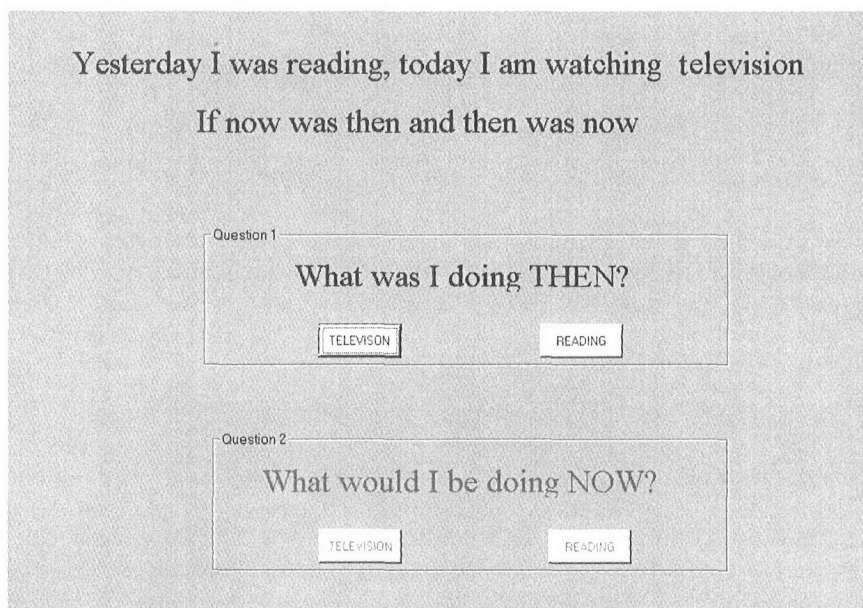

Figure 5. An example of one of the computer screens depicting a test trial presented during the automated procedure employed in Study 3.

Each screen consisted of a full-size gray background with a piece of text describing the individual trial located at the top and in the middle of the screen. This statement appeared immediately and remained present throughout the trial. In the current example provided in Figure 5, the statement presented at the top of the screen was as follows:

Yesterday I was reading, today I am watching television
If now was then and then was now

Below this text, there were two large gray boxes located in the middle of the screen, one above the other. Each box was identical in size and format. The box on top was labeled 'Question 1' with the box below labeled 'Question 2.' Each box contained a printed question, below which were located two button boxes, one on the left and one on the right. All of the information contained within each trial (i.e., a statement, two

questions, and four possible choices, two for each question) was identical to that provided during each trial in the original protocol employed in Study 1. That is, the statement, the two questions, and the four choices were specific to each trial. Consider again, for example, the reversed now-then trial depicted in Figure 4. The statement at the top of the screen indicated the scenario that defined the trial (Yesterday I was reading, today I am watching television. If now was then and then was now). The two questions located in the boxes below match the statement in terms of the relations being targeted (Question 1: What was I doing then? and Question 2: What would I be doing now?). The four available button options specified the only choices that are possibly coherent in terms of the statement and the questions. That is, in response to either question, the participant could select 'Television' or 'Reading.' All of the counterbalancing that was conducted during the original protocol in Study 1 was maintained in the automated procedure.

During the appearance of each test screen, both questions and their two related choices were immediately visible. However, only Question 1 was immediately active (i.e., participants could respond by clicking) whereas Question 2 was not. After selecting one of the choices in Question 1, this question then became inactive, and Question 2 became active. Once participants had selected one of the choices for Question 2, the trial was complete. All of the test trials were conducted in this way. At the end of each trial, the intermediate screen appeared immediately.

Each of the 62 test screens was followed by an intermediate screen, except for the last. After the last test screen had been completed, a final 'Thank-you' screen appeared immediately. This consisted of a gray full-size background with a large green text box in the middle, in which the following message appeared "Thank you for your participation so far. Please report to the Experimenter." In total, the automated protocol contained 125 screens (1 introductory screen, 62 test screens, 61 intermediate screens, and a 'thank-you' screen). Each automated test exposure lasted approximately 20 minutes. Each participant was exposed twice to the same procedure, she or he was thereafter thanked for participating and was debriefed.

Results and Discussion

The combined error rates for each participant across the second test exposure were analyzed to produce a mean error rate for each participant. Participants' mean error rates were compared with those of the same age (18-30) who had participated in the table-top procedure employed in Study 1. The overall mean error rates for both groups are presented in Figure 6.

Figure 6 indicates clearly that there were little or no differences between the performances of the adult participants exposed to the table-top and automated procedures. A one-way ANOVA confirmed no significant difference in error rates between these groups, $F(1, 46) = .374$,
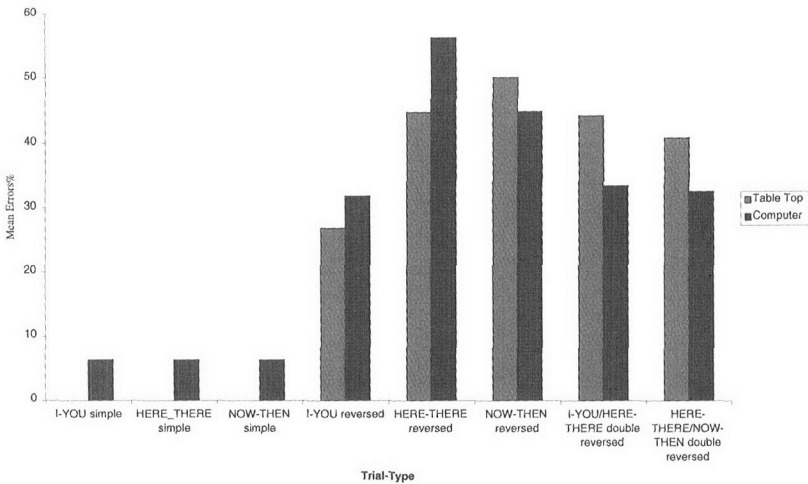
Figure 6. The overall mean percentage of errors produced by adult participants during the table-top procedure employed in Study 1 compared to age-similar controls exposed to the automated procedure employed in Study 3.

$p = .5437$. These findings indicate that it is highly unlikely that participants exposed to the table-top procedure were affected by experimenter cueing, because their performances were not significantly different from those of the same age group exposed to the same trials during an automated procedure in which the experimenter was completely absent.

General Discussion

The current study contained three studies, a primary empirical investigation (i.e., Study 1) and two related control studies (Studies 2 and 3). The results from this work may be summarized as follows. In Study 1, errors decreased, in general, as a function of age. Specifically, the early childhood group (3- to 5-year-olds) produced the highest number of errors across trial-types whereas the adult participants produced the fewest. With regard to relation type, in general, participants produced fewer errors on trial-types involving I-you relations and most on the now-then relations. With regard to relational complexity, participants overall produced more errors on reversed than on simple trial-types.

In Study 2, two groups of children in early and middle childhood were exposed to foiled reversed and double reversed relations to determine the possible effects of word length in responding to these complex relations. The performances of these groups were compared to those of age-similar counterparts exposed to the original trial-types in Study 1. Overall, children from these age groups produced significantly fewer errors in response to the foils than to the original trial-types on both the reversed and double reversed relations. These findings provided

additional evidence that the poor performances of the young children in Study 1 were due, at least in part, to deficits in relational responding rather than to the length of the questions per se.

In Study 3, a group of adult participants were exposed to the original protocol in the form of an automated procedure. The performances of this group were then compared to those of age-similar counterparts exposed to the same trials presented as part of the table-top procedure employed in Study 1. No significant difference was recorded between these performances, suggesting that participants exposed to the table-top procedure were not affected by experimenter cueing.

Two key findings regarding relational complexity were obtained from the current research. First, the early childhood group produced large numbers of errors relative to the other age groups, particularly on reversed and double reversed trial-types. Second, participants overall produced significantly more errors in response to reversed relations than to simple relations. These findings together suggest that reversed and double reversed relations require more complex forms of derivation than simple relations, and that the level of relational complexity involved in reversed and double reversed relations extended beyond the relational repertoires of the youngest children relative to the older participants.

In addition to performance differences that arose from relational complexity, the current study also indicated a number of differences with regard to relation type (i.e., whether the trial-type involved the relational frame of I-you, here-there, or now-then). Overall, more errors were produced in response to now-then simple relations than to here-there simple relations, and participants also produced fewer errors on reversed I-you trial-types than on reversed here-there or reversed now-then trial-types. These data provide support for the suggestion that the relational responses targeted within each trial-type constitute distinct behavioral units.

As well as extending the RFT research program in this area, the current work appears to have significant overlap with both the traditional developmental literature, and the Theory of Mind literature in particular. For example, the finding that here-there relations appear to emerge before now-then relations supports evidence from the mainstream developmental literature that young children master spatial relations before temporal relations (Piaget, 1967). Furthermore, the traditional Theory of Mind literature argues that performances on simple Theory of Mind tasks should improve between the ages of 4 or 5 years old (Baron-Cohen et al., 2000). Indeed, by age 5, most normally developing children perform well on these tasks (Perner, Lang, & Stummer, 1998). This suggestion is consistent with the results from the current study in which the performances of children in their middle childhood more closely resembled those of older participants than those of the youngest group of children. The similarities in these findings suggest that responding in accordance with the three perspective-taking frames may involve behavioral processes that contribute to the development of skills normally tested under the rubric of Theory of Mind.

The fact that the current RFT data is consistent with traditional mainstream and Theory of Mind research suggests that relational perspective-taking is an important feature of normal cognitive development, which may be required for competent performances on both traditional cognitive and Theory of Mind tasks. The overlap between these various research traditions and the methodologies they employ was, of course, not the primary concern of the current work. Future research, however, might investigate, for example, whether explicit training in relational perspective-taking would produce concurrent (untrained) improvements in other cognitive tasks such as Theory of Mind tests (Howlin et al., 1999).

Analyzing perspective-taking and employing a cross-sectional developmental profile are not traditional hallmarks of behavior-analytic psychology. The current study, however, demonstrates that RFT may facilitate the analysis of psychological events that previously did not appear particularly amenable to a behavior-analytic investigation. Furthermore, the current work suggests that perspective-taking may be usefully defined in terms of functionally distinct relational operants, and the systematic analysis of these operants might well inform a behavioral understanding of what it means to take the perspective of another. In terms of application, a behavioral approach to these phenomena also suggests possible means of establishing these repertoires in individuals for whom they appear to be absent. This development, therefore, could have implications for researchers across the broad field of psychology as a whole.

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