Factors affecting responses of children with autism spectrum disorder to yes/no questions

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Abstract

This study aimed to clarify factors related to difficulties in responding to Yes/No questions among 52 children with autism spectrum disorder (ASD), 41 boys and 11 girls aged between 3:5–16:0 years. Participants completed the Tanaka–Binet Intelligence Scale V, the Picture Vocabulary Test–Revised (PVT-R), and the Pervasive Developmental Disorder–Autism Society Japan Rating Scale (PARS). A Yes/No test, developed for this study, included two types of task: a naming true/false task and a request-intention task. For the naming true/false task, clear Yes/No responses accounted for 60% of responses among preschool children and more than 90% of

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responses among school-aged children in the normal IQ and mildly cognitively-impaired groups. In contrast, clear Yes/No responses accounted for less than 30% of responses in the moderately cognitively-impaired group and less than 1% in the severely cognitively-impaired group. For the request-intention task, clear Yes/No responses were higher than for naming true/false tasks. Multiple logistic regression analysis indicated that scores of PARS, estimated mental age, vocabulary age according to the PVT-R, and IQ are associated with clear Yes/No responses. These findings appear to indicate that ability or inability to respond to Yes/No questions follows a developmental pattern in children with ASD.

I Introduction

There has been little research into the responses to Yes/No questions (Y/N-Qs) among children with autism spectrum disorder (ASD), and the results of the few published studies are inconsistent.

Several reports have hypothesized that the greater the cognitive load of the task, the more readily immediate echolalia occurs. For example, immediate echolalia occurs less readily with greater ability for natural language understanding (Roberts, 1989), more readily with unfamiliar topics (Charlop, 1986), and more readily following high constraint adult utterances, including Y/N-Qs (Rydell and Mirenda, 1994). Paccia and Curcio (1982) suggest that Y/N-Qs may be associated with a higher cognitive load for autistic children than wh- questions (Wh-Qs; questions beginning with "what", "when", "where", "who", and "why"). However, the children with ASD that participated in these studies of echolalia were cognitively delayed. It may be difficult for children with ASD and cognitive delay to respond adequately to Y/N-Qs.

The situation is reversed in children with high-functioning ASD (HFASD), who have more difficulty responding adequately to Wh-Qs than to Y/N-Qs (Oi, 2010) and several studies support this finding. Oi (2005) examined videos of conversations with adults of 11 Japanese children aged 6–11 years with Asperger syndrome or HFASD, sampled them for conversations that appeared to have broken down, and carried out a pragmatic analysis. Among these conversations, there were cases in which

the child's intended meaning was unclear and the adult assistant was unable to clarify it using Wh-Qs. When the adult changed to Y/N-Qs the meaning could be clarified. This suggests that, from the point of view of adults involved with HFASD children, Y/N-Qs are a more effective tool for clarifying a child's intended meaning.

Curcio and Paccia (1987) examined conversations between four children with ASD and their mothers and teachers in a semi-structured context. The children were aged between 7:4 and12:8 years, had a verbal IQ between 47 and 70 [based on Wechsler Intelligence Scale for Children-Revised (WISC-R) or Peabody Picture Vocabulary Test (PPVT)], and no echolalia. The adults' eliciting utterances were evaluated in terms of topical contingency, conceptual complexity, and which question type they contained, and the proportion of adequate responses by the child to these utterances was calculated. As the number of the above features in the adults' eliciting utterances increased, so did the proportion of adequate replies from children. Although the average adequate response to Y/N-Qs, low conceptual complexity, and/or topical contingency was 60%, the average adequate response to Wh-Qs, conceptual complexity, and no topical contingency was only 27%. Thus, this study suggested that Y/N-Qs presented at a middle to low language level are not difficult for school-aged children with ASD to understand and are easier to respond to than other types of questions.

Some studies have directly compared differences in replies and responses to Y/N-Qs and Wh-Qs. In a study of 12 Japanese children with HFASD of chronological

age 7:3–14:8, matched for receptive vocabulary with 12 typically developing (TD) children, Oi (2010) used a semi-structured setting in which the children were shown an 8-minute cartoon and their mothers then asked them about what they had seen. A comparative investigation of the children's responses was performed. In both HFASD and TD groups, inadequate answers were significantly more common with Wh-Qs than Y/N-Qs, and this difference was greater in children with HFASD than TD children. The author concluded that Wh-Qs are more difficult for school-aged children with HFASD to respond to than Y/N-Qs.

These studies indicate that when attempting to clarify children's communication intentions, echolalic children with ASD have difficulty responding to Y/N-Qs, but school-aged children with HFASD and non-echolalic low-level children with ASD find Y/N-Qs easier to respond to than Wh-Qs.

However, one study showed that children with ASD are not necessarily less likely to respond to Wh-Qs than Y/N-Qs. Capps, Kehers and Sigman (1998) compared the behavior of 15 children with ASD (mean chronological age 11:9, mean IQ 75.2) and 15 children with developmental delays matched on language ability within the context of a semi-structured conversation. Across the groups, children were as likely to respond to Y/N-Qs as to Wh-Qs. In fact, children appeared more likely to provide elaborate, relevant responses following Wh-Qs than following Y/N-Qs.

Based on this background, we can hypothesize that difficulty in responding to Y/N-Qs is associated with intellectual development. However, this hypothesis needs

to be verified. In addition, in studies that identified a problem with responses to Y/N-Qs, the ASD children studied had an extremely limited profile, and intelligence, language ability, and clinical condition differed within the individual studies. Thus, the profile of ASD children that experience difficulty in responding to Y/N-Qs needs to be clarified.

The goal of the present study is to answer the following questions:

(1) At what age do children and adolescents with ASD become able to answer Y/N-Qs?;

(2) Do children and adolescents with ASD show poor performance on Y/N-Qs?; (3) Is poor performance explained by impaired intelligence, language ability, and severity of ASD?

II Methods

1. Participants

The study was carried out at four facilities in a prefecture (an administrative division) situated roughly in the center of Japan. The prefecture has a population of about 7.4 million, and has flourishing machine tool and other industries. The study recruited participants from three facilities: an ear, nose, and throat hospital, a public rehabilitation center and a university clinic. Each of these facilities has an assigned speech-language therapist and carries out language training for children with disabilities. The participants were children attending these facilities and children of their guardians' friends, recruited by the speech-language therapist of each facility. Participants satisfied the following three criteria: (1) the child was between 3 and 18 years of age; (2) the child had been diagnosed by a physician as having an ASD such as pervasive developmental disorder (PDD), Asperger's disorder, or autistic disorder; (3) the child was able to understand the names of objects as reported by the child's guardian or speech and language therapist. The participants were required to understand the names of objects in order to complete the Yes/No-test.

The age range of participants was wide, because one aim of this research was to clarify the age at which the ability or inability to understand Y/N-Qs develops at all intelligence levels. A total of 52 ASD children and their guardians participated. The age range of children was 3:5–16:0 years, mean age was 8:3 years (S.D. 3:4), and there were 41 boys and 11 girls. 20 participants were aged 3:5–6:11 years (the pre-school

group) and 32 children were aged over 7 years (the school-age group).

Tests were carried out to assess participant's intelligence, language comprehension, and severity of ASD. The intelligence test was the Tanaka-Binet Intelligence Scale (V), (a Japanese version of the Stanford–Binet Intelligence Scale). It was carried out at the same time as the Yes/No-tests (see below), unless it had already been carried out within the previous 2 years, in which case that result was used. Twenty-one children had normal intellectual development (IQ $\geq$70); 14 had mild intellectual impairment (IQ 50–69), nine had moderate intellectual impairment (IQ 35–49), and eight had severe intellectual impairment (IQ $\leq$34). Mental age was also estimated from the results of Tanaka-Binet. The estimated MA range was 1:5–10:2 years (mean estimated MA 4:9).

Language comprehension was assessed by the Picture Vocabulary Test–Revised (PVT-R), which requires children to select the picture named by the experimenter from an array of four pictures (Ueno, Nagoshi and Konuki, 2008). This test clarifies the age of receptive vocabulary (VA) development. The PVT-R tests were carried out at the same time as the Yes/No tests. The VA range was from under 3:0 years to 10:6 years.

Severity of autism was measured using the Pervasive Developmental Disorder (PDD)–Autism Society Japan Rating Scale (PARS), a scale of 57 items assessed through an interview with the child's mother. Each item consists of a single statement/question such as 'Little/no eye contact' or 'Copies someone else's speech

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frequently. Each item is evaluated with a score ranging from 0 to 2 based on frequency in respective states (0 means never, 1 means sometime, 2 means frequently) Each item is evaluated for the present and peak (the most remarkable condition of ASD in infancy) state. 'PARS-present' is the sum of the present scores, and 'PARS-peak' is the sum of the peak scores. A higher score on this scale suggests stronger PDD characteristics. The PARS tests were carried out at the same time as the Yes/No tests.

Table 1 shows the range, mean and standard deviation (S.D.) of participants' chronological age (CA), IQ, estimated mental age (MA), receptive vocabulary age (VA), and PARS-peak, and PARS-present scores.

Table 1 Range, mean and SD of IQ, Estimated MA, PARS-peak, PARS-present and VA.

	Range	Mean	SD
CA	3:5-16:0	8:3	3:4
Tanaka-Binet IQ	19-105	64.4	26.2
Estimated MA	1:5-10:2	4:9	1:11
PARS-peak	5-59	36.8	11.4
PARS-present	6-50	27.3	10.7
VA(PVT-R)	Under 3:0–10:6	-	-

N=52

2. The Yes/No Test

The Yes/No Test was developed for this study to investigate responses to Y/N-Qs. The test was drawn up with reference to the method of Neef et al. (1984), which was revised to suit the present objectives. The test of Neef et al. comprised two types of subtests: the naming true-false subtest, which examines whether the name of an item is true or false, and the request-intention subtest, which examines the presence of the intentions of a request. Steffensen (1977) suggested that a young child might respond differently to questions that were ego-oriented (Do you want a cookie?) and those that were not (Is the dolly pretty?). Thus, two versions of each subtest were created: standard and individual tasks. Standard tasks used the same items for all children. Individual tasks used items specific to each child. These individual tasks were set to remove the potential influence of focusing on restricted interests peculiar to ASD when carrying out only standard tasks. Thus, four subtests were assessed: naming true/false (standard), naming true/false (individual), request-intention (standard), and request-intention (individual).

a) Naming true/false tasks

In the naming true/false tasks, the child judges whether the name of a picture he or she is shown is true or false, the test examines whether the child can respond with "yes" or "no" to the question, "Is this a ___?" The standard questions used the PVT-R pictures, and the individual questions used pictures selected for the child by his/her guardian.

Standard task: As the participating child needs to know the name of the picture

being used, pictures from the PVT-R were selected with this in mind. Four pictures (cat, glasses, hat, apple) were copied onto a separate card for each picture. The cards were laid out in a 2×2 fashion, the researcher said one of the picture names, and the child selected the card corresponding to that name. When the questions for all the cards were complete, the cards were shuffled and arranged again, and the selection procedure was repeated. The procedure was carried out three times, and picture cards that had a correct response three times in a row were accepted for use in the naming true/false task. The procedure was carried out three times in order to reduce the probability of a correct response from 0.25 (one in four) to approximately 0.016.

If the number of cards with three correct responses was less than three, a different set of four PVT-R pictures (tricycle, dog, banana, shoe) was used and the same test as the previous four pictures was carried out. All tests were to be terminated if the total number of cards accepted was less than three after the second set of cards was used. However, in the present study, all children correctly selected the cards from the first set (cat, glasses, hat, apple) so that these four cards were accepted for use in the subsequent tasks for all the children.

The child was then shown one of the picture cards and asked, "Is this a ___?" There were 10 questions altogether, five Yes-questions (questions with the answer "Yes") and five No-questions (questions with the answer "No"). When five picture cards had previously been recognized by the child, each card was used for one Yes-question and one No-question. When four picture cards had previously been

recognized by the child, three cards were used for one Yes-question and one No-question each, and one card was used for two of each question type. The questions were asked in the order Yes, No, No, Yes, No, No, Yes, Yes, No, Yes. Only one question was asked at each showing of the cards.

Individual task: In the individual task, the procedure was almost the same as the standard task, but the pictures used were pictures that the individual child was specifically interested in. For the cards in this task, the child's guardian was asked to choose five pictures that he or she thought the child would be interested in and would know their names. These pictures were then made into cards and used for the task. Before the Y/N-Qs, each card was shown to the child, who was asked to name the picture, in order to examine what name the child used. For example, if the child was shown a picture of a *shinkansen* (bullet train) and said, "N700 series *shinkansen* with lights," this would be used to form the Y/N-Qs. Each child was given a total of 10 questions, five Yes-questions, and five No-questions. The questions were asked in the order Yes, No, No, Yes, No, No, Yes, Yes, No, Yes. Only one question was asked at each showing of the cards.

b) Request-intention tasks

In the request-intention tasks, the child responds whether or not the object shown by the researcher is the object the child requested, and the test examines whether the child can respond with "yes" or "no" to the question, "This one?" The standard test uses one

of a predetermined set of toys: jigsaw puzzles, coloring sheets, a toy vending machine, a marble track, and a train set. The individual test uses foods that each individual child likes and dislikes.

Standard task: Six toys were prepared, and a situation created for each toy in which the child repeatedly requests an object relating to the toy. The child is allowed to select which toy to play with, and if he or she does not express any particular preference, the researcher chooses one for him or her. After the child starts to play with the toy, the Y/N-Qs are carried out in accordance with the scenario prepared. When the child makes a request regarding playing with an object associated with the toy, either the requested object or a different one is presented, and the child is asked, "This one?" Only one question was asked each time an object was shown (i.e., a yes question or a no question). The researcher asked 10 questions in total, five Yes-questions and five No-questions. The toys that were prepared and the conditions to facilitate the requests planned by the researcher are shown in Table 2.

Table2 Request-intention tasks (standard)

Jigsaw puzzles	Jigsaw puzzles with two, four, and six pieces are prepared and shown one at a time to the child. After the child has completed one or two of these puzzles, he or she is passed a puzzle with one or two pieces missing. The researcher shows the child a number of pieces mixed together, and waits for the child to request a missing piece. When the child makes the request, he or she is presented either with the necessary piece or with an unrelated piece.
Toy vending machine	The child is given a toy vending machine and one or two coins and is allowed to play with them. The researcher then shows child a coin and some objects that clearly differ from the coin, such as an eraser or a pencil, and waits for the child to request the coin. When the request is made, the researcher presents either the coin or a different object.
Coloring sheets	Several coloring sheets depicting cartoon characters the child will probably be interested in are prepared. The researcher shows the child some colored pencils, and waits for the child to request a pencil. When the child makes the request, the researcher presents a pencil of either the requested color or a different color.
Toy train set	The child is given two or three pieces of track from a toy train set, and is allowed to join them together. The researcher then shows the child a piece of track together with various other objects, such as a tunnel, a station, or a train, and waits for the child to make a request. When the child makes a request, the researcher judges the state of progress of the child's railway and presents him or her with either the requested object or a different object.
Marble track	The child is given a marble track (a toy which children play with by watching marbles roll down a track) and two or three marbles. After the child has rolled the marbles once, they are collected. The researcher then shows the child a marble together with various different objects, such as an eraser and a battery, and when the marbles have gone the researcher waits for the child to request a marble. When the child makes the request, the researcher presents him or her with either a marble or a different object.

If the child responded to a total of 10 Y/N-Qs for one of these toys, the task is completed with that toy. If the total of Y/N-Qs for a toy was less than 10, the researcher moved to another toy and added the number of responses for the new toy to the existing total. When the total of Y/N-Qs reaches 10, the test is complete.

Individual task: The child's mother was asked to prepare food that the child likes and food that he or she dislikes. The researcher placed the food the child likes and the food he or she dislikes together out of the child's reach, and waited for the child to request the food he or she likes. When the child makes the request, the researcher presents the child with one of the foods and asks, "This one?" Only one question was asked each time a food was shown (i.e., a yes question when the correct food was offered or a no question when another food was offered). The researcher asked 10 questions in total, five Yes-questions and five No-questions. A request was judged to have been made specifically if the child made a clear expression of desire, such as pointing or saying the name of the food he or she wanted. In addition, bending toward the food or making gestures meant to bring the researcher's attention to the food were also judged to be requests.

3. Procedures

The Yes/No-tests were carried out by two researchers. The researchers were qualified speech-language therapists with clinical experience of 22 and 8 years, one of whom was the present author. The locations for the tests were rooms that the children used

daily for language training or community center rooms. The researchers sat at a desk opposite the child, as if at an interview.

All the children's responses to each Y/N-Qs were video-recorded, and responses were coded based on communication functions. The coding system was created by the present author on the basis of a sample of 10 children. Six codes were extracted (see Table 3). After the codes were determined, all the participant responses were again coded by the present author in line with these definitions.

Table 3   Six codes for the children's responses to Y/N-Qs

Ordinary	Responses that express a clear Yes/No through patterns of expression commonly used in society, including entire or partial verbal expressions of affirmation or negation such as "Yes," "No," "That's right," or "Not that," and gestures such as nodding for affirmation or shaking the head for negation. For example, verbal expressions of "Yes" such as "That's it," "Right," and "Spot on," nodding, or nodding and saying the word(s) spoken by the adult are behaviors expressing "Yes." Verbal expressions such as "Not that," "Uh-uh," or "Sorry," shaking the head, or waving the palm of the head at the questioner are behaviors expressing "No."
Naming	Responding with the name of the picture card. Affirmation actions such as nodding or negation actions such as shaking the head that are coded as ordinary are not observed. For example, when shown a picture of a shoe and asked, "Is this an apple?"↗ (up arrow represents rising intonation) the child answers , "Shoe"↘ (down arrow represents falling intonation)before the question was over; when shown a picture of an apple and asked "Is this an apple?"↗ the child answers, "Apple"↘ before the question was over.

Request	A response requesting something the child wants. This includes responses such as turning the face away from an unwanted object or brushing it away with the hand, or reaching the hand toward the desired object. Affirmation actions such as nodding or negation actions such as shaking the head that are coded as ordinary are not observed. For example, when the researcher points to an object and asks, "This one?"↗, the child simply reaches toward the desired object before the question was over; when the researcher points to an object and asks, "This one?"↗, the child frowns before the question was over; when the researcher points to an object and asks, "This one?"↗, the child brushes the object away before the question was over.
Echolalia	This is pure echolalia, in which the child responds by repeating back all or in part the intonation, the sentence, or the words spoken by the researcher. For example, when the researcher points to a picture of an apple and asks, "Is this an apple?"↗, the child responds, "This an apple?"↗; when the researcher points to a picture of a shoe and asks, "Is this an apple?"↗, the child responds, "This an apple?"↗.
Other	Although the child makes a recognizable response to the question, the response cannot be categorized as ordinary, naming, request, or echolalia. For example, the child shakes his or her head and says, "That's right."
No response	Although the child is aware of the question, he or she makes no attempt to respond. For example, when shown an object and asked, "This one?"↗, the child remains silent.

To examine the reliability of the coding another specialist with 8 years' experience as a speech-language therapist coded the responses of 15% (n=8) of all participating children, and the κ coefficient of the codes determined by the two specialists was calculated. The high coefficient, $\kappa=0.896$, indicated nearly complete

agreement.

The results of the Yes/No Test were totaled for children in each of four groups based on level of intellectual disability (normal, mild, moderate, severe) and by age group (preschool,<7 years; school,≥7 years). For each task the ratio of ordinary responses (responses that express a clear Yes/No through patterns of expression commonly used in society) to total number of responses was calculated. A multiple logistic regression analysis was carried out with the results of the Yes/No test subtests as dependent variables and the results of the tests measuring intelligence, receptive vocabulary, and severity of ASD as independent variables.

Multiple logistic regression analysis was used to control for the possible confounding effects of variables related to ability or inability to provide Ordinary responses on the Yes/No test, and odds ratios for each outcome in relation to Ordinary responses for each task of the Yes/No test were estimated after adjustment for the following variables: CA, IQ, estimated MA, VA, PARS-peak, and PARS-present.

In the multiple logistic regression analysis, the pass criterion line for the Yes/No test was set at 8/10 Ordinary (correct) responses, and scores of the Yes/No test were recoded into two values, pass and not pass. The pass criterion was set at this level because the probability of eight successes of 10 by chance in a binomial test is $p<0.05$. All statistical analyses were carried out using SPSS 18.0J (SPSS Japan, IBM Japan, Ltd., Tokyo, Japan).

III Results

1. Yes/No Test responses according to level of intellectual development and age.

Table 4 shows the results of the Yes/No Tests in each group.

**Table 4** Relationships between age, rate of ordinary response, and intelligence

Mental Level	Age Range	N	Naming True/False		Request-intention	
			Standard	Individual	Standard	Individual
Normal IQ	School	9	.97	.97	.93	1.00
	Preschool	12	.49	.63	.94	.90
Mild IQ	School	7	.90	.91	.97	.98
	Preschool	7	.60	.64	.91	.93
Moderate IQ	School	8	.21	.27	.73	.80
	Preschool	1	-	-	-	-
Severe IQ	School	8	.01	.01	.28	.30
	Preschool	0	-	-	-	-

As the severe group included no preschool children and only one school-aged child, these are not shown in the results.

In the both standard and individual naming true/false tasks, ordinary responses accounted for around 60% of responses at preschool age but accounted for more than 90% of responses at school age in the normal IQ and mild intellectual

impairment groups. In contrast, ordinary responses accounted for less than 30% of responses in the moderately impaired group, and less than 1% of responses in the severely impaired group. Figures 1 and 2 show scatterplots of ordinary responses in the naming true/false standard and naming true/false individual tasks. A logarithmic trend line determined by the least squares method has been added to each figure to guide the eye.

Figure 1 Scatterplots of ordinary responses in the standard naming true/false task
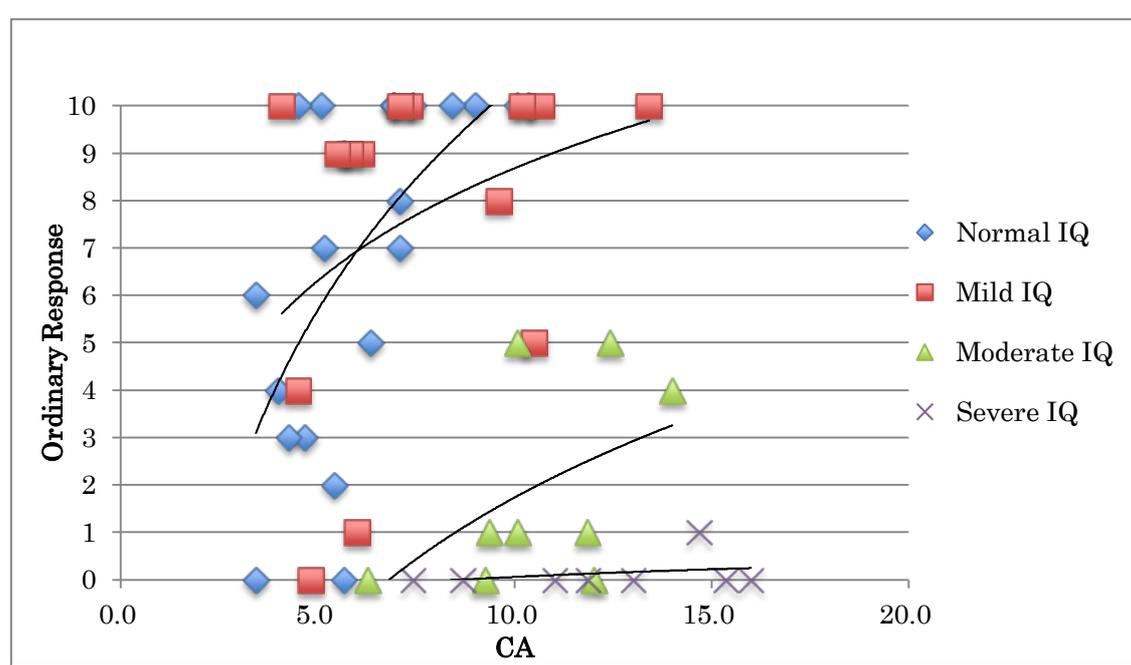
A logarithmic trendline determined by the least squares method has been added.

Figure 2 Scatterplots of ordinary responses in the individual naming true/false task
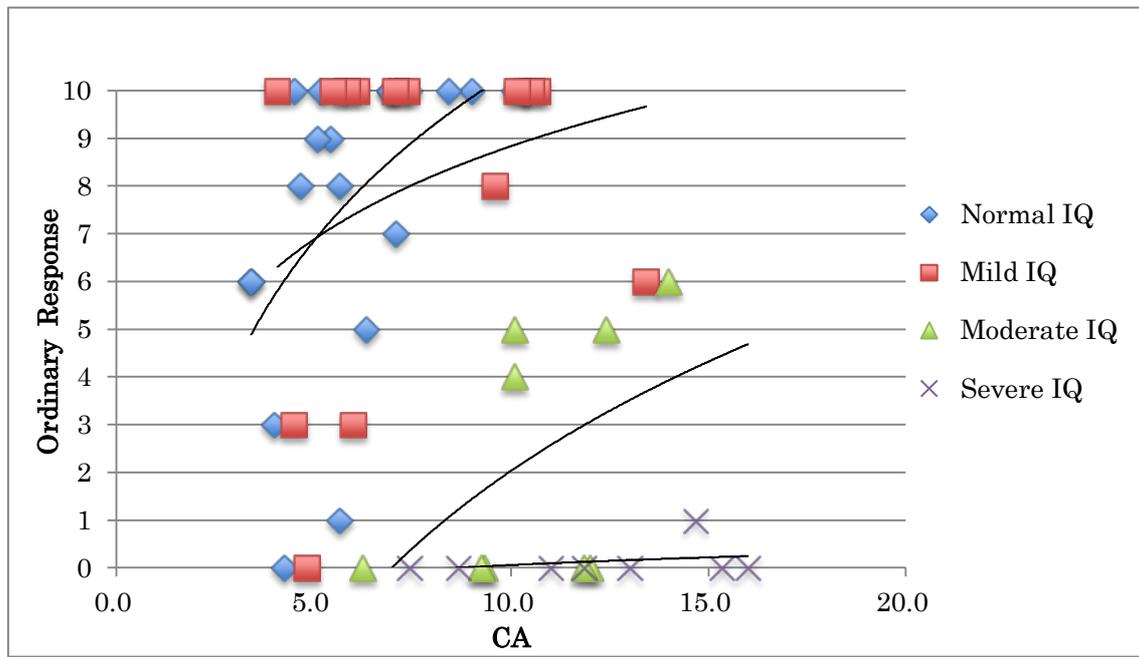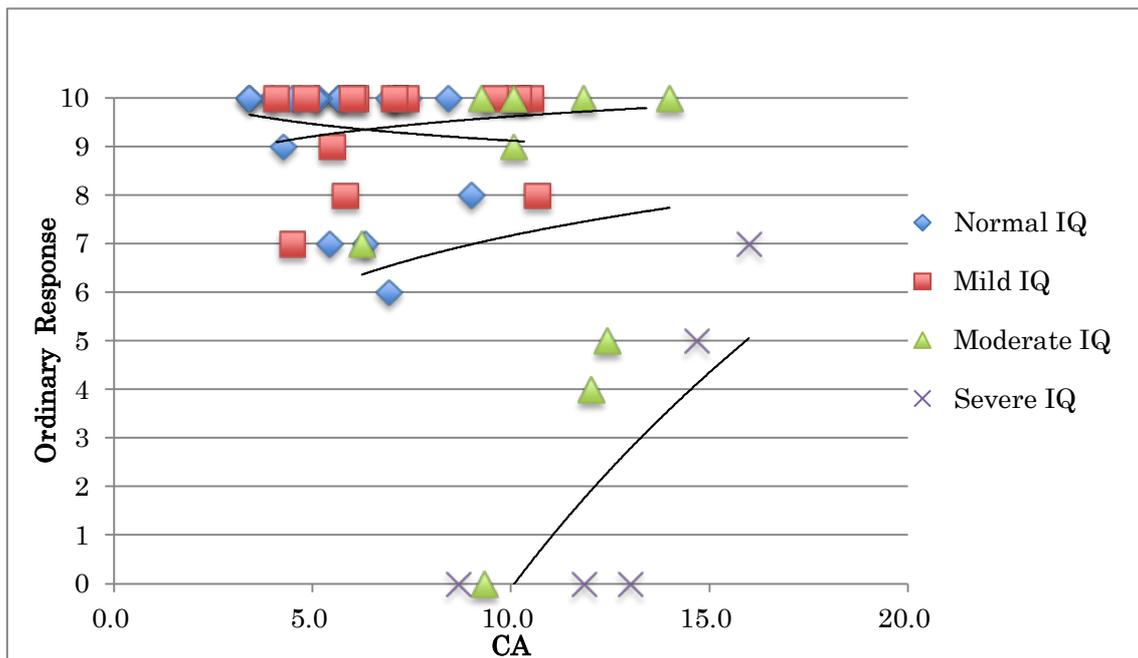

A logarithmic trendline determined by the least squares method has been added.

From the scatter plots, it can be seen that there is considerable variation at preschool age in the normal IQ and mildly impaired groups in both standard and individual tasks, with some children successfully completing tasks and others unable to do so.

In both standard and individual request-intention tasks, ordinary responses accounted for more than 90% of responses among school-age and preschool children in the normal IQ and mildly impaired groups. Ordinary responses accounted for 73% of responses among school-aged children in the moderately impaired group, 30% of responses among school-aged children in the severely impaired group. Figures 3 and 4

show scatterplots of Ordinary responses in the request-intention standard and request-intention individual tasks. The scatter plots show that in the normal IQ and mildly impaired groups, for both standard and individual tasks results are concentrated on or above the pass criterion of 8/10. In comparison, there was considerable variation in the moderately impaired group, with some children successfully completing the tasks and others not. No children in the severely impaired group successfully completed the tasks at the criterion of 8 out of 10.

Figure 3 Scatterplots of ordinary responses in the standard request-intention task

A logarithmic trendline determined by the least squares method has been added.

Figure 4 Scatterplots of ordinary responses in the individual request-intention task
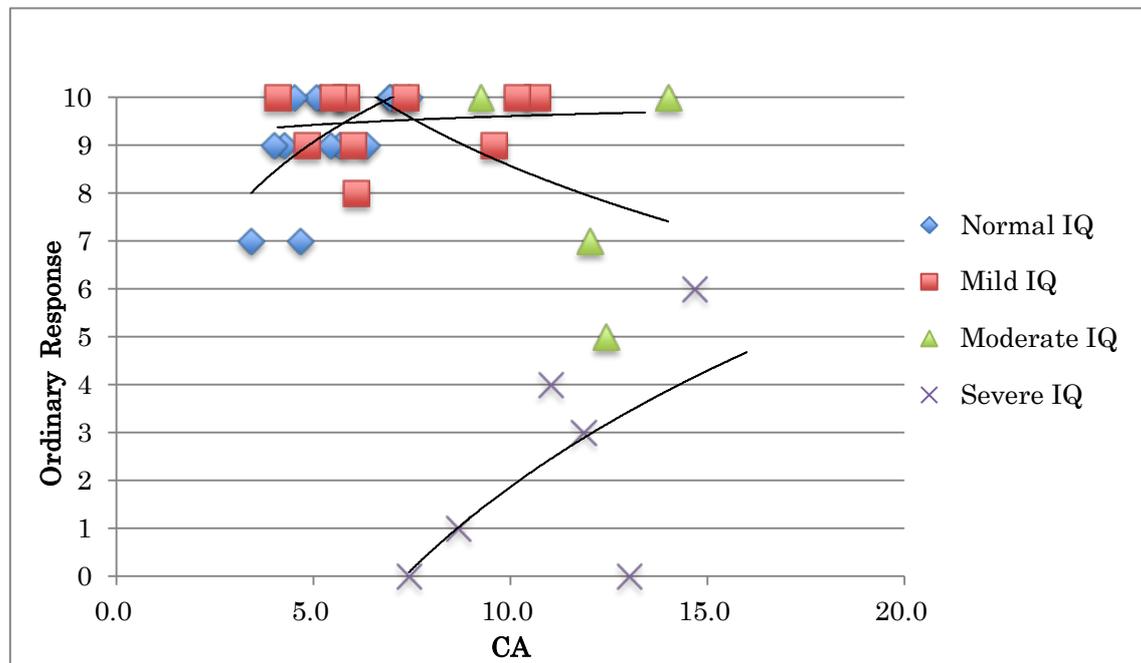
A logarithmic trendline determined by the least squares method has been added.

To investigate differences between normal IQ and mildly impaired, mildly impaired and moderately impaired, and moderately impaired and severely impaired groups for each task, a Mann-Whitney test with Bonferroni correction was performed. Significant differences (with an adjusted p-value with Bonferroni correction of $p < 0.017$) were found between the mildly impaired and moderately impaired groups in the naming true/false standard and individual tasks, and between the moderately impaired and severely impaired groups in the request-intention standard and individual tasks.

2. Comparisons across tasks

To investigate differences between the standard and individual tasks for the naming true/false task, standard and individual tasks for the request-intention task, the naming true/false task and the request-intention task for the standard task, and the naming true/false task and the request-intention task for the individual task, a Wilcoxon signed-rank test with Bonferroni correction was performed (adjusted p-value < 0.013). Significant differences were found all pairs(see Table 5).

Table 5 Comparison across tasks

	Standard	Individual
	Mean correct responses (S.D.)	Mean correct responses (S.D.)
Naming true/false	5.1 (4.2)	5.6 (4.2)
Request Intention	8.1 (3.1)	7.8 (3.2)

3. Variables affecting the tasks in the Yes/No Test

To determine the variables affecting responses in each task of the Yes/No test, a multiple logistic regression analysis was carried out by forward selection using the likelihood ratio (Table 6). The independent variables were CA, IQ, estimated MA, VA, PARS-peak, and PARS-present. Prior to the analysis, scatterplots of all variables were created, and none were found to show noticeable linear relationships. The model chi-square test was significant at p<0.01, and each variable was significant (p<0.01). The results for each task were as follows.

〔<-Table 6 here〕

a. Naming true/false (standard): PARS-present（odds ratio [OR] 0.895; 95% confidence interval [CI] 0.828 to 0.968; p=0.006）and estimated MA（OR 1.068; 95% CI 1.026 to 1.111; p=0.001） were associated with the naming true/false tasks (standard). The result of the Hosmer-Lemeshow test was p=0.704, showing good fit, and the Discriminant Hitting Ratio was also high at 80.8%.

b. Naming true/false (individual): PARS-present（OR 0.857; 95% CI 0.778 to 0.944; p=0.002） and VA（OR 1.127; 95% CI 1.039 to 1.221; p=0.004） were associated with the naming true/false tasks (individual). The result of the Hosmer-Lemeshow test was p=0.625, showing good fit, and the Discriminant Hitting Ratio was also high at 80.8%.

c. Request-intention (standard): IQ（OR 1.049; 95% CI 1.016 to 1.083; p=0.003） was

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associated with the request-intention tasks (standard). The result of the Hosmer-Lemeshow test was p=0.103, showing good fit, and the Discriminant Hitting Ratio was also high at 79.6%.

d. Request-intention (individual): IQ（OR 1.067; 95% CI 1.023 to 1.113; p=0.002）was associated with the request-intention tasks (individual). The Discriminant Hitting Ratio was high at 91.7%, but the result of the Hosmer-Lemeshow test was p=0.000, indicating that the model was not a good fit.

Table 5 Association of CA, PARS-present, PARS-peak, IQ, Estimated MA and VA with ordinary responses

		Variable	Partial Regression Coefficient	P Value (p)	Odds Ratio	95% Confidence Interval	Discriminant Hitting Ratio
Naming true/ false	Standard	PARS-present	-0.111	0.006	0.895	0.828-0.968	80.8%
		Estimated MA	0.066	0.001	1.068	1.026-1.111	
		Constant	-1.314	0.336			
	Individual	PARS-present	-0.154	0.002	0.857	0.778-0.944	80.8%
		VA	0.119	0.004	1.127	1.039-1.221	
		Constant	2.142	0.097			
Request-intention	Standard	IQ	0.048	0.003	1.049	1.016-1.083	79.6%
		Constant	-1.991	0.041			
	Individual	IQ	0.065	0.002	1.067	1.023-1.113	91.7%
		Constant	-2.919	0.017			

Model χ^2-test, p<0.01

IV Discussion

Four Y/N-Qs tasks (naming true/false standard, naming true/false individual, request-intention standard, and request-intention individual) were given to 52 children with ASD to help understand how these children respond to Y/N-Qs.

It was assumed that with the naming true/false tasks, there would be considerable variation before the children entered school in the normal IQ and mildly intellectually impaired groups, with some children able to complete the tasks and others unable to, and that all children in these groups would become able to complete the tasks after entering school. It was also assumed that in the moderately intellectually impaired and severely impaired groups, the tasks would be difficult and the children would be unable to complete them even after entering school. With the request-intention tasks, it was assumed that children in the normal IQ and mildly intellectually impaired groups would be able to complete the tasks before entering school and children in the moderately impaired group would be able to complete the tasks after entering school, whereas children in the severely impaired group would have difficulty with the tasks even after entering school.

1. At what age do children with ASD become able to answer the Y/N-Qs?

In the present study, most children with ASD in the normal IQ and mildly intellectually

impaired groups were able to answer Y/N-Qs appropriately after age 7 years, fewer were able to answer appropriately at pre-school age.   In contrast, many children with ASD in the moderately intellectually impaired and severely impaired IQ groups were not able to answer Y/N-Qs appropriately even after reaching the age of 7 years.

The participants in the study by Oi (2010) appear to correspond to the present normal IQ group participants aged ≥7 years. This is the stage at which children became able to give adequate answers to the Y/N-Qs in the present study, which supports findings of previous studies (Oi 2005, 2010). In addition, the participants in the study by Paccia and Curcio (1982) appear to correspond to the present moderate or severe IQ group participants aged ≥7 years. This is the stage at which children didn't become able to give adequate answers to the Y/N-Qs in the present study, which also supports the results of previous study (Paccia and Curcio 1982) that it may be difficult for children with ASD and cognitive delay to respond adequately to Y/N-Qs.

2. Are there differences in performance on different tasks?

The present research showed significant differences in responses to the naming true/false tasks and the request-intention tasks. In a longitudinal study Steffensen (1977) studied the development of two typically developing English-speaking children's responses to Y/N-Qs, between the age of 1:5–2:2 years and 1:8–2:2 years. He reported that the two children showed no difference in correct responses to Y/N-Qs, whether ego-orientated ('Do you want a cookie?') or not ('Is the dolly pretty?'). We

infer that the request-intention tasks are categorized as the ego-orientated, while the naming true/false tasks are not. In the present research, children with ASD show significantly different responses depending on the type of question (request-intention or naming true/false). The results suggest that children with ASD may show a different profile of performance with respect to Y/N-Qs as compared to typically-developing children.

3. Do children and adolescents with ASD perform poorly on Y/N-Qs?

To identify whether children with ASD show a poor performance on the Y/N-Qs, it is necessary to compare results with children developing typically. Steffensen (1978) reported that appropriate responses accounted for more than 90% of Yes responses to Y/N-Qs in typically developing children at the age of 2:2, and that No responses to Y/N-Qs were correct at about age 2:8 years. In the study reported here, pre-school children with ASD and normal IQ (aged 3:5–7:1) were between 50 and 63% accurate with the naming true false/task, suggesting that they performed less well than the typically developing 2 year-olds reported on by Steffensen (1978). However, this can only be a tentative indication of poorer performance in children with ASD, as there was no control group of typically developing children who completed the same Yes/No tasks as the children with ASD in this study.

4. Is performance on Yes/NO tasks explained by intellectual

impairment, language ability, and severity of ASD?

The results of the Yes/No Test differed significantly on the naming true/false task between the mildly intellectually impaired group and the moderately impaired group, and on the request-intention task between the moderately intellectually impaired group and the severely impaired group. These findings indicate that intellectual capacity affects response behavior with respect to Y/N-Qs.

In the naming true/false tasks, multiple logistic regression analysis indicated that PARS-present (as a measure of severity of ASD) is associated with performance on both standard and individual tasks. Estimated mental age had an effect in the standard task and receptive vocabulary age had an effect in the individual task. In the request-intention tasks IQ was associated with performance on both the standard and individual tasks. These findings appear to indicate that ability to respond appropriately to Y/N-Qs is related to severity of ASD, intellectual level and language ability.

5. Methodological limitation and recommendation for further research

Only one question was asked at each showing of the objects (i.e., a yes question or a no question). This procedure was used to eliminate the effects of repeated questioning on young children (Memon and Vartoukian, 1996). However, the possibility of the effects of multiple questioning isn't excluded, as children were asked a total of 40 questions.

More detailed analysis of the pattern of responses would determine whether or not the repeated questioning was affecting the results.

Age, understanding of language, severity of ASD and level of intellectual development were all shown to be factors in responding to Y/N-Qs. The relative influence of these factors on the ability to respond appropriately to Y/N-Qs might be clarified if data was also collected on control groups of typically-developing children, matched for chronological age, for mental age, and for vocabulary age with a group of children with ASD.

The present study was not able to offer an explanation for why the difficulty with respect to Y/N-Qs and Wh-Qs is opposite in echolalic children and high-functioning children. A detailed description and an analysis of specific ways in which children responded to Y/N-Qs in the present study would be required. We intend to address this in future work.

6. Conclusions

Age and intellectual ability affect responses to Y/N-Qs in children with ASD. Children with ASD with normal IQ and mild intellectual impairment were able to answer Y/N-Qs appropriately after the age of 7 years. In contrast, children with ASD with moderate or severe intellectual impairment had difficulty answering the Y/N-Qs appropriately even after the age of 7 years. Severity of ASD and receptive vocabulary knowledge also have an impact on performance on Y/N-Qs.

There are differences in the number of appropriate responses to Y/N-Qs given by children with ASD depending on the task, with more appropriate responses given in the request-intention task than in the naming true/false task. There was also some difference in responses, depending on whether the material selected was of particular interest to the child.

Acknowledgments

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