ORIGINAL RESEARCH

Pragmatic abilities in children with neurodevelopmental disorders: development of Pragmatic Abilities Questionnaire based on the Rasch rating scale model

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Background: Pragmatic abilities includes a set of skills that could vary by culture and which are absolutely essential for social communication. These abilities can be impaired in many children with neurodevelopmental disorders and may lead to educational and psychological difficulties. Assessing pragmatic abilities requires valid and reliable instruments that should be developed with cultural differences in mind.

Purpose: This paper reports on the development of a new instrument for measuring and evaluating pragmatic abilities in children with neurodevelopmental disorders.

Methods and participants: The questionnaire items were generated based on a literature review on the theoretical basis of pragmatic abilities, the available pragmatic assessment instruments, interviews with experts and the mothers of children with neurodevelopmental disorders and the observation of their interaction with children based on the pragmatic protocol. Item selection and reliability and validity assessment for the instrument were carried out based on the Rasch rating scale model analysis. The Pragmatic Abilities Questionnaire (PAQ) was completed by the mothers of 185 normally-developing children and the mothers of 120 children with neurodevelopmental disorders, including Autism Spectrum Disorder (ASD), Specific Language Impairment (SLI), Attention-Deficit/Hyperactivity Disorder (ADHD) and Social (Pragmatic) Communication Disorder (SPCD).

Results: The initial pool of 119 items, reflecting the characteristics of pragmatic abilities, was first reduced to 80 after a review by ten experts, and then further reduced to 40 using the Rasch analysis for removing the misfitting items. The final PAQ had a person measure reliability of 0.97 with a separation of 6.03 and an item measure reliability of 0.99. The remaining items formed the questionnaire and measured a single construct, which explained 63.8% of the variance.

Conclusion: The 40 items of the PAQ appear to construe a psychometrically-sound measure of pragmatic abilities.

Keywords: pragmatics, social communication, assessment

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Introduction

Pragmatic abilities comprise one of the underlying components of social communication[1–4] that can be defined as a set of abilities used for the proper utilization and interpretation of language in different communicative situations.[5] Some of these abilities can be impaired in children with Autism Spectrum Disorder (ASD),[6–11] Intellectual Disability (ID),[12,13] Attention-Deficit/Hyperactivity Disorder

(ADHD),[14–16] Learning Disabilities (LD),[17–22] and Specific Language Impairment (SLI).[23–25] With the introduction of a new diagnostic category to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5),[26] namely Social (Pragmatic) Communication Disorder (SPCD), and the proposals for adding Pragmatic Language Impairment (PLI) to the International classification of Diseases-11 (ICD-11),[27] the emphasis on pragmatic abilities and methods for assessing these abilities in children with pragmatic impairment has been growing.

Some checklists are available for examining the various aspects of pragmatics within the theoretical framework from which the instrument was developed.[4] Some of these checklists focus only on one aspect rather than all the aspects of pragmatics comprehensively; examples include the Discourse Skills Checklist[28] and the Parent-Report Rating Scale.[29] The Pragmatic Protocol,[30] on the other hand, has considerable merit as a checklist and covers various aspects of pragmatics, although its results are mainly dichotomous and do not reveal a range of behaviors, and also, the tool has not yet been validated.[31,32] In addition, some of the available tools lack adequate reliability; for example, the Targeted Observation of Pragmatics in Children's Conversations (TOPICC).[33,34]

The Children's Communication Checklist-2 (CCC-2)[35] is probably the most widely-used questionnaire in the linguistics field.[4] Although It is norm-referenced and well-validated, there are some accepted limitations on its diagnostic accuracy and also some risk of inconsistent parent reports.[32,34] While some studies have found that pragmatic impairment exists separately from other language impairments,[26,36] this checklist is specifically designed to check for pragmatic language problems in children with an identified SLI[4] and includes scales for language functions (speech, syntax and semantics).

Several points have to be considered in the assessment of pragmatic abilities. First, pragmatics are influenced by culture, and cultural differences must therefore be considered in the assessment of pragmatic language.[3,4,34,37] To identify cultural differences in pragmatics, there is also a need to avoid developing instruments that are not ecologically valid,[38] although no culture-based instruments exist for measuring pragmatic abilities in Farsi-speaking children. Second, there is a need for valid and reliable instruments for use in children with pragmatic impairment.[31,39] Third, a good measurement instrument must include a range of perspectives (interviews with family members, teachers and specialists involved with the child) and

contexts (observations in daily and clinical environments) in order to gather information and get a comprehensive view of children's pragmatic abilities.[4,32] And finally, because pragmatic abilities include the comprehension and use of speech acts and communicative intentions, the organization and management of discourse, adapting communication to the social context, understanding nonliteral language, inference of the speaker's intended meaning and nonverbal behaviors,[4,5,32,40] pragmatic assessment measures have to consider the various aspects of pragmatics more comprehensively rather than focusing on one or two components.

Current study

Given the points noted for the development of a new instrument to measure pragmatic abilities, four main sources were used in this study, including a literature review of the theoretical basis of pragmatic abilities, the available pragmatic measures, interviews with experts and the mothers of children with neurodevelopmental disorders about pragmatic abilities and the observation of their children, and finally the Rasch model. Rasch analysis is based on the probability theory and is a powerful tool for evaluating construct validity by which researchers can evaluate the validity and reliability of a measurement more thoroughly compared to the traditional analysis.[41,42] This paper reports on the development of a new instrument for measuring pragmatic abilities for application in children with neurodevelopmental disorders aged five to nine years, especially those with normal structural language skills (such as children with SPCD).

Methods

This study was carried out in three stages:

Stage 1

Stage 1 consisted of a qualitative study. The aim of this stage was to generate items using literature review, the currently-available measures, interviews with experts and mothers and the observation of the mothers' interaction with their children.

Participants

The interviews and observations were conducted by the first author. The interview framework was semi-structured. Fourteen experts, including speech and language pathologists (3), linguists (2), teachers of children with special needs (2), occupational therapist (2), child psychologists

(2), a child psychiatrist (1), a school counselor (1) and a rehabilitation counselor (1), who had five years or more of professional work experience, plus 15 mothers of children with ASD (4), ADHD (8), SLI (2) and SPCD (1) with a mean age of 76±12.07 months were selected through convenience sampling and interviewed and their conversational interaction with the children were observed at home and in the examination room of a rehabilitation center based on the Pragmatic Protocol.[30] The duration of the interviews was 30–60 min and the duration of the observations 15 min. A team consisting of the authors as well as a linguist (1), a child psychologist (1) and a speech and language pathologist (1) transcribed the recorded interviews and analyzed the interview transcripts based on thematic content analysis. Ultimately, 119 items were identified.

Stage 2

The aim of stage 2 was investigating the content validity of the items, which is the extent to which an instrument measures the intended concept and is supported by evidence from qualitative studies which demonstrate the items and domains of the instrument are appropriate and comprehensive in relation to its intended concept, study population and application.[43] Without evidence of content adequacy, an instrument may include construct-irrelevant variance or underrepresent the construct.[44] In this stage, a questionnaire consisting of 119 items was prepared and the discussed experts rated the items.

Participants

The questionnaire was evaluated by ten experts, including speech and language pathologists (2), linguists (2), a teacher of children with special needs (1), an occupational therapist (1), a child psychologist (1), a child psychiatrist (1), a school counselor (1) and a rehabilitation counselor (1) with five years or more of professional work experience. Judgment was based on a 5-point Likert scale in which 1 indicated a "very irrelevant item" and 5 a "very relevant item." Finally, after the professionals gave their feedback on the questionnaire, the items were reduced to 80.

Stage 3

Stage 3 involved the drafting and analysis of the psychometric properties of the main questionnaire.

Participants

Convenience sampling was used in stage 3 to select 185 normally-developing children and 120 children with neurodevelopmental disorder over a 12-month period (September 2017–2018). The sample size was adequate for supporting the planned Rasch analysis,[42] because Person (sample, test) reliability is independent of sample size in this analysis. That is, reliability depends chiefly on sample ability variance (wider ability range = higher person reliability), and If the additional person sample is more central than the original sample, then the person separation will reduce.[45] Sample size depends on many items in every study; for example, the number of items, the location of the items along a trait, the overlap of the items along a trait, the distribution of the respondents along a trait, the number of respondents, the targeting of the items to the persons along a trait and the goal of the instrument.[42] This study was conducted in accordance with the Declaration of Helsinki. Also the Ethic Committee of Tehran University of Social Welfare and Rehabilitation Sciences approved the study proposal, and written informed consent was obtained from all the parents.

A total of 185 normally-developing children (96 boys and 89 girls) were recruited from six preschools and schools. The children were aged 60–108 months (boys: M=83.98, SD=13.99; girls: M=85.37, SD=15.06) and had no history of special educational placement. They were all in the appropriate grade for age and their parents reported that they had no developmental concerns. A total of 120 children with neurodevelopmental disorders (ASD, SLI, ADHD and SPCD) were recruited from 11 rehabilitation centers. These children were also aged 60–108 months (ASD: M=80.04, SD=15.06; ADHD: M=89.72, SD=11.91; ADD: M=79.20, SD=15.91; SLI: M=68.71, SD=5.76; and SPCD: M=86.15, SD=15.64). They had been diagnosed by a multidisciplinary team consisting of a child psychiatrist, a child psychologist and a speech-language pathologist based on the review of all the tests, observations, medical and family histories and extensive group discussions using the DSM-5 guidelines.

For the children with ASD (n=24), the Persian version of tests including the Gilliam Autism Rating Scale (GARS),[46] the Stanford–Binet intelligence scales- 5th edition (SB5)[47] and the Test Of Language Development (TOLD-P3)[48] were used. The children with ASD were excluded if their IQ scores were more than 2 SD below the normal mean.

For the Children with SLI (n=21), the GARS, SB5, TOLD-P3 and the Persian version of the Diagnostic

Evaluation of Articulation and Phonology (P-DEAP)[49] were used. These children were identified as cases of specific language impairment when they met the following criteria:[50] Spoke Persian as their primary language, had no history of intellectual disabilities, autism, neurological problems or sensory neural hearing loss, had a performance IQ greater than 85 on the non-verbal subtests of the SB5, and a performance more than 1.25 SD below the mean on the TOLD-P3.

For the children with ADHD (n=49), the SB5, TOLD-P3 and the Persian version of the Swanson, Nolan and Pelham Rating scale (SNAP-IV)[51,52] were used. A total of 24 of these children met the criteria for the predominantly inattentive type (attention deficiency disorder) and 25 had the combined type. They did not have sensory neural hearing loss and were excluded if they had IQ scores greater than 2 SD below the normal mean on the SB5.

For the Children with SPCD (n=26), the GARS, SB5, TOLD-P3, P-DEAP and the Persian version of Children's Communication Checklist Version 2[53] were used. These children did not have sensory neural hearing loss, intellectual disability or apraxia. The children with SPCD were excluded if they had a TOLD score 1 SD below the normal mean.

Table 1 presents the data on the IQ and language scores of the children.

Table 1 The characteristics of children with neurodevelopmental disorders

Disorder	Non-Verbal IQ	Verbal IQ	Syntax	Semantic
ASD (n=24)				
M	97.62	91.16	82.58	89.29
SD	15.97	11.95	9.82	9.92
ADHD (n=25)				
M	94.24	96.88	92.20	97.04
SD	8.44	6.83	8.94	7.08
ADD (n=24)				
M	94.25	94.16	91.08	94.83
SD	8.59	6.83	9.56	9.63
SLI (n=21)				
M	99.85	85.95	74.33	79.66
SD	4.90	4.84	4.07	3.83
SPCD (n=26)				
M	102.19	99.57	106.19	108.42
SD	6.60	5.51	4.56	5.50

Abbreviations: n, number of children; M, mean; SD, standard division; ASD, autism spectrum disorder; ADHD, attention-deficit/hyperactivity disorder; ADD, attention deficiency disorder; SLI, specific language impairment; SPCD, social (pragmatic) communication disorder.

Instrument

The Pragmatic Abilities Questionnaire (PAQ) was developed with 119 items. Thirty items were removed after the review of the tool's content analysis by ten experts. The remaining 80 items were administered in written format to assess the pragmatic abilities of the examined children. The response categories for all the items included "never", "very rarely", "rarely", "occasionally", "very frequently" and "always". The six-point scale (0–5) used for scoring the items was reversed for the negatively-worded items.

Data analytic plan
Stage 1
Data analysis started with thematic content analysis in stage 1, which involves extracting themes from the interview transcripts and attempting to verify, confirm and qualify them by searching through the data and repeating the process for identifying further themes and categories.[54,55]

Stage 2
Content validity refers to the extent to which the items on a test are fairly representative of the entire domain which the test seeks to measure, and a standard method for assessing this measure is to seek the views of experts with expertise in the content of the test. Good items have high scores, indicating the high agreement among raters.[56] Content validity was established in this stage and the items were rated.

Stage 3
The analyses performed to assess the psychometric properties of the PAQ were based on the Rasch rating scale model. Rasch developed a measurement model for responses to dichotomous items that shows the procedures for constructing measurement instruments and documenting the measurement properties of these instruments.[57,58] This model also incorporates a method for ordering persons based on their abilities and also ordering the items based on their difficulty. The probability of correct responses increases with the level of the item's difficulty and the individual's ability.[59]

Unidimensionality
The Rasch model is based on the assumption that effective measurement involves the examination of only one attribute at a time, which is referred to as unidimensionality.[42,59]

There are two ways to test for unidimensionality; first, examining the mean-square infit and outfit statistics, and second, conducting a Principal Component Analysis (PCA) of the standardized residuals.[58]

Construct validity

Construct validity is shown by fit,[60] which consists of Information-weighted fit (Infit) Mean Square (MnSq), Outlier-sensitive fit mean score (Outfit) MnSq and Z-score-standardized (Zstd) fit statistics. The items were considered a misfit for the model and deemed not to belong to the constructs when MnSq was >1.4 and were associated Zstd > positive 2.0.[59]

Reliability

This model contains two reliability indices, including person reliability and item reliability, and also two separation indices, including person separation and item separation.[42] The item and person reliability was estimated as >0.7, suggesting a good reliability. The item and person separation indices were also estimated as >2, suggesting a good separation. A low person separation implies that the instrument may not be sensitive enough to distinguish between high and low pragmatic abilities. A low item separation implies that the person sample is not large enough to confirm the item difficulty hierarchy or the construct validity of the instrument, and a low person separation with a relevant person sample implies that the instrument may not be sensitive enough to distinguish between high and low performers.[45]

The person-item map (Wright Map)

The person-item map (also called the Wright map) is an accurate graphical representation of the relationship between measures of persons and items[42] that is used to explain the locations of the respondents and the item thresholds on the construct. It can be calculated based on the difficulty of the test items and expressed using the same linear scale used for expressing the person measure.[57,61]

Systematic steps based on psychometric inquiry were used to obtain an appropriate and valid subset of items. The items with poor psychometric properties were excluded based on the item Infit and Outfit and item-measure (point biserial [PTBIS]) correlations. Another Rasch analysis was performed after eliminating the misfitting items and persons. This process was repeated until the entire remaining respondents and items fit. Winsteps (version 3.64) was run to evaluate the psychometric properties

and hierarchies of item difficulty placed on the person-item map.

Results

Stage 1

The thematic content analysis, observations, literature review and study of available pragmatic measures led to the generation of 119 items.

Stage 2

Content validity was established according to the experts' understanding of the construct.[62] The items of the questionnaire were rated by ten professionals based on their relevance to pragmatic abilities using a rating scale from 1 to 5. The median of the items was calculated and 39 items were omitted due to their low median (4<). Instances of the eliminated items include "He/she talks to himself/herself", "He/she uses many long pauses, repetitions and revisions when talking", "He/she excuses himself/herself when interrupting the speech of another", "He/she may hurt other children" and "He/she is silent when he/she should respond to questions". To estimate the rater reliability, the Intraclass Correlation Coefficient (ICC) was calculated and reported as 0.78 (P<0.01), indicating the high inter-rater agreement about the PAQ items.

Stage 3

After the original items of the PAQ were reduced to 80 based on the experts' views, further item reduction was performed through RSM measures. This process reduced the questionnaire items from 80 to 40. The items were considered poor representations of the constructs of the PAQ when the Mean Square (MnSq) was above 1.4 and were associated with a Z-standardized (Zstd) greater than positive 2.0, thus exceeding the "fit" criteria. The PAQ items were therefore reduced to 40 (Table 2).

Unidimensionality

To examine unidimensionality, the Rasch PCA was performed on the residuals of the items. As shown in Table 3, 63.8% of the variance in the PAQ was explained and the criteria for unidimensionality were met (>40%). The 40-item PAQ was therefore deemed unidimensional.

Construct validity

The construct validity of PAQ was examined so as to reduce the misfitting items based on the Rasch model. Item reduction was performed on the 80-item draft of the

Table 2 The item characteristics of the final Pragmatic Abilities Questionnaire

Original Item Number	Item Content	Measure	Model SE	Infit MnSq	Infit Zstd	Outfit MnSq	Outfit Zstd	Item Measure Correlation
27	He/she can make comments relevant to the topic of a conversation and complete it.	-2.22	0.13	2.12	2	2.16	1.9	0.56
20	He/she is able to initiate conversation.	-0.78	0.13	1.50	2	1.47	1.8	0.48
38	If he/she does not understand something that is said to him/her, he/she asks for clarification.	1.45	0.11	1.46	1.9	1.42	1.8	0.64
11	He/she uses eye contact while talking and/or listening.	-1.15	0.15	1.35	1.8	1.30	2.0	0.56
31	He/she talks properly in routine daily conversations (for example: "Hello", "How are you?", "I'm fine, thanks").	0.08	0.12	1.23	1.7	1.33	1.7	0.76
44	He/she can make promises to others (for example "I promise to sleep at night").	-0.46	0.12	1.32	1.7	1.33	1.8	0.78
59	He/she uses the politeness markers "please", "thank you" and "excuse me" properly.	1.87	0.11	1.30	1.7	1.31	2.0	0.76
63	He/she requests more information if not understanding the topic.	1.37	0.12	1.31	1.6	1.28	2.0	0.67
12	He/she uses facial expression, gestures or body movements to convey his/her feelings or thoughts.	-1.80	0.14	1.26	1.6	1.24	1.9	0.36
35	He/she is able to respond to questions.	1.87	0.11	1.24	1.5	1.24	1.7	0.73
69	He/she introduces new topics in the discourse.	0.46	0.12	1.15	1.5	1.22	1.6	0.76
07	He/she plays alone.	-1.67	0.16	1.09	0.8	1.08	0.7	0.52
06	He/she seems to be perceived as odd and unusual by other people.	-3.20	0.25	1.07	0.4	1.01	0.1	0.24
66	He/she can agree or disagree with a topic of conversation.	-1.09	0.14	1.03	0.3	0.99	0.0	0.57
32	He/she asks questions when not knowing something.	-0.45	0.12	0.96	-0.4	1.01	0.2	0.76
18	He/she talks clearly about something that the listener does not know about.	-1.19	0.13	1.01	0.2	0.97	-0.2	0.50
42	He/she can warn about something; for example, "take care that the door won't hit your head".	1.14	0.12	0.99	-0.1	0.99	-0.1	0.73
09	He/she follows the rules of games.	-2.80	0.30	0.99	0	0.95	-0.1	0.27
24	When his/her intention has not been understood, he/she repeats or explains it so that more information is conveyed to the listener.	0.09	0.12	0.98	-0.2	0.94	-0.6	0.74
74	He/she can produce long and complicated sentences.	-0.33	0.12	0.88	-1.3	0.94	-0.6	0.74
30	He/she does not infer correct meaning from a speaker's message and gives unusual responses as a result.	0.22	0.12	0.94	-0.6	0.91	-0.9	0.74
52	He/she can understand sarcasm.	1.88	0.11	0.91	-0.9	0.90	-1.1	0.79
05	The children let him/her to take part in group activities.	-1.63	0.15	0.91	-0.8	0.86	-1.2	0.64
67	He/she gives up the top of conversations.	2.10	0.11	0.90	-1.1	0.90	-1.0	0.76
21	He/she ends conversations in a correct manner.	1.02	0.12	0.86	-1.5	0.83	-1.8	0.82
04	He/she avoids talking to adults.	-2.16	0.17	0.83	-1.3	0.78	-1.8	0.54
40	He/she understands indirect requests (for example, in response to the question "Would you like to eat with your hands?", doesn't answer "yes" or "no", but washes his/her hands).	-1.05	0.13	0.82	-1.8	0.78	-2.2	0.68
15	He/she understands other people's emotions (for example, sadness, happiness and anger).	-1.01	0.13	0.81	-2.0	0.76	-2.4	0.67
45	He/she can tell a story or describe what he/she has done in an orderly sequence of events.	1.98	0.11	0.81	-2.1	0.79	-2.3	0.78
50	He/she can talk differently in harmony with the context or needs of the listener (for example, talking differently to a child vs an adult).	2.07	0.11	0.76	-2.6	0.79	-2.3	0.80
03	When he/she is with other children, he/she talks to them.	-2.06	0.16	0.78	-1.9	0.75	-2.2	0.53

(*Continued*)

Table 2 (Continued).

Original Item Number	Item Content	Measure	Model SE	Infit MnSq	Infit Zstd	Outfit MnSq	Outfit Zstd	Item Measure Correlation
37	He/she tries to negotiate with other people if they disagree with his/her ideas.	1.73	0.11	0.74	−2.9	0.77	−2.6	0.80
53	He/she can understand idioms; for example "wipe that smile off your face".	1.36	0.12	0.75	−2.8	0.74	−2.9	0.79
22	He/she uses verbal behaviors, such as "yeah" and "really", and non-verbal behaviors, such as head nods, smiling and looking, to give feedback to the speaker.	1.29	0.12	0.72	−3.1	0.74	−2.8	0.79
60	He/she talks about his/her wishes in the future.	1.45	0.11	0.70	−3.4	0.72	−3.1	0.81
10	He/she seems inattentive, distant or preoccupied in the presence of familiar adults.	−1.65	0.14	0.67	−3.3	0.65	−3.5	0.62
51	He/she talks in a way appropriate for different characters when playing.	1.50	0.11	0.67	−3.8	0.64	−4.1	0.78
39	He/she is able to defend himself/herself by talking (for example, "this pencil is mine; give it back to me").	1.20	0.12	0.66	−3.9	0.64	−4.2	0.80
56	When he/she listens to a narration, he/she can understand what is not explicitly stated. For example "Ali's father had already said to Ali "If you get a good score, I will buy a bike for you". Ali is riding a bike now. Does he/she understand that Ali has scored?	−1.76	0.14	0.65	−3.6	0.63	−3.7	0.60
36	He/she talks about his/her emotions.	2.31	0.11	0.64	−4.2	0.64	−4.3	0.85

Abbreviations: MnSq, Mean Square; SE, standard error; Zstd, Z-score standardized fit statistics.

PAQ to reach an appropriate and valid subset of items. The infit and outfit mean-square values indicate the degree to which the items and persons fit the model. Infit mean-squares are sensitive to inliers and outfit mean-squares to outliers, which suggests unexpected response patterns.[63] The infit and outfit values for the 40 items suggest that the PAQ meets the criteria for the construct validity assumption of the Rasch model. Construct validity is also supported by the positive item (point biserial [PTBIS]) correlations (Table 2).

Reliability

The reliability of the PAQ was excellent given the item measure reliability of 0.99, which suggests that the items can be discriminated from one another based on their difficulty. The person measure reliability was 0.97, which suggests that the scale can discriminate between pragmatic abilities based on their estimated pragmatic level. The item separation index of 10.91 indicates that the PAQ items have the potential to be categorized into ten levels. The person separation index was 6.03. This index is an estimate of how well one can differentiate persons in terms of the measured pragmatic abilities; that is, it estimates the replicability of person placement across the other items measuring the same construct[59] and shows that the participants can be divided into six groups based on their pragmatic abilities level, although these groups are not the same five groups of different disorders (ie groups of children with ASD, ADHD, ADD, SLI and SPCD) and children with normally developing group. In other words, there are six response patterns, but it is not the case that each response pattern is related to only one type of neurodevelopmental disorder. For example, children with autism may have response patterns similar to children with ADHD. The separation index cannot be solely attributed to the type of disorder (ie ASD, ADHS, ADD, SLI and SPCD); rather, it is affected by factors such as sample pragmatic ability variance (which depends on the disorder, gender and age), length of the test, the number of categories per item, and sample-item targeting.[45]

The person-item map (Wright Map)

The person-item map demonstrates a continuum of pragmatic abilities generated by the measurement of the individuals' ratings of each item (Figure 1). This map indicates that items and persons are appropriately targeted.[45] The items are placed on the right-hand side and the persons on the left-hand side of the dividing line,

Table 3 The main component analysis of the Pragmatic Abilities Questionnaire based on the Rasch model

The Standardized Residual Variance Scree Plot				
The Table of Standardized Residual Variance (in Eigenvalue Units)				
		Empirical		**Modeled**
Total variance in observations	110.5	100.0%		100.0%
Variance explained by measures	70.5	63.8%		63.8%
Unexplained variance (total)	40.0	36.2%	100.0%	36.2%
Unexplained variance in 1st contrast	5.1	4.6%	12.8%	
Unexplained variance in 2nd contrast	3.1	2.8%	7.7%	
Unexplained variance in 3rd contrast	2.4	2.2%	6.1%	
Unexplained variance in 4th contrast	1.9	1.7%	4.8%	
Unexplained variance in 5th contrast	1.8	1.7%	4.6%	

Note: The variance explained was 63.8% of the total variance in the PAQ.
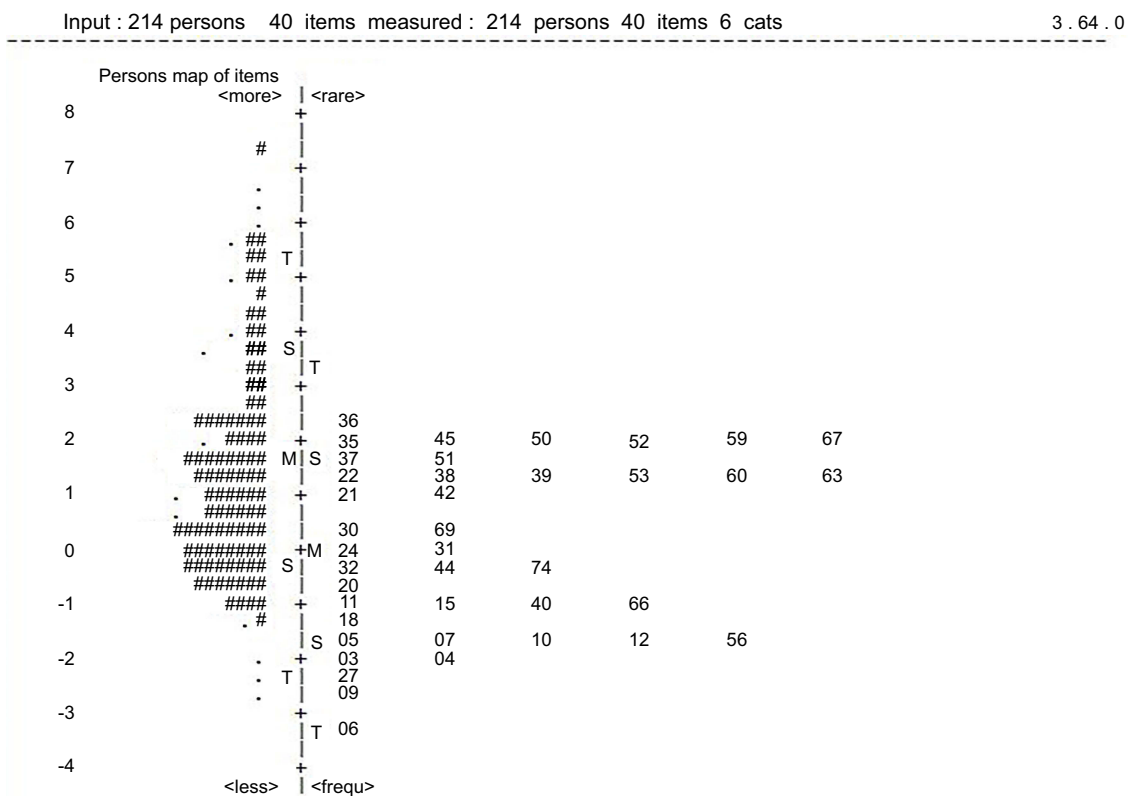
Figure 1 The person-item map of the Pragmatic Abilities Questionnaire.

and the number of persons are indicated by the symbols #=2 and .=1. The item estimates range from approximately +2.5 to −3.2 logits. The more difficult items appear toward the top of the map (item 36 is the most difficult item in this set) and the easier items toward the bottom (item 6 is the easiest one). There are no gaps between the items. The person ability estimates show a wide range of abilities.

The mean measure for person ability is higher up on the left-hand side of the dividing line; that is, the mean person abilities is higher than the mean item difficulties.

Discussion

Cultural and linguistic diversity and valid and reliable instruments are important factors in assessing pragmatic

abilities. This study was conducted to develop and test the reliability and validity of a new instrument for assessing pragmatic abilities in children with neurodevelopmental disorders aged five to nine years, especially those with normal structural language skills; for example, children with SPCD.

The PAQ developed in this research consists of 40 items that assess pragmatic abilities and have good psychometric properties. The infit and outfit mean-square values and the positive item-measure (point biserial [PTBIS]) correlations prove the construct validity of the instrument. The results showed that the PAQ has an acceptable construct validity (Table 2). The dimensionality (ie the structure of a specific phenomenon) of the PAQ was investigated as a necessary stage in gathering evidence to support the validity of interpretations based on the total score of the instrument, particularly when assessment development and analysis are carried out within the Rasch measurement framework.[64] All the residual items of the questionnaire measured a single construct and explained 63.8% of the variance (Table 3), which is an important finding because unambiguous interpretations require scores that represent a single defined attribute. That is, scores obtained on a scale that is used for measuring a single variable should not be appreciably affected by varying levels of one or more other variables. In addition, if scores do not represent a common line of inquiry, then it will be unclear whether two individuals with the same score can be considered comparable.[65] Unidimensionality (the existence of one underlying measurement construct that accounts for variation in examinee responses) indicates an instrument that is less ambiguous, more precise and ready for use with promising statistical methods, such as structural models.[66]

The PAQ has an item measure reliability of 0.99 and a person reliability of 0.97 with a separation index of 6.03. Person separation and item separation indexes are a superior way for assessing an instrument's function, since they are not associated with any ceiling effects (ie their minimum value is 0 and they have no maximum values). Item separation and person separation are additional techniques by which one can assess (1) how well a set of items is able to differentiate between respondents and (2) how well the set of items is able to be differentiated by the group of respondents.[42] The person separation index (6.03) shows that a set of items is able to differentiate between six groups, and the PAQ was found to be sufficiently sensitive for distinguishing between high and low performers. The item separation index (10.91) for this instrument showed

that the person sample is large enough for confirming the item difficulty hierarchy of the PAQ or its construct validity.

In the person-item map, the person scores and the difficulty level of the items showed that the strong persons answered the easy items correctly and the weak persons answered the difficult ones wrongly. It is worth noting that the difficulty level of one item was lower, such that the weakest person was also able to answer it (item 6). Additionally, there were no items for the persons with the highest ability measures.

The findings of this study suggest that the PAQ has a good construct validity and all its items measure pragmatic abilities and that the Rasch measurement model is a useful method for developing new assessment measures to use in psychological and psychiatric settings. Similar results have been reported by some researchers.[59,67–69]

Conclusion

It is imperative for professionals working with children to have access to effective pragmatic assessments, because pragmatic impairment may cause psychological problems, difficulties in social relationships and difficult attainment of educational and academic goals.

This study demonstrated that the PAQ has acceptable construct validity and reliability. Further research to validate the PAQ in a broader sample of children with neurodevelopmental disorders is required.

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Disclosure

The authors report no conflicts of interest in this work.

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