RESEARCH

Construction of a tool for assessment of joint attention in Egyptian Cairene children

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Abstract

Background: Joint attention (JA) is a basic social communicative skill important for language development. JA deficits appear prior to language acquisition. Because autism is often not diagnosed until a child is three or four years of age, it is important to look for indicators prior to language acquisition such as JA to provide appropriate treatment at a younger age. Therefore, the aim of this study is to construct an objective tool for assessment of joint attention skills in young Egyptian children to detect the presence of autistic behaviour in high-risk children in order to conduct plans for early intervention. The questionnaire was constructed to assess the five main components of JA and was termed Egyptian Joint Attention Questionnaire. The questions were formulated in the colloquial Egyptian Arabic language and in an 'easy-to understand' design that would be comprehensible by mothers. No question was directly translated from another questionnaire. Ten typically developing (TD) children, with an age range of 18–54 months, were included in the pilot study of the test design. It was applied to 90 TD children and 30 autistic children (contrast group) within the same age range. Participant's responses were statistically analysed to assess the validity and reliability of the questionnaire and to compare the responses related to TD children and autistic children.

Results: There was high internal consistency and reliability of the questionnaire (Cronbach's $a = 0.9$, Intra-class correlation $= .776$), with a statistically significant difference between TD and autistic children ($P < 0.001$).

Conclusions: The questionnaire is a valid and reliable assessment tool that could be used in early detection of autistic Egyptian children.

Keywords: Joint attention, Questionnaire, Assessment, Autism

1 Background

Joint attention (JA) is an early social communicative behaviour in which two people share the same focus of attention related to an object or event. JA appears in two forms: responding to joint attention (RJA) and initiating joint attention (IJA). RJA refers to infants' ability to follow the direction of the eye gaze or gestures of others in order to share a common point of reference. Alternatively, IJA involves infants' use of gestures and eye contact to direct others' attention to objects, events, or to themselves. The

function of IJA is to show or spontaneously seek to share interests or pleasurable experience with others, not to request others to bring something; i.e., a social function. The child indicates an object through pointing, showing, giving; as a means of obtaining the adult's attention (proto-declarative). This reflects the infant's growing understanding of the world and motivation to interact with adults by indicating interesting objects [1].

Development of JA: As early as 3 months of age, infants will share eye contact and show enjoyment with a caregiver and then turn to look at what the adult looks at. Beginning around 8 months of age, children will share attention by shifting gaze from person to object and back to person, and around 12 months, they use gestures to direct attention. By 12 to 15 months of age, this develops

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Muhammad *et al. Beni-Suef Univ J Basic Appl Sci*   (2021) 10:91

Page 2 of 8

into coordinated joint attention that involves following the adult's lead in play as well as integrating turns [2].

Problems with JA have long been considered a relevant, if not primary, dimension of the social phenotype of autism [3]. Joint attention items play a primary role in diagnostic instruments for younger children [4] as well as early screening instruments [5]. Detection of joint attention disturbance in autistic children has recently become an important target of effective early intervention [6].

2 Objective
To construct an objective tool for assessment of JA skills in young Egyptian children to be used as an early detector of the presence of autistic behaviours in high-risk children in order to guide plans for early intervention.

3 Methods
The study protocol was approved by the Ain Shams Institute of Ethical Committee of Human Research and all parents of children involved in the study provided an informed consent. Patient privacy and confidentiality were protected. The questions were designed in the colloquial Egyptian Arabic (CEA) and in a form easy for the mothers to understand. No question was directly translated from another questionnaire. The questionnaire was evaluated by three senior phoniatricians, of at least 10 years' experience, to ensure the clarity and relevance of the questions. This was further tested by presenting it to parents of a pilot-tested group of 10 typically developing Egyptian children. Accordingly, modifications were done as needed. The questionnaire was applied to 90 typically developing (TD) children (group I) to obtain normative data, in addition to 30 autistic children diagnosed by Child Autistic Rating Scale "CARS" [7] (group II). The questionnaire was termed Egyptian Joint Attention Questionnaire (EJAQ).

3.1 Study design
This study is a cross-sectional study, including TD children attending nurseries and preschool in addition to autistic children from different public and private clinics, during the period between November 2018 to July 2021. All children resided in the city of Cairo, capital of Egypt.

3.2 Design stage

(a) An Arabic questionnaire for detecting joint attention development was constructed in Colloquial Egyptian Arabic (CEA), taking in consideration social, cultural and language considerations appropriate to the vicinity of Cairo.
(b) The questionnaire consisted of 44 items assessing 5 main areas of joint attention: eye gaze (EG) (11 questions), responding to joint attention (RJA) (9 questions), initiating joint attention (IJA) (9 questions), coordinated joint attention (7 questions) and facial expressions (8 questions). The eye gaze of the child was investigated in regard to the situations when he/she looks at others; as at persons seen for the first time, or at mother only, and whether the purpose was to follow or to attract attention. RJA questions were designed to identify the situations of response to joint attention; whether to name, showing or pointing. IJA questions investigated how the child initiates attention; through pointing or calling or other means. The mechanism of coordinated joint attention was explored in the questionnaire to identify if the child sustains attention with play participant verbally or non-verbally. The facial expressions that the child gives in different situations were also included in the questionnaire.

(c) The questionnaire was directed to the parent/caregiver. Items were scored on 5-point scale as follows:

> 0 = never or no response (0% of the time).
> 1 = seldom happens (about 25% of the time).
> 2 = occurs occasionally (about 50% of the time).
> 3 = occurs frequently (about 75% of the time).
> 4 = happens always (100% of the time).

(d) The scoring of the questionnaire: Scores were calculated separately for each area of joint attention: 44 for eye gaze (EG) (impaired if < 26.5), 36 for RJA (impaired if < 19), 36 for IJA (impaired if < 14.50), 28 for coordinated JA (impaired if < 14.50), and 32 for facial expressions (impaired if < 25.50).

Total score of the five items was 176. Scores < 102.5 indicated joint attention impairment.

3.3 Standardization sample
Ninety TD Egyptian (group I) children were randomly selected from different public and private nurseries. They were divided into three subgroups:

1. Group I-A: from 18 months to one day less than 30 months
2. Group I-B: from 30 months to one day less than 42 months
3. Group I-C: from 42 months to one day less than 54 months

3.3.1 Inclusion criteria of the standardization sample include

- Egyptian Arabic native speaking children

Muhammad *et al. Beni-Suef Univ J Basic Appl Sci* (2021) 10:91

Page 3 of 8

- Age range 18–54 months
- Children having typical attention, hearing, language, and mental ability as reported by their teachers or caregivers. Average intelligence was proved by applying Stanford-Binet intelligence scale "5th edition—Arabic version" [8]. Language assessment was done by Revised Arabic Language Test [9] to determine receptive, expressive and total language ages.
- Children from upper and lower middle classes

3.3.2 For construct validity

Thirty autistic children, as a contrast group (group II), diagnosed by CARS, were chosen in the same age range 18–54 months old and included in the validity study.

3.3.3 For retest reliability

Thirty children were chosen randomly from the standardization group for retesting after 2 weeks of primary evaluation.

3.4 Test application

The test was applied to the sample of standardization (30 from each age range with a total of 90). Validity and reliability were tested through the resultant scores.

3.5 Testing procedure

Test items were presented in Colloquial Egyptian Arabic (CEA). It took the parent of the child about 15–20 min to complete the test. Environment for applying the test was a quiet, well-lighted, and well-ventilated room with no distracting elements.

3.6 Tests of validity

Construct and Face Validity tests were implemented. Construct Validity correlated the test scores of the group of children with autism (30) with those of the group of typically developing children in the original sample of standardization. Face Validity tested the superficial validity of the test to measure the investigated items through feedback from 10 parents and 3 senior phoniatricians. Only 2 questions were reformulated upon recommendations.

3.7 Tests of reliability

Test–Retest Reliability was used to compare the responses of 30 parents at two different settings two weeks apart. The questionnaire was re-administered by the same clinician and the scores were correlated by intra-class correlation. Cronbach's Alpha test was also applied for internal consistency.

3.8 Statistical analysis

Statistical analysis was done using the SPSS (Statistical Package for Social Sciences) version 25. Descriptive statistics were calculated in the form of: 1. Mean ± Standard Deviation (SD). 2. Frequency (number- per cent).

Analytical statistics were used in comparison between the different groups:

1. Student's t test (unpaired): between means of two different groups of numerical parametric data.
2. One-way ANOVA (analysis of variance): between means of more than two groups of numerical parametric data.

Significance was set at P value = or < 0.05.

4 Results

4.1 The demographic data of the study groups (Table 1)

This study was conducted on 2 groups of Egyptian Arabic-speaking children: Group I consisted of 90 typically developing children in the age range between 18–54 months (mean ± SD = 37 ± 11), including 48 males (53%) and 42 females (47%). Group II (contrast group) consisted of 30 children diagnosed with ASD in the same age range (mean ± SD = 45 ± 9), including 22 males (73%) and 8 females (27%).

4.2 Descriptive statistics and comparative analysis of the raw scores of EJAQ Questionnaire in the three subgroups of group I (Table 2)

Descriptive statistics: The mean total score was 143 (±17) for group I-A, 148 (±17) for group I-B and 155 (±17) for group I-C. The mean of scores of the questionnaire items (Eye gaze, responding to joint attention, initiating joint attention, coordinated joint attention and facial expressions) for each of the three subgroups I-A, I-B and I-C are also shown in the table.

Comparative analysis of the scores: The means of joint attention abilities among the three subgroups of group I show that:

Table 1 The demographic data of the two groups of TD and autistic children with age expressed in months

	Group (I) n = 90	Group (II) n = 30
Age in months (mean ± SD)	37 ± 11	45 ± 9
IQ (mean ± SD)	92 ± 2	62 ± 10
Language age (mean ± SD)	35 ± 10	16 ± 6
Gender		
Male	48 (53%)	22 (73%)
Female	42 (47%)	8 (27%)

Muhammad *et al. Beni-Suef Univ J Basic Appl Sci*   (2021) 10:91

Page 4 of 8

- There is no statistical difference in values of eye gaze and facial expressions between the three subgroups.
- There is statistical difference between the three subgroups in IJA, RJA, and coordinated joint attention at *P* values 0.01, 0.01, and 0.05 respectively.
- There is significance difference in the total score of the questionnaire between the three subgroups at *P* value 0.02.

4.3 Descriptive statistics of the EJAQ Questionnaire items in group II of autistic children (Table 3)

The mean score of the whole group was 47.70 ($\pm$29). The mean scores of the test items (eye gaze, responding to joint attention, initiating joint attention, coordinated joint attention and facial expressions) are shown in the table.

4.4 Comparative analysis of results in the two groups of TD and autism in the EJAQ Questionnaire (Table 4).

Comparative analysis was done between the two studied groups of TD and autistic children in the scores of the items of the questionnaire:

1. Typically developing (TD) children (group I) showed statistically high significant scores in all items when compared to ASD (group II).
2. The two studied groups were matched in age. However, the number of males was statistically significantly higher in ASD (group II) children when compared to typically developing children (group I) ($P < 0.001$).
3. Autistic children (group II) showed higher scores of responding to joint attention than initiating joint attention. IJA is considered the most affected item in the EJAQ Questionnaire.
4. The lower IQ scores in autistic children (group II) showed statistically significant difference when compared to typically developing children (group I) ($P = 0.001$).
5. Typically developing children (group I) showed higher language ages when compared to autistic children (group II), with significant difference between both groups ($P = 0.001$).

Table 3 Raw scores of the questionnaire items in group II of autistic children

Subtests	Total score of each subtest of the questionnaire	Mean $\pm$ SD
Eye gaze (11 items)	44	12.97 $\pm$ 7.93
Responding to JA (9 items)	36	8.70 $\pm$ 6.15
Initiating JA (9 items)	36	6.00 $\pm$ 6.77
Coordinated JA (7 items)	28	7.73 $\pm$ 4.22
Facial expressions (8 items)	32	12.30 $\pm$ 8.88
Total (44 items)	176	47.70 $\pm$ 29.27

SD, standard deviation

Table 2 Raw scores of the three subgroups (I-A, I-B & I-C) of TD children and statistical comparison between them

Subtests	Total score of each subtest	Subgroup 1-A (18–30 months) Mean $\pm$ SD	Subgroup 1-B (30–42 months) Mean $\pm$ SD	Subgroup 1-C (42–54 months) Mean $\pm$ SD	*P* value
Eye gaze (11 items)	44	36 $\pm$ 5	37 $\pm$ 6	39 $\pm$ 4	0.10
Responding to joint attention (9 items)	36	30 $\pm$ 3	30 $\pm$ 4	33 $\pm$ 2	0.01*
Initiating joint attention (9 items)	36	28 $\pm$ 6	30 $\pm$ 4	32 $\pm$ 4	0.01*
Coordinated joint attention (8 items)	28	19 $\pm$ 3	20 $\pm$ 3	21 $\pm$ 3	0.05*
Facial expressions (8 items)	32	29 $\pm$ 3	30 $\pm$ 3	30 $\pm$ 2	0.81
Total score (44 items)	176	143 $\pm$ 17	148 $\pm$ 17	155 $\pm$ 12	0.02*

Data expressed as mean $\pm$ SD. Test used: ONE-WAY ANOVA

SD, standard deviation; *P*, probability

* significance < 0.05

Muhammad *et al. Beni-Suef Univ J Basic Appl Sci* (2021) 10:91

Page 5 of 8

Table 4 Comparison between typically developing children and autistic children as regards means and standard deviations of the subtests of the EJAQ Questionnaire

	Group I (TD children) Mean ± SD	Group II (Autistic children) Mean ± SD	*t**	*P* value
Age (months)	37.17 ± 10.63	45.10 ± 9.37	3.64	< 0.001
IQ test	92.34 ± 2.34	62.23 ± 10.01	16.33	< 0.001
Language age	35.51 ± 10.64	16.33 ± 6.19	12.05	< 0.001
Eye gaze	37.41 ± 5.39	12.97 ± 7.93	15.71	< 0.001
Responding to joint attention	31.22 ± 3.53	8.70 ± 6.15	19.03	< 0.001
Initiating joint attention	30.10 ± 5.17	6.00 ± 6.77	20.39	< 0.001
Coordinated joint attention	20.26 ± 3.32	7.73 ± 4.22	16.67	< 0.001
Facial expression	29.67 ± 2.43	12.30 ± 8.88	10.58	< 0.001
Total score	148.66 ± 16.05	47.70 ± 29.27	18.01	< 0.001

Data expressed as mean ± SD. Test used: Student t test

SD, standard deviation; *P*, probability

* significance < 0.05

4.5 Comparative analysis between male and female TD children with respect to responding to joint attention (RJA) and initiating joint attention (IJA) (Table 5)

Results have shown that there was no significant difference between male and female TD children in developing responding and initiating joint attention. Mean of responding to joint attention in females (No. = 42) was 31.40 (± 4.23) and in males (No. = 48) was 31.06 (± 2.82) (*P* value = 0.649) and the mean of initiating joint attention in females (No. = 42) was 29.83 (± 5.73) and in males (No. = 48) was 30.33 (± 4.67) (*P* value = 0.650).

4.6 Tests of validity
Validity was measured by the following methods:

1. Face validity: From the superficial point of view, the test appears to be valid, since it measures various domains of joint attention including eye gaze, responding to JA, Initiating JA coordinated JA and facial expressions.
2. Construct validity proved that all items are valid.

4.7 Tests of reliability
It was measured by the following:

(1) Test–retest method

Intra-class correlation was used for testing test–retest reliability analysis of the questionnaire groups I-A, I-B and I-C (Table 6). From the table, the correlation between the whole test scores for the first and second administration is statistically significant (< 0.001), indicating that the test is highly reliable.

(2) Cronbach's alpha test

Internal consistency reliability was determined using Cronbach's alpha coefficient. Cronbach's alpha values for the Arabic questionnaire for the entire sample of group I-A aged 18: < 30 months were 0.918, of group I-B aged 30: < 42 months were 0.952, and of group I-C aged 42: < 54; were 0.917 indicating high reliability of this questionnaire (Table 7).

5 Discussion
Behavioural evidence of atypical joint attention behaviours is striking in its presence in preschool development. Items measuring behaviours of joint attention are central

Table 5 Comparison between TD male and female children regards mean and standard deviation

		Females No. = 42	Males No. = 48	Test value[a]	*P* value	Sig
Responding	Mean ± SD	31.40 ± 4.23	31.06 ± 2.82	0.456	0.649	NS
	Range	20–36	26–36			
Initiating	Mean ± SD	29.83 ± 5.73	30.33 ± 4.67	− 0.456	0.650	NS
	Range	15–36	11–36			

[a] Independent *t* test

Muhammad *et al. Beni-Suef Univ J Basic Appl Sci*   (2021) 10:91

Page 6 of 8

Table 6 Intra-class correlation

Intra-class correlation	95% confidence interval		F test with true value 0	
	Lower bound	Upper bound	Value	Sig
0.776	0.570	0.891	7.934	< 0.001

Table 7 Cronbach's alpha coefficients for each age group

Age (months)	Number of children	Number of items	Alpha
18–30	30	44	0.918
31–42	30	44	0.952
43–54	30	44	0.917

to the early, preschool detection of children affected by autism, or at risk of autism [10]. This study aimed at constructing a questionnaire called EJAQ for JA skills in young Egyptian children to be used as an early detector of the presence of autistic behaviours in high-risk children in order to guide plans for early intervention. It is a parent or caregiver report questionnaire for assessment of joint attention in Arabic-speaking children, taking in consideration social, cultural and language considerations appropriate to Egyptian society. The questionnaire consisted of 44 items covering 5 domains of joint attention behaviours. It was evaluated by three phoniatricians before the presentation of the questionnaire to the pilot study group. After application of the pilot study on 10 children, two questions were modified after the pilot study to be easily understood by the parent.

The advantage of the ability to use the questionnaire for the assessment of joint attention is the flexibility it affords when assessing difficult populations. Children with autism, particularly those more impacted by the disorder, often have difficulty sitting and attending for extended period of time. Highly structured assessments, like the Early Social Communication Scales (ESCS), may be difficult for some of these children to complete. As research in autism moves towards identifying early indicators, appropriate assessment must be developed and altered to address their developmental appropriateness. In the cases of highly impacted children and infants, these children may not be able to sufficiently display their full range of abilities within traditional structured assessment.

In the present study after application of EJAQ Questionnaire on the TD children, the results have shown that the core or basic joint attention abilities, namely eye gaze and facial expressions, are acquired early at 30 months of age; while other abilities, RJA, IJA, and coordinated joint attention, continue to grow. This finding coincides with previous researches [11–13]. It was drawn from the fact that there was no significant difference in eye gaze and facial expressions between the three age subgroups of TD children in the questionnaire results. As the age limit of the first subgroup I-A is 30 months, then it is expected that these abilities are well developed by this age. On the other hand, RJA, IJA, and coordinated joint attention are expected to continue to grow until the age of 54 months which is the age limit of the subgroup I-C, as there was significant difference in these abilities between the three subgroups.

After applying EJAQ Questionnaire on autistic children, they showed lower performance than TD children in all domains of joint attention (eye gaze, RJA, IJA, coordinated joint attention and facial expressions). This result is in line with previous studies [14–16]. In the present study, autism is more prevalent in males (73%) than in females (27%) which concurs with previous studies reporting higher prevalence of ASD among males [17–19]. In the autistic group, the mean of initiating JA was lower than the mean of responding to JA which coincides with the research by Gangi et al. [20].

Most of the present tests measure joint attention as a part of social communication assessment scales such as Early Social Communication Scales (ESCS) [21], Communication and Symbolic Behaviour Scales (CSBS) [22] and Social Communication Assessment for Toddlers with Autism (SCATA) [23]. Social communication questionnaire (SCQ) [24] is also a parent report questionnaire for screening of autism. Its items include questions referring to reciprocal social interaction, language and communication, and repetitive stereotyped patterns of behaviour. Unlike all these scales, EJAQ is a specific questionnaire which assesses joint attention behaviours in details.

ESCS [21] is the most commonly used test for assessment of joint attention. It is a videotaped structured observation measure that requires between 15 to 25 min to administer. It provides measures of individual differences in nonverbal communication skills that typically emerge in children between 8 and 30 months of age. A set of 25 semi-structured eliciting situations were developed to encourage interaction between an adult tester and the child. While the ESCS is an effective and validated measure, it does have limitations. The assessment requires a controlled setting, with assessors trained in the standardized administration. This can place high demands on both the child and the assessor. Very young children or children with attention difficulties may have difficulty expressing their full capabilities in such a structured setting. While standardized administration is the strength of the ESCS, it may also make it difficult for professionals

Muhammad *et al. Beni-Suef Univ J Basic Appl Sci*   (2021) 10:91

Page 7 of 8

outside of research institutions to effectively administer. In EJAQ, on the other hand, behavioural requests were excluded as they do not represent joint attention skills, while social interaction behaviours were included in coordinated joint engagement. Eye gaze and facial expressions were also included as they are very important in the development of joint attention.

Although this questionnaire appears to be similar in structure to the childhood joint attention rating scale(C-JARS) [25], there are discrepancies. The EJAQ assesses the 5 domains of joint attention that include eye gaze, responding to JA, initiating JA, coordinated JA and facial expressions and is applied on the preschool period to be an early screening tool of autism. On the other hand, C-JARS is done for older verbal children and during adolescence and it assesses responding to JA, initiating JA and joint action.

EJAQ Questionnaire displayed high sensitivity and high specificity for diagnostic identification of autistic children. This was the case for both males and females with autism. The joint attention skills differed strikingly in individuals of autism compared to TD children. Reliability and validity test results showed that EJAQ is a valid and highly reliable questionnaire that reflects joint attention abilities in developing Egyptian Arabic children between 18 and 54 months.

6 Conclusions

This study presents a comprehensive, valid and reliable tool that can assess joint attention with its subcategories. This questionnaire can be used as an assessment tool of joint attention behaviours. It provides an estimate of the child's eye gaze frequency, response to joint attention, initiating joint attention, coordinated joint attention and facial expressions, which helps in early diagnosis of autistic children.

7 Recommendations

Performing comparative statistics for some of the metrics by gender to determine if RJA or IJA is more or less impaired in male versus female children.

Abbreviations
JA: Joint attention; TD: Typically developing; EJAQ: Egyptian Joint Attention Questionnaire; CEA: Colloquial Egyptian Arabic; RJA: Responding to joint attention; IJA: Initiating Joint Attention; CARS: Child Autistic Rating Scale; EG: Eye gaze; SD: Standard deviation; SPSS: Statistical Package for Social Sciences; ESCS: Early Social Communication Scales; CSBS: Communication and Symbolic Behaviour Scales; SCATA: Social Communication Assessment for Toddlers with Autism; SCQ: Social communication questionnaire; C-JARS: Childhood joint attention rating scale.

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Muhammad *et al. Beni-Suef Univ J Basic Appl Sci*   (2021) 10:91

Page 8 of 8

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