Malta Journal of Health Sciences
http://www.um.edu.mt/healthsciences/mjhs
Doi: http://dx.medra.org/10.14614/NATURAUTISM.2.1.16

Research paper

THE USE OF JOINT ATTENTION IN THE NATURALISTIC SETTING IN CHILDREN WITH AUTISM SPECTRUM DISORDER

Cheryl Dalli, Joseph Agius
Department of Communication Therapy, Faculty of Health Sciences, University of Malta, Msida, Malta

Abstract. This study investigates the deficits in the quantity and quality of joint attention in children with Autism Spectrum Disorder (ASD). To obtain a holistic measure of joint attention, the following four aspects were considered: a) the quantity of Initiation Joint Attention (IJA) and Response Joint Attention (RJA), b) non-verbal behaviours which were atypically used during joint attention, c) the quality of joint attention and d) the association between quality and quantity of joint attention in children with ASD. These aspects were measured in three children with ASD and three typically-developing children (TDC). Measures were derived from 30-minute video recordings of a play session between each child and his/her caregiver and compared. This study established that there was a statistically significant difference in the quantity of joint attention in both IJA and RJA. The difference in the quality of joint attention was not statistically significant. However, when analysing children with ASD individually, a deficit in the quality of joint attention was identified in two of the three subjects. Compared to TDC, children with ASD engaged significantly less in IJA through manipulation of objects and eye-gaze and significantly more in IJA and RJA through challenging behaviour. In addition, there was no association between the deficits in quality and quantity of joint attention within individuals with ASD, as the three subjects portrayed diverse profiles. Children with ASD exhibited atypical joint attention skills when compared to the control group. Moreover, the frequency of initiations of joint attention bids was the most negatively affected aspect in children with ASD. Quality of joint attention is rarely researched and to the researchers' knowledge, no other study has measured both quality and quantity of joint attention in children with ASD.

Keywords: joint attention, Initiation Joint Attention, Autism Spectrum Disorder, Response Joint Attention

1 Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterised by an impairment in social communication and social interaction, together with restricted and repetitive behaviours (American Psychiatric Association, 2013; Levy, Mandell & Schultz, 2009). Children with ASD show atypical development of joint attention skills (Buxbaum & Hof, 2013). Joint attention is a triadic exchange between two individuals with a common intent, upon the same object (Hafner & Kaplan, 2006). An agent is required to intentionally influence or track the other agent's attention for the process to be considered as joint attention (Hafner & Kaplan, 2006). Thus, simultaneous looking, which is when two agents look at an object together without a common intent, is not considered as joint attention.

A shift in attention is realised through the use of non-verbal behaviours (Hafner & Kaplan, 2006). These behaviours can be used to initiate or respond to attempts of social interaction with another agent (Block et al., 2007; Hogan, Mundy & Seibert, 1982). Thus, joint attention is categorised into two main classifications, Responding Joint Attention (RJA) and Initiating Joint Attention (IJA) (Boucher, 2007). IJA and RJA are diverse yet related processes (Mundy & Newell, 2007). RJA refers to the active following or response to the social partner's bid to an object or event. IJA is the ability to use these behaviours to seek the social partner's attention and direct it to an event, object or experience (Block et al., 2007; Bruinsma, Koegel & Koegel, 2004).

Of the two types of joint attention, IJA is especially associated with language and social development (Carr, Feeley & Jones, 2006). IJA supports language acquisition in instances where the caregiver takes the opportunity to name the object when the child spontaneously refers to it in the immediate environment (Mundy & Sigman, 2006; Tomasello, 1995). In a study by Gomes and Mundy (1998), a positive correlation between expressive language and IJA was identified. Mundy (1995) described IJA as the intrinsic motivation to share one's experience with another within the same context, thus stressing the importance of IJA in social development.

In the first years of life, the caregiver creates learning opportunities by specifying a particular object, or event, in the surrounding environment. The child is then required to differentiate between the object being referred to and other objects in the same context. This facilitates the process of mapping, whereby a new word is acquired and associated to the object it refers to (Mundy & Sigman, 2006). Thus, the child's RJA reflects that s/he is able, to some extent, to understand the initiator's intent. Through the adult's eye-gaze or gesture, the child is exposed to a learning experience. Thus, an impairment in RJA impedes this social or linguistic learning opportunity (Bauman et al., 2007).

Correspondence to: Cheryl Dalli
(cheryldalli@gmail.com)
Received: 21.10.14 - Revised: 18.02.15 - Accepted: 22.02.15 - Published: 25.05.15

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Impairment in IJA and RJA affects a child's long-term social behaviour (Anderson et al., 2013). Since joint attention is a precursor of several other developmental abilities, exploring both the quality and quantity of joint attention behaviour in children with ASD can provide a better understanding of the deficits observed (Kasari & Lawton, 2012). To obtain a holistic measure of a child's abilities, quality of joint attention may be assessed in various contexts and with different social partners (Kasari & Lawton, 2012). In a longitudinal study, Kasari and Lawton (2012) explored the quality of joint attention in 52 pre-school children. These authors defined quality as "shared positive affect during joint attention" together with "shared positive affect and utterances during joint attention" (p.307). When positive emotions are expressed during social interaction, the child would be engaging in Shared Positive Affect (SPA). A study by Gernsbacher et al. (2008) compared measures of joint attention in a naturalistic setting and structured setting. The structured assessment was carried out using the Early Social Communication Scale (ESCS). A second session was then carried out to assess joint attention in a naturalistic administrator-child play session. Both sessions were video recorded. Video recorded sessions were then observed and decoded. Results demonstrated that both settings have potential to provide a realistic measure of joint attention skills in children with ASD (Gernsbacher et al., 2008). Thus, for the present study, a naturalistic setting was used to compare joint attention skills in children with ASD and in typically-developing children (TDC).

It was hypothesised that children with ASD would present with deficits in joint attention. The following research questions were investigated to better understand the use of joint attention in children with ASD: a) How is the quantity of RJA and IJA affected in children with ASD? b) Which types of non-verbal behaviours are atypically used in children with ASD? c) How is the quality of joint attention affected in children with ASD? d) What is the association between the quality and quantity of joint attention in children with ASD?

2 Methods

2.1 Participants

Three children with ASD and a control group of three TDC participated in the study. For each child with ASD, a TDC from the same school and having the same age and gender was recruited, to counteract the possibility that subject-related variables affected results. The latter is particularly likely when the number of study participants is limited (Cohen, Manion & Morrison, 2007). Research shows that joint attention continues to develop at least till the age of three years (Adamson et al., 2004; Block et al., 2007). Therefore, the age criterion for subject selection was set to 3;0-4;0 years. The means and standard deviations (SD) of the chronological ages (CA) of both groups of children are shown in Table 1. The subjects with ASD were recruited through the Speech-Language Department in Malta and had been diagnosed with autism by a psychologist independently from the study. The TDC were contacted through the schools the children with ASD attended and were matched for age and gender. Two pairs of male subjects and a pair of female subjects were recruited.

Table 1. Means and standard deviations (SD) of chronological age (years; months) for both subject groups.

Group	Sample Size	Mean	SD
TDC	3	3;07	0.04
ASD	3	3;08	0.03

2.2 Procedure

The children's joint attention behaviours were assessed in a naturalistic setting due to the latter's accessibility and effectiveness in measuring joint attention skills. The first author video recorded a 30-minute free play session between each child and his/her caregiver. Researchers have assessed joint attention during child-tester interaction, as well as child-caregiver interaction (Block et al., 2012; Gernsbacher et al., 2008). However, Mundy and Sigman (2006) argued that the relationship between the caregiver and the child can provide a more realistic measure of joint attention skills, as the child's performance would be to the best of the child's abilities. Thus, choosing the caregiver as the child's social partner improves the child's performance while maintaining a naturalistic setting. In this study, therefore, each child's social partner was the caregiver and playtime took place in the child's home, in order to ensure that the play setting was naturalistic. For every child, the mother volunteered to take part in the study as the caregiver.

A standard set of toys was used during playtime. This consisted of toy bricks, a puzzle, a book which encouraged touch, plain paper and crayons, a bubble bottle and a toy train. These toys are recommended by the Early Bird team of the National Autistic Society (Shields, 2011) to promote communication. Prior to the session, caregivers were instructed to present the child with one toy at a time. Toys were only replaced when the child requested a change or started to get distracted.

2.3 Data coding

The video recordings were viewed by the first author and coded for quantity and quality of joint attention. This section describes the preparation required for coding, as well as the coding process employed and the underlying rationale.

Measuring joint attention requires identification of the subject's intent. Thus, formal training is usually required to differentiate between simultaneous looking and joint attention. For example, in a study by Gernsbacher et al. (2008), coders were trained prior to scoring the outcomes of a structured assessment and a play sample. Since formal training or experienced raters were unavailable in the current study, a coding system was drawn up and practised on the video recording of a pilot play session (see Section 2.4). This recording was scored repeatedly by the first author until two consecutive identical scores were obtained. To enhance consistent scoring, definitions for each non-verbal behaviour for both IJA and RJA were compiled, together with a set of guidelines for scoring based upon instructions in the ESCS manual (Block et al., 2003). The adapted guidelines included instructions such as the following: if a joint attention behaviour is portrayed by more than one non-verbal behaviour, the first non-verbal behaviour performed by the child should be scored. In addition, more detailed definitions of the non-verbal joint attention behaviours listed in the Checklist of Non-verbal Communication (Agius, 2009) were drawn up, enabling identification of the different types of behaviours together with their frequencies. Among the non-verbal behaviours measured were manipulation of objects, eye-gaze and challenging behaviour.

During the main study, all recordings were viewed twice prior to scoring in order for the coder to become familiar with the session dynamics and gain insight on the subjects' intent during joint attention. Quantity of joint attention was coded in terms of frequency, following various studies and assessments (see Block et al., 2003; Gernsbacher et al., 2008). Coding of each video recorded session for the quantitative aspect took place in two stages. First, the joint attention non-verbal behaviour was identified. The recording was then either viewed again or paused to identify who commenced the bid, thus enabling classification of the behaviour as IJA or RJA and leading to a measure of the quantity of each. For coding purposes, quality of joint attention was considered in triadic exchanges in which child and caregiver showed a

common intent related to an object or event and portrayed positive emotion in the process. Non-verbal behaviours which demonstrated positive emotion were smiling and laughing. When these behaviours occurred without joint attention, they were not scored. Since quantity of joint attention was measured on the basis of the first nonverbal behaviour performed by the child, quality of joint attention could not be calculated through these scores. Quality of joint attention needed to be scored separately so that instances of joint attention which may not have initiated with a smile or a laugh, but included these behaviours at a point during the joint attention bid, could be identified. Quality is sometimes scored in terms of duration of these behaviours instead of frequency. For example, Kasari et al. (1990) and McMahon (2009) scored joint attention and SPA through a continuous coding system, using specialised software to code duration of joint attention. Such software programmes were not available during the study and are costly to acquire. For this reason, quality of joint attention was measured through frequency. Thus, similar to quantity of joint attention, quality of joint attention was scored in terms of frequency. Unlike quality of joint attention, however, it was not scored as either IJA or RJA.

Measures of inter-rater reliability were not implemented. Due to limited human resources and time constraints, it was not possible to find an individual who would undergo training to distinguish joint attention from simultaneous looking.

2.4 Pilot study

Prior to recording the subjects' play sessions, a pilot study was carried out. A play session between a typically-developing child aged 4;01 years and his caregiver was video recorded and coded following viewing. This session gave insight on the method employed and enabled preparation for the subsequent recordings. The video recording also allowed the researcher to train in coding joint attention bids in a consistent manner.

2.5 Analysis

Statistical analysis involved the comparison of IJA and RJA between the two groups to identify differences in frequency of use of non-verbal behaviours and differences in frequency related to quality of joint attention.

The Independent Samples T-Test was used to compare quantity and quality of joint attention mean scores obtained by the children with ASD and the TDC. The null hypothesis specified that the mean scores were comparable between the two groups and would be accepted if the p-value exceeded the 0.05 level of significance. The alternative hypothesis specified that the mean scores differed significantly between the groups and would be accepted if the p-value was less than 0.05. A one-tailed test was employed throughout since prior knowledge from the research literature led to the expectation that TDC would score significantly higher for quantity and quality of joint attention skills than children with ASD. Each child with ASD was then paired with his/her typically-developing control and the raw scores of the resulting subject pairs, Pairs A, B and C, were analysed separately since statistical analysis of the data for each pair was not viable.

2.6 Ethical considerations

Recruitment of subjects commenced once approval from the University of Malta's Research Ethics Committee had been granted. Privacy and confidentiality were maintained, as no information which could reveal the participants' identity was specified in the study. All of the caregivers signed consent forms before data collection was initiated. The findings and results reported are true.

3 Results

Differences in quantity of joint attention across the two groups are reported first. Quantity of joint attention is then examined amongst pairs. The same approach is used to explore differences in quality of joint attention in TDC and children with ASD.

For quantity of joint attention, Table 2 shows the descriptive statistics for IJA obtained for both subject groups. The mean IJA score for TDC exceeded the mean IJA for children with ASD by more than 30 scale points. This difference was found to be statistically significant (t (4) = 4.65, p = 0.005, (1-tailed)). Thus, the alternative hypothesis was satisfied.

Table 2. Means, standard deviations (SD) and standard error means for quantity of joint attention (IJA) in TDC and children with ASD.

Group	Sample Size	Mean	SD	Std. Error Mean
TDC	3	56.00	2.00	1.16
ASD	3	23.00	12.12	7.00

Descriptive statistics obtained for quantity of joint attention (RJA) are presented in Table 3. The mean RJA score for TDC exceeded that obtained for children with ASD by more than 20 scale points. This difference was found to be statistically significant (t (4) = 2.30, p = 0.041 (1-tailed)), satisfying the alternative hypothesis.

Table 3. Means, standard deviations (SD) and standard error means for quantity of joint attention (RJA) in TDC and children with ASD.

Group	Sample Size	Mean	SD	Std. Error Mean
TDC	3	76.33	10.07	5.81
ASD	3	54.00	13.45	7.77

Mean scores of IJA through manipulation of objects and through eye-gaze in TDC exceeded that of children with ASD, with these differences resulting as statistically significant (see Table 4).

Table 4. Means, standard deviations (SD), standard error means and p-values for quantity of joint attention (IJA bids through manipulation of objects and eye-gaze) in TDC and children with ASD.

Non-Verbal Behaviour	Group	Sample Size	Mean	SD	Std. Error Mean	p-value
IJA through manipulation of objects	TDC	3	30.00	7.55	4.36	0.041
	ASD	3	7.67	6.03	3.48	
IJA through eye-gaze	TDC	3	2.00	0.00	0.00	0.004
	ASD	3	0.33	0.57	0.33	

Table 5. Means, standard deviations (SD), standard error means and p-values for quantity of joint attention (IJA and RJA bids through challenging behaviour) in TDC and children with ASD.

Non-Verbal Behaviour	Group	Sample Size	Mean	SD	Std. Error Mean	p-value
IJA through challenging behaviour	TDC	3	0.00	0.00	0.00	0.029
	ASD	3	2.33	1.53	0.88	
RJA through challenging behaviour	TDC	3	0.00	0.00	0.00	0.034
	ASD	3	1.67	1.16	0.67	

The mean scores of IJA and RJA through Challenging Behaviour in children with ASD exceeded those of TDC. In both IJA and RJA, this difference was found to be statistically significant (see Table 5), satisfying the alternative hypothesis.

With regards to quality of joint attention (SPA during joint attention), the mean score for TDC exceeded the mean score for children with ASD by more than 25 scale points (refer to Table 6 for the relevant descriptive statistics). However, this difference was not statistically significant (t (4) = 1.55, p = 0.099 (1-tailed)), disproving the alternative hypothesis.

Table 6. Means, standard deviations (SD) and standard error means for quality of joint attention (SPA during joint attention) in TDC and children with ASD.

Group	Sample Size	Mean	SD	Std. Error Mean
TDC	3	39.67	17.67	10.20
ASD	3	14.33	22.23	12.84

4 Discussion

4.1 Quantity of joint attention

Children with ASD scored significantly less in frequency of RJA than TDC. The difference in IJA between the two groups was also statistically significant. Mundy and Newell (2007) proposed that these differences in RJA and IJA can be observed throughout the child's development.

Since joint attention skills develop by the age of three (Block et al., 2007), it can be hypothesised that any identified deficits in RJA and IJA will persist at later stages of development. Therefore, at a mean CA of 3;08 years, the group of children with ASD observed in this study would be inclined to engage in fewer instances of RJA and IJA.

When comparing quality of joint attention (SPA during joint attention) in pairs, the score for the child with ASD in Pair A exceeded the score of the typically-developing control by more than 10 scale points. However, in Pairs B and C, the TDC's scores exceeded the scores of the children with ASD by 30 and 60 scale points respectively. Table 7 lists the scores obtained.

Table 7. Means, standard deviations (SD) and standard error means for quality of joint attention (SPA during Joint Attention) in TDC and children with ASD.

Pair	Child	SPA score
A	TDC	28
	ASD	40
B	TDC	31
	ASD	2
C	TDC	60
	ASD	1

TDC showed fewer instances of RJA than IJA. However, the discrepancy between the two processes of joint attention was more pronounced in children with ASD. When comparing RJA to IJA, it is evident that even though both processes were significantly reduced in children with ASD, deficits in IJA were more severe. This discrepancy between the two processes is noticeable through p-values; with a p-value of 0.041 for RJA and 0.005 for IJA, the latter is decidedly more impaired. This result adheres to Mundy and Newell's (2007) statement that children with ASD engage more in RJA than in IJA, with deficits in IJA being more prominent and persistent. Since both processes were found to be impaired but to a different degree, this result corresponds with Mundy and Newell's (2007) finding that IJA and RJA are diverse yet related processes.

4.1.1 Pair A

RJA scores in Pair A were almost equal. Such a score could have occurred as a result of two possibilities. The child with ASD may have had minimal or even no impairment in RJA. The other possibility is that the child with ASD had a deficit in RJA which was masked or diminished by the mother's interactive and positively reinforcing method of play.

The frequency score for IJA was marginally more than half of that for RJA in the child with ASD. The discrepancy between the two processes was not as extensive in the typically-developing control. Such a result affirms the severity of impairment in IJA; even though RJA may only be minimally affected, IJA is still severely impaired.

4.1.2 Pair B

RJA scores varied in the typically-developing child and the child with ASD. However, the IJA scores were even more distinct. The child with ASD engaged nearly half as much in IJA as in RJA. This degree of impairment in IJA is congruent with the degree of impairment in the child with ASD in Pair A. RJA was more impaired in the child with ASD in Pair B than in Pair A.

4.1.3 Pair C

RJA and IJA scores were acutely reduced in the child with ASD. RJA in the typically-developing child was twice as much, while IJA scores were six times as much as the control's. IJA is a voluntary goal-oriented system which is reinforced and/or modified by the responder (Mundy & Newell, 2007). Through the video recording, it was noted that the interaction between the mother and child with ASD in Pair C was not reinforcing, thus influencing the child's performance. It can be argued that such a mode of interaction was adopted as a result of the child's social communication and social interaction difficulties. This chain of events was described by Abbott et al. (2004) as a 'negative feedback loop' resulting from an impairment in joint attention.

On the other hand, the typically-developing child in Pair C obtained a particularly high score in RJA, due to the interactive mode of play adopted by the child's parent. The interaction approach used demanded several RJA bids during playtime. This increase in RJA emphasised the differences in RJA between the two subjects within Pair C. Nevertheless, the child with ASD in Pair C did obtain the lowest scores in both IJA and RJA among all the subjects.

Even though all subjects with ASD obtained lower scores in both RJA and IJA than their typically-developing controls, the degree of impairment in the quantity of both RJA and IJA varied from one subject to another.

4.1.4 Non-verbal behaviours

The non-verbal behaviours which were most frequently used were identified through the adaptation of the Checklist of Non-verbal Communication (Agius, 2009). Statistically significant differences between the two groups were observed in IJA through manipulation of objects, IJA through eye-gaze and IJA and RJA through challenging behaviour.

In the TDC, joint attention was most frequently initiated through manipulation of objects. Since individuals with ASD have reduced quantity of joint attention, it was expected that the most frequently used behaviour in TDC would present with the largest discrepancy in use in relation to children with ASD.

When it comes to IJA through eye-gaze, this non-verbal behaviour was seldom used in the TDC and the children with ASD. Still, the resulting difference between the two groups was statis-

tically significant. In order to be scored, such a behaviour required verbal expression to attract the social partner's attention and transfer it to the object or event intended. Verbal abilities in the children with ASD were not at par with verbal abilities in the TDC. This factor may therefore reflect the use of verbal language during IJA through eye-gaze. Verbal skills were not assessed in the TDC and the children with ASD. Thus, claims made regarding their verbal abilities are based upon observations.

Challenging behaviour was only observed during interaction between children with ASD and their caregivers. Thus, the children with ASD engaged more in IJA and RJA through challenging behaviour than did the TDC. In addition, the use of negative expressions can impair social interaction between the child and communicative partner, resulting in a 'negative feedback loop' (McMahon, 2009).

4.2 Quality of joint attention

Quality of joint attention was assessed through the frequency of SPA during joint attention. The difference in mean scores for the two groups was not statistically significant. This result may have occurred due to a limited sample size. Another possibility is that SPA was measured according to frequency and not duration. Thus, a child who maintained SPA for a prolonged period of time during a single bid was scored the same as a child who momentarily used SPA during a bid.

4.2.1 Pair A

The child with ASD exceeded the typically-developing child in frequency of SPA. Yet, the typically-developing control did not have a low SPA score when compared to the TDC of Pairs B and C. The interaction between the caregiver and the child with ASD involved continuous positive reinforcement. This approach may have influenced the quality of joint attention.

4.2.2 Pair B

The difference in quality of joint attention between the two subjects was clearly visible within Pair B. The child with ASD engaged in SPA during joint attention in two instances, emphasising the deficit in quality of joint attention within the pair.

4.2.3 Pair C

The typically-developing control obtained a score of 60 joint attention bids which involved SPA. Such a high score stands to reason since this child engaged in a large number of joint attention bids, especially RJA. However, the child with ASD only engaged once in SPA during joint attention. This subject was also the one to engage least in joint attention bids. In addition, the interaction between mother and child did not include positive reinforcement, which fact could have influenced the result obtained.

Among the three subjects with ASD, two showed severely impaired SPA during joint attention. In fact, these subjects engaged more in either neutral or negative behaviours. Previous research identifies shared negative affect as not being a reliable determiner for identifying differences in joint attention between TDC and children with ASD (Kasari et al., 1990; McMahon, 2009). Thus, by elimination, children with ASD who seldom engage in SPA often engage in neutral behaviour. McMahon (2009) stated that both negative and neutral behaviours act as a 'negative feedback loop' in the interaction between communicative partner and child. Parents of children with ASD whose SPA during joint attention was low, engaged in fewer instances of positive reinforcement. The process of reinforcement was not measured, but was observed during the viewing of the recordings.

4.3 The association between the quality and quantity of joint attention in children with Autism Spectrum Disorder

No association between the two aspects of joint attention was found. The two subjects with ASD from Pairs A and B engaged in similar quantities of IJA and RJA. However, their scores in SPA during joint attention were decidedly diverse; 40 and 2 respectively. In addition, children with ASD in Pairs B and C obtained similar scores in SPA during joint attention; 2 and 1 respectively. However, their scores in quantity of joint attention varied.

5 Conclusion

The quantity of both IJA and RJA was found to be impaired in the subjects with ASD, confirming current theoretical knowledge. In addition, deficits in IJA were more profound than deficits in RJA. The quality of joint attention was not affected in children with ASD. However, when evaluating the children's performance individually, two of the three children with ASD showed a deficit in quality of joint attention. The other child with ASD did not show such an impairment. The quality of joint attention in children with ASD is seldom researched and evaluated. Thus, further research is required to determine accurate profiles of joint attention in children with ASD, particularly in quality of joint attention. In order to establish a holistic measure of the child's abilities, the quality of joint attention may be assessed in various contexts and with different social partners. In addition, identifying correlations between the two aspects of joint attention is also beneficial to understand the nature of such a skill, its effect on children with ASD and even on their interactive partners. Furthermore, future research should investigate the influence of the caregiver's interaction with the child on the child's joint attention skills, particularly in relation to the 'negative feedback loop'. Intervention can improve both quality and quantity of joint attention. However, accurately identifying such aspects of joint attention paves the way to developing an effective, evidence-based intervention programme which targets both quantity and quality of joint attention.

6 Funding

This research has received no specific grant from any funding agency in the public, commercial or non-profit sectors.

7 Conflicts of interest

The authors report no conflicts of interest.

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