The Relationship between Intellectual Functioning and Relational Perspective-Taking

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Abstract

Several studies have employed an RFT-based test protocol as an assessment of perspective-taking with both typical and atypical samples of adults and children. In addition, other RFT protocols have found significant correlations between competencies on specific relations and outcomes on standardised IQ measures. However, there is no research to date that has examined correlations between relational perspective-taking and IQ. In the current study, 24 adults with varying levels of intellectual disability were exposed to standard measures of language ability and IQ, as well as an RFT-based test protocol for perspective-taking. In line with previous evidence, the results indicated significant differences across performances on different aspects of the perspective-taking protocol. Furthermore, the data indicated that perspective-taking correlated with verbal ability, full-scale IQ and performance IQ. These findings provide further evidence of the utility of the RFT-based protocol of deictic frames and highlight the role of intellectual functioning in perspective-taking.
Key words: RFT, Perspective-Taking, Intellectual Disability, IQ, Verbal Abilities.

Resumen

Varios estudios han empleado un protocolo conductual basado en la RFT para la eva-luación de la toma de perspectiva con adultos y niños. Además, otros protocolos han encontrado correlaciones significativas entre competencias en relaciones específicas y resultados en medidas estandarizadas del CI. Sin embargo, hasta la fecha no hay estudios que examinen las correlaciones entre toma de perspectiva relacional y CI. En el presente estudio 24 adultos con diferentes niveles de discapacidad intelectual fueron expuestos a medidas estándar de habilidad en lenguaje y CI, así como a un protocolo basado en la RFT para la evaluación de la toma de perspectiva. En línea con la evidencia previa, los resultados indicaron diferencias significativas en las ejecuciones en diferentes aspectos del protocolo de toma de perspectiva. Además, los datos indicaron que la toma de perspectiva correlacionó con habilidad verbal y CI. Estos hallazgos apuntan al papel que tiene el funcionamiento intelectual en el lenguaje conductual y proporcionan nueva evidencia de la utilidad del protocolo de marcos deícticos basado en la RFT y aportan datos sobre el papel del funcionamiento intelectual en la toma de perspectiva.
Palabras clave: RFT, toma de perspectiva, discapacidad intelectual, habilidades verba-les.

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Perspective-taking has traditionally been studied within a cognitive-developmental framework, often under the rubric of Theory of Mind (ToM, see Baron-Cohen, Tager-Flusberg, & Cohen, 2000). Support for this account is in part derived from the study of persons with autistic spectrum disorder (ASD) who demonstrate significant difficulties in perspective-taking that are interpreted as deficits in the development of a complete understanding of the minds of the self and others (i.e. a theory of mind, Baron-Cohen, 2001). The relationships among ToM, perspective-taking and ASD are not however straight forward, in light of two sources of evidence. First, persons diagnosed with high-functioning ASD have reportedly passed ToM tasks (Royers, Buysse, Ponnet, & Pichal, 2001). Second, ToM deficits have been observed in other persons with diagnosed intellectual disabilities in the absence of ASD (Jahoda, Pert, & Trower, 2006).

The ToM approach to perspective-taking is embedded within a cognitive and specifically representational understanding, according to which a particular meta-re-presentational module has been identified as the key process behind one's ability to demonstrate a ToM. As well as being relatively ill-defined and difficult to integrate with other accounts of these phenomena, the research noted above suggests that there may be more to perspective-taking than the functioning of a particular cognitive module. As an alternative, some cognitive researchers have suggested the possible utility of a domain-general approach (Bowler, Briskman, Gurvidi, & Fornells-Ambrojo, 2005).

A domain-general approach has also been proposed by behavioural researchers, although they have not articulated it in this way and their account is located under the general functional theory of human language and cognition, known as Relational Frame Theory (RFT; Hayes, Barnes-Holmes, & Roche, 2001). In short, this is a broad contextual account of language and cognition, at the heart of which lies the processes of deriving arbitrary stimulus relations. These relations can be categorised according to various families of relational frames that specify the types of relations by which higher-order behaviour is organised.

Perspective-taking skills, as behaviourally defined, appear to overlap considerably with ToM performances. For RFT, the former involves a family of deictic relational frames that control all aspects of taking the perspective of oneself and others. According to this account, three such frames appear to be critical for the development of perspective-taking and these have been referred to as I vs. YOU, HERE vs. THERE, and NOW vs. THEN. 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?" across which the physical environment changes, but properties of the critical relations remain constant. For example, I is always from this perspective here, but not from the perspective of another person or somewhere else.

For RFT, it is important to emphasise that a range of spoken words many function as the relevant contextual cues that control the derivation of the perspective-taking relations. Although the most common examples include, as expected, the actual words "I", "you", "here", "there", "now" and "then", the co-ordination of these words with many other words and phrases generates an almost infinite array of substitute words that will function as cues to control perspective-taking relations. Consider the following example: "It is one o'clock (NOW) and I am at work (HERE), but Mary (NOT I) 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, "Mary" 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 generalised relational activity and not the actual words themselves (as is the case for all relational frames).

In order to test RFT predictions about perspective-taking, researchers have developed an assessment protocol derived from the three deictic frames (Barnes-Holmes, McHugh, & Barnes-Holmes, 2004). In studies with typically developing children and adults, a positive correlation has been reported between performances on a 62-item version of the perspective-taking protocol and chronological age (McHugh, Barnes-Holmes, & Barnes-Holmes, 2004). Furthermore, the same researchers have identified functional differences between different items on the protocol in terms of level of relational complexity and frame-type.

Rehfeldt, Dillen, Ziomek, and Kowalchuk (2007) reported two experiments in which children with ASD were exposed to a 57-item version of the perspective-taking protocol for assessment and training purposes. The study was also concerned with whether this sample would show deficits in perspective-taking, relative to age-matched typically-developing peers and whether accuracy in perspective-taking correlated with scores on standardised instruments for assessing ASD. The results of Experiment 1 demonstrated statistically significant differences in errors as a function of relational complexity and also showed that participants with ASD made more errors than the controls on two of the three relation-types. The results of Experiment 2 demonstrated that a history of reinforced relational responding improved performance on the perspective-taking protocol.

In a related study, Heagle and Rehfeldt (in press) used an extended version of the protocol to teach typically developing children between the ages of 6-11 perspective-taking skills and tested for generalisation to a real-world conversation. The results demonstrated the utility of the protocol as a training tool when all three participants displayed criterion performance on all three post tests for the reversed relations. One participant needed explicit training on simple relations and two required training on double reversals. Furthermore, the generalization probes indicated strong generalised performances on most relations for most participants in terms of novel stimuli and novel conversational arrangements. As a result, the latter work in particular highlighted the potential utility of the RFT protocol for the establishment of critical perspective-taking skills when they are found to be absent, as in ASD populations (see also Barnes-Holmes, 2001).

Well beyond the confines of RFT and behavioural psychology, researchers have argued that flexibility in relational responding is a core component of the skills that are believed to be markers of intelligence (Andrews & Halford, 1998; Cattell, 1971; Gentner & Loewenstein, 2002). Recent RFT studies support this view in demonstrating that specific patterns of relational responding predict performances on standardised IQ tests (O'Hora, Pelaez, & Barnes-Holmes, 2005; O'Hora, Pelaez, Barnes-Holmes, Rae, Robinson, & Chaudhary, 2008; O'Toole & Barnes-Holmes, 2009).

The first study by O'Hora *et al*. (2005) sought to determine if performances on relational tasks that targeted same, difference and before/after relations would predict outcomes on verbal and performance subtests of the Wechsler Adult Intelligence Scale (WAIS). Consistent with predictions, results indicated that those who completed the relational tasks performed significantly better on the verbal subtests than those who did not pass. Similarly, O'Hora *et al*. (2008) investigated whether the ability to respond in accordance with temporal relations predicted performance on the four indices of the WAIS. Again, consistent with predictions, completion of the relational tasks predicted better performance on the Verbal Comprehension and Perceptual Organisation indices. Furthermore, there were significant correlations between relational responding and each constituent subtest of Verbal Comprehension.

In the study by O'Toole and Barnes-Holmes (2009), participants were presented with relational tasks containing before/after and similar/different relations via the Implicit Relational Assessment Procedure (IRAP). That is, during consistent trials, they were required to respond correctly to the relations, while during inconsistent trials, they were required to give the "wrong" answer. The researchers predicted that participants would take longer to respond on inconsistent trials because these demand a relatively high degree of relational flexibility (in other words, getting the answer wrong is harder than getting it right when you know what the right answer is) and indeed this was the case. Participants also completed the Kaufman Brief Intelligence Test (K-BIT) and the researchers attempted to determine the relationship between performances on this test and on the relational tasks. The results demonstrated that performances on the inconsistent trials were better predictors of scores on the intelligence test than consistent trials, thus highlighting a correlation between relational flexibility and intelligence.

Although the foregoing studies provide good support for the overlap between relational responding and intelligence, no such relationship has been identified with the perspective-taking frames. Although Rehfeldt *et al*. (2007) focused on participants with a developmental disorder; their study did not include an explicit measure of intellectual or verbal functioning. The current study attempted to address this issue by investigating the relational perspective-taking profiles of 24 adults with intellectual disabilities on standard measures of IQ. Based on findings from the traditional ToM literature and previous RFT studies, we predicted that performance on the RFT protocol would be positively correlated with measures of intellectual and verbal functioning (O'Hara *et al*., 2008; O'Hora *et al*., 2005). In line with previous research, we also predicted differences in participant responses to the various levels of relational complexity and the three deictic frames within the RFT protocol (McHugh *et al.,* 2004).

METHOD

Participants

Participants were 24 adults (10 males and 14 females) with mild to moderate intellectual disabilities (average full scale IQ 62.83; Average verbal mental age 8.3 years) selected via social service providers in the North West of England and previously unk-

nown to the Researcher. General characteristics of participants are provided in Table 1. Three had Down Syndrome, with the remainder diagnosed with an intellectual disability of unknown origin. None of the participants had ASD and the Social Communication Questionnaire (SCQ) was completed prior to the study by participants' carers to ensure that individuals with potentially undiagnosed ASD were excluded (Rutter, Bailey, & Lord, 2003). All participants, except one, presented without significant sensory difficulties (this individual was unable to complete the performance IQ subtest). None of the participants had a mental health diagnosis.

Table 1. General Participant Characteristics.

Participant Variable	Variable Range (years)	Variable Mean (years)	Variable SD
Chronological Age	19-78	42.79	13.33
Verbal Mental Age on British Picture Vocabulary Scale	4.04-13.08	8.3	2.87
Full Scale IQ on Wechsler Abbreviated Scale of Intelligence	52-81	62.83	6.74
Verbal IQ on Wechsler Abbreviated Scale of Intelligence	19-78	42.79	13.33
Performance IQ on Wechsler Abbreviated Scale of Intelligence	56-82	66.65	6.41

Setting

The study was conducted in a quiet room free from distraction in each participant's residential or day care facility. All participation was on an individual basis. Although a carer known to each participant remained in the room throughout, this individual did not interact with participants at any time. The Researcher and participant were seated adjacent to one another on identical chairs (the purpose of this will become clear subsequently).

Materials

The current study employed two key standardised intelligence tests and a printed RFT-based perspective-taking test protocol.

British Picture Vocabulary Scale 2nd Edition (BPVS-II). The BPVS-II is a standardised measure of receptive language ability with established norms that allow computation of verbal mental age (Dunn, Dunn, Whetton, & Burley, 1997). The BPVS-II contains four training plates, followed by 14 sets of 12 test items, totalling 168 items. Items are arranged in order of difficulty. In each case the participant is presented with a page of four simple line drawings and asked to indicate which best represents a stimulus word (participants point to, or state, the correct picture). For instance, item 52 presents: a picture of three children pulling on a rope; two children play-fighting; a child holding a flag; and a child on a swing and asks "Which one is tugging?" The measure has a test-retest reliability of .75 and correlates with numerous other standardised tests of language ability (Dunn *et al*., 1997).

Wechsler Abbreviated Scale of Intelligence (WASI). The WASI is a relatively brief intelligence test, consisting of two verbal subtests that can be combined to provide a Verbal IQ score and two performance subtests that can be combined to provide a Performance IQ score (The Psychological Corporation, 1999). A full IQ score can also be computed based on all four subtests. Scores on the WASI correspond with those from the full-length Wechsler Adult Intelligence Scale (WAIS). Both tests have high test-retest reliability (.79-.90 for adults) and validity (The Psychological Corporation, 1999).

RFT Perspective-taking Protocol (RFT-PT). The RFT-PT consisted of 34 items selected from a 62-item protocol originally formulated by Barnes-Holmes *et al*. (2004). An abbreviated version of the protocol was employed currently to reduce completion time and the possibility of fatigue with this sample of participants. Adapted versions of this protocol have also been used by other RFT researchers. For instance, Rehfeldt *et al*. (2007) used a 57-item version. The 34 items used in the current study included all questions from the original protocol relating to simple items and a sample of randomly selected questions from each category of question-type at reversed and double-reversed levels of complexity. In each case the proportion of items selected from each question category was proportional to the number of items in that category on the original protocol. For instance, four out of the 8 original reversed I-YOU questions were randomly selected and 3 out of the original 6 double-reversed I-YOU/HERE-THERE questions. This ensured that sufficient exemplars of each question-type were incorporated to ensure reliability and to reduce the possibility of order effects. For instance, I-YOU reversed questions included both those that asked about the participant's perspective followed by the experimenter's and those that asked about these perspectives in the opposite order. A similar approach to selecting items was use by Rehfeldt *et al*. (2007).

Each of the 34 trials in the current 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. 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 relational complexity involving, single relations, reversed relations and double reversed relations. These combinations were presented across 8 trial-types. The order of all trials was randomised 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 items contained within the current protocol are presented in Table 2. The reader is strongly advised to study this table before proceeding. Please note that the table presents items in categories of complexity and frame-type and not in the order they were presented to participants.

Simple Relations. There were eight trials containing three trial-types that assessed simple relations, one for each of the three frames. Hence, these are referred to as Simple I-YOU, Simple HERE-THERE and Simple NOW-THEN relations. The current protocol contained a total of 8 trials of simple relations, two I-YOU, two HERE-THERE and four NOW-THEN trials. Consider a Simple I-YOU trial as follows: "If I (Researcher) have a red brick and you (Participant) have a green brick. Which brick do I have? Which brick do you have?" Responding correctly to all simple relations matched the

Table 2. RFT-PT Items Arranged in Terms of Complexity and Frame-type.

Simple Relations

I-YOU

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

HERE-THERE

3. 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?
4. 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?

NOW-THEN

5. Yesterday I was reading, today I am watching television. What was I doing then? What am I doing now?
6. Yesterday I was watching television, today I am reading. What am I doing now? What was I doing then?
7. Yesterday you were reading, today you are watching television. What are YOU doing now? What were YOU doing then?
8. Yesterday you were watching television, today you are reading. What were YOU doing then? What are YOU doing now?

Reversed Relations

I-YOU

9. 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?
10. 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?
11. 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?
12. 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?

HERE-THERE

13. 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?
14. 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 would I be sitting then?
15. 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 then? Where would you be sitting now?
16. 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?
17. 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 then? Where would I be sitting now?
18. 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 would you be sitting then?

NOW-THEN

19. Yesterday I was reading, today I am watching television. If now was then and then was now. What would I be doing now? What would I be doing then?
20. 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 then? Where would I be sitting now?
21. Yesterday I was watching television, today I am reading. If now was then and then was now. What would I be doing then? What would I be doing now?
22. 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 would you be sitting then?
23. 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 then? Where would you be sitting now?
24. Yesterday you were watching television, today you are reading. If now was then and then was now. What would you be doing then? What would you be doing now?
25. 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 would I be sitting then?
26. Yesterday you were reading, today you are watching television. If now was then and then was now. What would you be doing now? What would you be doing then?

Double Reversed Relations

I-YOU/HERE-THERE

27. 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?
28. 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?
29. 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?

HERE-THERE/NOW-THEN

30. 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?
31. 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?
32. 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?
33. 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?
34. 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?

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arrangements specified in the instructions: "You (Researcher) have a red brick and I (Participant) have a green brick" or words to that effect. (Most participants simply stated the colour names in the appropriate order). Across all trials at each level of complexity, the order in which the I and YOU questions were presented was randomised. Simple HERE-THERE relations were identical in format to I-YOU relations (see Table 2).

Simple NOW-THEN relations differed from the other simple relations because it did not involve responding to I and YOU simultaneously, hence these trials specified what only one person (I or YOU) was doing. As a result, all NOW-THEN trials contained two I questions or two YOU questions. Consider the following Simple NOW-THEN trial: "Yesterday I was watching television, today I am reading. What was I doing then? What am I doing now?" As with all questions, the sequencing of the NOW and THEN questions was randomised with all other items.

Reversed Relations. There were 18 trials containing three trial-types assessing reversed relations: Reversed I-YOU (4 trials), Reversed HERE-THERE (6 trials) and Reversed NOW-THEN relations (8 trials). Consider the following Reversed I-YOU relation: "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 and responding was deemed correct on this basis. Hence, the correct answer in this case would be "You (Researcher) would have the green brick and I (Participant) would have the red brick" or words to that effect. This type of answer constituted the correct response in all trials in which one relation was reversed. The Reversed HERE-THERE relations followed the same format, but included the statement "If HERE was THERE and THERE was HERE". Reversed NOW-THEN relations contained the statement "If NOW was THEN and THEN was NOW" and again required responding to only one person at a time.

Double Reversals. There were eight trials and two trial-types assessing the Double Reversed I-YOU/HERE-THERE (3 trials) and Double Reversed HERE-THERE/NOW-THEN relations (5 trials). 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.

Consider the following Double Reversed HERE-THERE/NOW-THEN trial: "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 (Researcher) would be sitting on the black chair, yesterday you would have been sitting on the blue chair" or words to that effect.

Procedure

All participation was conducted across two sessions. Each session lasted approximately 1hr, with a one-two week gap between sessions. All participants were exposed

to all three assessment procedures as a test and no feedback was provided for any response across any of the trials. In each case, the BPVS-II was administered first to help establish rapport (participants generally enjoy completing this measure) followed by the WASI and finally the RFT-PT. At the beginning of each session, each participant was taken to the experimental room and when he/she indicated readiness to begin the Researcher provided a brief set of instructions regarding the subsequent test. 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 each question". Participants were asked if they understood these instructions and then asked to begin. No participant indicated that they did not understand what was required.

Administering the RFT-PT. The RFT-PT test was used in printed form. Neither questions nor answers were visible to participants and the test sheets did not contain answers that might function as experimental cues. All items were read aloud in a monotone voice by the Researcher and recorded in writing as a letter code so as not to function as feedback for correct or incorrect responding to participants. For example, the Researcher simply wrote the first letter of the colour name emitted by participants. The Researcher ensured that no eye contact was made with participants by fixing their gaze at the question and answer sheets throughout the procedure. It is also important to emphasise that although the RFT-PT makes direct reference to actual items, seating locations etc., all of these were hypothetical and were not actually manipulated as part of the study.

Participants were permitted up to 1min. to respond, with only the first response accepted. Both questions within a trial must be correct for the trial to be recorded as correct. After answering the first question, participants were asked the second question immediately. The Researcher repeated a question once only, if requested to do so by a participant. Participants were provided with non-contingent social praise ("thank you") after each response, but no other form of feedback was provided. If a participant made any comment during a trial, the Researcher simply replied: "We can talk after we have finished our work." Participants did not receive any tangible reinforcement within or after sessions, but were invited to a presentation evening one month after all data had been collected.

Results

Individual participant data on all measures, including sub-scores, are presented in Table 3. The range of full-scale WASI scores was 52-81, with only one participant (P24) scoring well above 70. These outcomes confirmed that the majority of participants presented with mild-moderate levels of intellectual disability. As expected, sub-scores were in line with these outcomes. The range of scores on the BPVS-II was 4.04-13.08, thus indicating that all participants experienced a degree of language impairment and had a verbal mental age that was below their chronological age.

RFT-PT. All participants completed all trials on the RFT-PT. Individual scores by relational complexity and relation-type are presented in Table 3. In each case, scores relate to the percentage of correct responses. The mean percentage and range of correct

Table 3. Individual Data for All Participants.

| Participant | Ranked Score | RFT -PT | | | | | | BPVS | WASI | | |
		Simple	Reversed	Double Reversed	I-You	Here-There	Now-Then		Full-Scale	Verb.	Perf.
3	1	50	50	62.5	33.3	50	58.3	5.05	56	55	62
5	1	37.5	66.6	37.5	50	62.5	58.3	4.05	57	55	65
6	1	50	33.3	62.5	50	62.5	16.7	6.08	58	55	58
8	1	50	44.4	37.5	50	87.5	25	11.07	58	60	63
14	1	50	44.4	25	33.3	50	58.3	5.05	63	57	72
19	2	75	27.8	62.5	50	37.5	41.7	8.05	68	76	64
1	2	62.5	44.4	75	83.3	50	33.3	5.05	52	55	56
4	2	100	27.8	37.5	66.6	50	41.7	9.07	57	55	64
7	2	87.5	33.3	62.5	33.3	50	50	4.05	58	55	67
9	2	75	38.9	75	66.7	50	41.7	11.01	59	55	67
10	2	75	44.4	62.5	83.3	62.5	33.3	8.01	59	57	67
11	2	87.5	33.3	50	83.3	50	41.7	8.04	60	57	68
13	2	87.5	27.7	62.5	75	37.5	41.7	8.1	62	63	58
16	2	75	38.9	55.6	40	69.2	30	13.06	64	64	69
17	2	100	44.4	50	50	62.5	66.7	13.08	65	62	72
20	2	87.5	33.3	50	83.3	37.5	41.7	9.01	69	76	65
2	3	87.5	66.7	37.5	66.6	62.5	83.3	4.04	55	57	-
15	3	100	66.6	37.5	100	75	66.7	12	64	71	62
21	3	87.5	66.6	50	83.3	75	66.7	9.11	70	80	62
23	3	87.5	72.2	37.5	83.3	75	75	9.1	73	76	74
18	3	100	66.6	50	100	75	66.7	12	67	72	66
12	4	87.5	55.6	62.5	66.6	62.5	66.7	10.02	62	60	70
22	4	87.5	77.7	62.5	83.3	87.5	75	6.07	71	66	80
24	4	62.5	62.5	66.7	90	61.5	55	9.1	81	84	82

responses was also calculated for both relational complexity (for all relation-types) and relation-type (for simple and reversed levels of complexity and reversed items only) (see Table 4).

Relational Complexity. Overall, participants produced best performances on the simple items (accuracy: M= 77.08, SD= 18.67). Responding to the double reversals was next but considerably weaker (M= 53.01, SD= 13.44) and surprisingly the weakest performances were recorded on the reversed relations (M= 48.64, SD= 15.86), although the difference between the latter two was small.

A one-way repeated measures analysis of variance (ANOVA) indicated large significant differences between: simple vs. reversed relations $F(1, 23)$= 34.31, p >.01 and simple vs. double-reversed relations $F(1, 23)$= 25.42, p >.01. The difference between reversed and double-reversed items was non-significant (p= .37).

The RFT-PT data were also ranked according to a 50% pass criterion at each level of difficulty to test whether participants were responding at above chance levels. Ranking was conducted in a cumulative fashion to distinguish between those participants who attempted to reverse items and those who made no such attempts. For instance, it was possible for a participant to never reverse relations, thus passing simple items, failing reversed items, but passing double-reversed items. In contrast, a participant who passed reversed items may have failed to consistently make two reversals on double-reversed items and therefore have obtained a lower score at this level of difficulty. These issues had been noted previously by Rehfeldt *et al*. (2007).

In light of these factors, the following ranking system was employed: 1= Failed 50% of Simple relations (regardless of what else passed); 2= Passed over 50% of simple relations, but failed 50% of reversed relations (regardless of performance on double-reversed relations); 3= Passed over 50% of simple relations and over 50% of reversed relations, but failed 50% of double reversals; and 4= Passed over 50% at all levels of complexity (see Table 3). The highest number of participants responded at Ranking Level 2 (n= 11, 45.8%), followed by Level 1 (n= 5, 20.8%), and 3 (n= 5, 20.8%) with a small number responding at Level 4 (n= 3, 12.5%). In summary, applying the ranking system suggested that approximately a fifth of participants failed all three levels; almost half passed the simple relations only; approximately one fifth passed simple and reversed relations and just over tenth passed all three levels.

Table 4. Score Means and Range by Question Type.

Question Type		Mean Percentage Correct	Range Percentage Correct
Relational Complexity	Simple	77.08	37.5-100
	Reversed	48.63	27.5-77.7
	Double Reversed	53.01	37.5-75
Relation-type (Simple and reversed levels of complexity combined)	I-YOU	66.85	33.3-100
	HERE-THERE	60.13	37.5-87.5
	NOW-THEN	51.47	16.7-83.3
Relation Type (Reversed items only)	I-YOU	59.91	24.72
	HERE-THERE	49.47	19.74
	NOW-THEN	44.53	20.79

Relation-type. Differences between relation-types were assessed using simple and reversed items only, based on the perspective-taking frame that was explicitly questioned or reversed in each item. The I-YOU relations produced the highest mean (M= 66.85, SD= 21.07), although HERE-THERE relations were close (M= 60.13, SD= 14.38). NOW-THEN generated the lowest accuracies (M= 51.47, SD= 17.49). A one-way repeated measures ANOVA indicated significant differences between: I-YOU vs. NOW-THEN, $F(1, 23)$= 10.02, p >.01 and HERE-THERE vs. NOW-THEN $F(1, 23)$= 5.08, p >.05. I-YOU and HERE-THERE relations did not differ significantly (p= .16).

Because this type of analysis did not preclude the possibility that the significant differences noted above may have related to a greater proportion of simple responses on I-YOU and HERE-THERE relations, relation-type was also assessed using reversed items only, in order to hold level of relational complexity constant. The mean for I-YOU relations was highest (M= 59.91, SD= 24.72), followed by HERE-THERE (M= 49.74, SD= 19.74) and NOW-THEN (M= 44.53, SD= 20.79). These data were then subjected to a one-way repeated measures ANOVA. The difference between I-YOU and NOW-THEN remained highly significant, $F(1, 23)$= 8.26, p >.01 and I-YOU vs. HERE-THERE approached significance, $F(1, 23)$= 3.31, p= .08. HERE-THERE vs. NOW-THEN was non-significant (p= .25). In short, responding on I-YOU relations remained significantly better than NOW-THEN relations and almost significantly better than HERE-THERE relations.

Associations between RFT-PT and Other Areas of Functioning. Associations between the IQ scores/sub-scores and accuracy for relational complexity and relation-type on the RFT-PT were assessed using Pearson's product-moment correlation and (where parametric assumptions were not met) Spearman's rho correlation. Additional associations were also examined between IQ outcomes, the ranked score and a combined RFT-PT score calculated from the sum of participant's performance on simple and reversed items.

RFT-PT Performance and Language. There was a significant positive correlation between participants' verbal mental age on the BPVS-II and responding to simple relations only (r= .46, p= .02, all other p's >.13). There was also a significant positive correlation between verbal IQ on the WASI and the combined RFT-PT score (r= .45, p= .03), as well as with the ranked RFT-PT scores (rs= .61, p= .01). The correlation between verbal IQ and reversed relations approached significance (r= .36, p= .09, all other p's >.15).

RFT-PT Performance, Non-verbal IQ and General Intellectual Functioning. There was a significant positive correlation between full-scale-IQ on the WASI and the combined RFT scores (r= .43, p= .04), as well as ranked RFT-PT scores (rs= .56, p= .01, all other p's >.22). Performance IQ scores on the WASI showed a significant positive correlation with reversed items (r= .45, p= .03) and approached significance with ranked RFT-PT scores (rs= .41, p= .06) and combined scores (r= .38, p= .08, all other p's >.54).

DISCUSSION

The current study investigated the potential relationship among performances on an RFT perspective-taking protocol and a number of standard measures of intellectual and language abilities. Furthermore, the research examined differences in responding to various features of the perspective-taking protocol, particularly with regard to level of relational complexity and relation-type. In both regards, the study was concerned with the possible overlap with outcomes from previous research, but aimed to be the first to examine the relationship between relational perspective-taking and IQ in a population with intellectual disabilities.

The results of the current research showed significant differences in performances for both relation-type and relational complexity. In terms of outcomes relating to frame-type, these were similar to those recorded previously by Barnes-Holmes *et al*. (2004) using a 62-item protocol with typical children and adults but different to those reported by Rehfeldt *et al*. (2007) using a 57-item version with participants with ASD. Whilst the number of items in each of these studies has differed, each has included items based on all three frames of perspective and at three levels of complexity. It is therefore possible to compare findings from each study.

In the current study significant differences were apparent between questions based on I-YOU compared to NOW-THEN frames and those based on HERE-THERE compared to NOW-THEN frames. When controlling for differences in the proportion of simple items in each of these categories and comparing differences on reversed items only, a significant difference was still found between I-YOU and NOW-THEN questions. The study reported by Barnes-Holmes *et al*. (2004) reported the same differences and also found I-YOU questions to be significantly easier than HERE-THERE questions for reversed items. This latter difference approached significance in the current study.

In contrast to Barnes-Holmes *et al*. (2004) and the current study, Rehfeldt *et al*. (2007) did not find any overall difference in the performance of participants with ASD for questions based on each type of relational frame. Taken together the studies suggest that the performance of adults with intellectual disabilities reflects a 'delay' of typical development rather than a different developmental pathway as has often been suggested for children with ASD (Baron-Cohen, 1991; Weisz & Yeates, 1981). Future RFT research might usefully investigate further similarities and differences between participants with intellectual disability only and those with ASD.

For relational complexity, the best outcomes in the current study were on simple relations, which differed significantly from both reversed and double reversed relations. A significant difference was not found between reversed and double-reversed items. Further analyses of the complexity using a 50% accuracy criterion indicated that the majority (almost half) of participants passed the simple relations only; approximately a fifth of participants failed all three levels; a further fifth passed simple and reversed relations and just over tenth passed all three levels.

The finding that simple relations are the easiest to solve and are often accompanied by significantly better performances is comparable across all existing studies. For example, McHugh *et al*. (2004) reported that children of all age groups produced

significantly fewest errors on simple relations, relative to the two other levels of complexity and Rehfeldt *et al*. (2007) found performance on simple relations to be better than on reversed. Barnes-Holmes *et al*. (2004) also reported that double reversals were significantly more difficult than reversals.

According to RFT, answering simple relations involves responding in accordance with a deictic relation under the contextual control of an if-then relation. For instance, 'If I have a green brick then you have a red brick.' In contrast, answering a reversed item involves a transformation of stimulus functions in accordance with a mutually entailed relation between components of a deictic frame, under contextual control of an if-then relation. For instance, 'If I am you then I have a red brick.' Double-reversals involve combinatorially entailed transformations of function. According to this view, therefore, there are functional distinctions between the two types of reversal that would appear to make one more complex than the other.

The lack of difference between reversed and double reversed relations in the current study and those of McHugh *et al*. (2004) and Rehfeldt *et al*. (2007) may however simply reflect the use of a single response strategy for double reversals. In short, at least some participants may have derived that correct responding on double reversals returns one to the original logical starting point, so that one need not follow the logic of the questions at all, but simply give the answer as stated in the non-reversed part of the trial. In the current study, we ranked the data in an attempt to circumvent this possibility and thus separate the two types of reversal. Although the ranked data did separate responding on the two levels, it also indicated that almost half of the participants failed to reverse items at all while only a fifth passed reversed relations but failed the double reversal. As a result, it remains a possibility that some, but not all, participants had derived such a rule.

A number of associations were found between measures of intellectual and verbal functioning and responses on the RFT measure. In particular, a positive correlation was found between RFT-PT score and participants' verbal mental age. Significant correlations were also found between verbal-IQ and combined and ranked RFT scores, suggesting the importance of language for perspective-taking ability as measured by the RFT-PT. Interestingly, Happe (1995) noted that verbal ability and a ToM are often considered to be unrelated amongst people with intellectual disability who do not have ASD. Given the potential overlap between ToM and relational perspective-taking, the current data do not support such a hypothesis.

Further associations were evident between RFT-PT scores, general intellectual functioning and performance measures. This included positive correlations between full-scale-IQ and combined and ranked RFT-PT scores. These findings are consistent with prior suggestions that flexibility and complexity of relational responding relates closely to intellectual functioning (Andrews & Halford, 1998; Cattell, 1971; Gentner & Loewenstein, 2002) and recent RFT studies that have shown patterns of relational responding to predict performances on standardised IQ tests (O'Hora, Pelaez, & Barnes-Holmes, 2005; O'Hora, Pelaez, Barnes-Holmes, Rae, Robinson, & Chaudhary, 2008; O'Toole & Barnes-Holmes, 2009). It is important to note however that no prior RFT study has explicitly investigated the association between IQ/verbal ability and perspective-taking

ability. In contrast to associations with language, numerous non-behavioural authors have also proposed that general abilities may be closely related to ToM functioning in adults with intellectual disabilities (Yirmiya & Shulman, 1996; Yirmiya, Solomonica-Levi, & Shulman, 1996). The current data certainly support this view.

While participants' scores on reversed RFT-PT items were not related to verbal ability they were found to correlate significantly with performance-IQ scores. These findings suggest that other cognitive abilities may be related to performance on the RFT-PT, even when items are presented verbally. The association with reversed items may be of particular theoretical significance when considering visual and spatial skills required to complete performance sub-domains on the WASI. For instance, the kind of movement and positioning of formal stimuli involved within the WASI block design subtest would seem to parallel the manipulation of non-formal relational stimuli within RFT-PT reversed items. It is therefore possible that formal stimuli could be used to good effect when developing treatments to enhance more abstract perspective-taking abilities.

As with participant response to frames of each type, response differences in terms of complexity from the current study, overlap considerably with previous research, and suggest that perspective-taking amongst individuals with intellectual disabilities reflects a delay of the same sequence as demonstrated in typically-developing populations (Barnes-Holmes *et al*., 2004). Further support for the delayed-hypothesis is evident from the associations between RFT-PT score and participants' verbal mental age. This closely resembled associations between chronological age and ability amongst typically developing populations on the RFT-PT (Barnes-Holmes *et al*., 2004) where participant performance for simple items was found to increase with age and reflected developmental stages discussed in the ToM literature (Howlin *et al*., 1999).

In summary, the current study aimed to further investigate associations between intellectual functioning and relational responding with regard to performance on an RFT perspective taking protocol. It was found that participant's performance differed in accordance with level of complexity and the deictic-frame central to each question that paralleled previous studies in the area for typically developing populations but differed in some ways from those with ASD. The study also demonstrated that relational perspective-taking varies in accordance with verbal, performance and full-scale IQ, providing further evidence of the importance of relational responding for intellectual functioning.

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