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The perception of integrated events in Autism Spectrum Disorders: The role of semantic relatedness and timing

by

Venetia Bakirtzi

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Advisory committee:

Athanassios Protopapas, Associate Professor, Department of Philosophy and History of Science

Argiro Vatakis, Researcher, Cognitive Systems Research Institute

Konstantinos Moutoussis, Associate Professor, Department of Philosophy and History of Science

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ΕΘΝΙΚΟ ΚΑΙ ΚΑΠΟΔΙΣΤΡΙΑΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

ΤΜΗΜΑ ΜΕΘΟΔΟΛΟΓΙΑΣ, ΙΣΤΟΡΙΑΣ ΚΑΙ ΘΕΩΡΙΑΣ ΤΗΣ ΕΠΙΣΤΗΜΗΣ

ΤΜΗΜΑ ΠΛΗΡΟΦΟΡΙΚΗΣ ΚΑΙ ΤΗΛΕΠΙΚΟΙΝΩΝΙΩΝ

ΤΜΗΜΑ ΝΟΣΗΛΕΥΤΙΚΗΣ

ΤΜΗΜΑ ΦΙΛΟΣΟΦΙΑΣ, ΠΑΙΔΑΓΩΓΙΚΗΣ ΚΑΙ ΨΥΧΟΛΟΓΙΑΣ

& ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

ΤΜΗΜΑ ΠΛΗΡΟΦΟΡΙΚΗΣ

Η αντίληψη των ενοποιημένων γεγονότων στις διαταραχές του αυτιστικού φάσματος: Ο ρόλος της εννοιολογικής σχέσης και του χρονισμού

της

Βενετίας Μπακιρτζή

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Βασική και Εφαρμοσμένη Γνωσιακή Επιστήμη

Επιβλέποντες:

Αθανάσιος Πρωτόπαπας, Αναπληρωτής καθηγητής, τμήμα Μ.Ι.Θ.Ε., Εθνικό & Καποδιστριακό Πανεπιστήμιο Αθηνών

Αργυρώ Βατάκη, Ερευνήτρια, Ερευνήτρια στο Ινστιτούτο Γνωσιακής Έρευνας και Τεχνολογίας

Κωνσταντίνος Μουτούσης, Αναπληρωτής καθηγητής, τμήμα Μ.Ι.Θ.Ε., Εθνικό & Καποδιστριακό Πανεπιστήμιο Αθηνών

Αθήνα

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The thesis is approved

Athanassios Protopapas .....

Argiro Vatakis.....

Konstantinos Moutoussis.....

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Contents

Abstract

The aim of the present study was to dissociate the timing and integration mechanisms in Autism Spectrum Disorders (ASD). We utilized an identical set of stimuli in two different tasks - a reaction time (RT) and a simultaneity judgment (SJ) task. Each task tapped at different hypothesized processes. Through the RT task, we examined the multisensory integration of ASD children as compared to a control group. Participants were asked to complete a speeded detection of two targets, presented unimodally (auditory or visual) or bimodally (audiovisual) in a congruent or incongruent format. The SJ task examined the temporal sensitivity in multisensory events of the above-mentioned groups. Based on recent findings, it was expected that timing and integration processes would be different rather the same and that ASD individuals would present integration and timing impairments. Finally, we examined the relationship between autism and Attentional Deficit Hyperactivity Disorders (ADHD) symptoms with participants' performance in both tasks. Results showed that timing and integration processes are different but interconnected. ASD participants revealed unimpaired multisensory integration in the RT task and impaired timing in SJ task. The latter timing impairments affected participants' integration capabilities with patients performing similarly for matching and mismatching presentations. Finally, there was a positive relationship of autistic and ADHD symptoms with both RT and the SJ tasks, indicating that autistic symptoms could be an index for slower multisensory integration and perception of synchrony impairments, however, in any case ADHD symptoms involvement should be also taken into account.

Keywords: Autism spectrum disorders; Audiovisual perception; Multisensory processing; Synchrony perception; Audiovisual integration.

Περίληψη

Ο σκοπός της παρούσας έρευνας ήταν να διαχωρίσουμε τους μηχανισμούς του χρονισμού και της πολυαισθητηριακής απαρτίωσης στις διαταραχές του αυτιστικού φάσματος. Χρησιμοποιήσαμε όμοια ερεθίσματα σε δύο διαφορετικά έργα, όπου το κάθε έργο σχετιζόταν με τις διαφορετικές ενδεχόμενες λειτουργίες. Στο πρώτο έργο (έργο χρόνου απόκρισης), εξετάσαμε την πολαυαισθητηριακή απαρτίωση σε παιδιά με αυτισμό συγκριτικά με μία ομάδα ελέγχου. Οι συμμετέχοντες κλήθηκαν να εντοπίσουν δύο στόχους που παρουσιάζονταν μονοτροπικά ή διτροπικά όσο το δυνατόν γρηγορότερα. Στο δεύτερο έργο (έργο κρίσης συγχρονίας) εξετάσαμε την χρονική ευαισθησία σε πολυαισθητηριακά γεγονότα στους ίδιους συμμετέχοντες. Υποθέσαμε ότι οι μηχανισμοί του χρονισμού και της απαρτίωσης θα είναι διαφορετικοί, και ότι οι συμμετέχοντες με αυτισμό θα παρουσίαζαν ελλείμματα στην απαρτίωση και στον χρονισμό σύμφωνα με προηγούμενες έρευνες. Τέλος, εξετάσαμε την σχέση των αυτιστικών συμπτωμάτων και της επίδοσης των συμμετεχόντων στα δύο έργα. Τα αποτελέσματα έδειξαν ότι οι διεργασίες της απαρτίωσης και του χρονισμού πράγματι διαφέρουν. Οι συμμετέχοντες με αυτισμό δεν εμφάνισαν ελλείμματα στην πολυαισθητηριακή απαρτίωση στο έργο χρόνου απόκρισης, αλλά στον χρονισμό στο έργο κρίσης συγχρονίας. Ωστόσο, τα ελλείμματα στο χρονισμό επηρέασαν την ενοποίηση. Τέλος, δείξαμε την σχέση των αυτιστικών συμπτωμάτων με τα δύο έργα, τα οποία θα μπορούσαν να αποτελέσουν δείκτη για πιο αργή πολυαισθητηριακή επεξεργασία και για ελλείμματα στον χρονισμό.

Λέξεις κλειδιά: Διαταραχές του αυτιστικού φάσματος, οπτικοακουστική αντίληψη, πολυαισθητηριακή επεξεργασία, οπτικοακουστική απαρτίωση, χρονισμός.

1. Introduction

1.1 Autism

Autism Spectrum Disorder (ASD) is one of the most common pervasive neurodevelopmental disorders characterized by deficits in communication and social behaviors and the presence of stereotyped, repetitive movements (American Psychiatric Association [APA], 2013). Rogers and Ozonoff (2005) proposed that these ASD impairments may be the result of ineffective processing of sensory inputs (Kwakye et al., 2011). A number of studies have investigated how sensory inputs are combined in ASD, however, their findings did not always converge, resulting in ambiguities on ASD multisensory processing capabilities (Vatakis & Allman, 2015). Therefore, the unisensory and multisensory processing findings from research in ASD have not been completely clarified and further research on the topic should be conducted.

1.2 Multisensory processing in ASD: Timing and Semantics

Starting from nascence, the world is perceived through the combination of all sensory inputs. Multisensory integration is the process by which multiple sensory inputs are merged to form a unified representation of an object (e.g., Iarocci & McDonald, 2006). Thus, multisensory integration capacity in an individual's development is very important (Wallace et al., 2004). This process seems to be altered or impaired in ASD population (Foxe et al., 2013) and it remains unclear whether ASD individuals are impaired in terms of timing and/or binding.

Initial empirical studies on multisensory temporal processing in ASD have focused on the investigation of simple stimulus paradigms (e.g., Foss-Feig et al., 2010; Kwakye et al., 2011; van der Smagt et al., 2007). For example, van der Smagt et al. (2007) examined low-level multisensory integration in high-functioning adults with ASD (M~20.5 years of age for

both groups, intelligence quotient, IQ, matched, ASD diagnosis: autistic disorder, Asperger's syndrome) using the double flash illusion (where an individual perceives multiple flashes when a single flash is accompanied by several beeps; see Shams et al., 2000). Specifically, they presented three visual stimuli (flashes) with or without auditory stimulation (beeps) in four different conditions (no sound, one beep, two beeps, three beeps). Participants had to indicate the number of perceived flashes by pressing three response keys. The performance of the individuals with ASD was no different from that of typical developing (TD) individuals, suggesting no specific ASD impairment in the integration of low-level multisensory stimuli. In a similar study, Foss-Feig et al. assessed and compared the temporal window of audiovisual integration (the time window within which an audiovisual event is perceived as unified; see Vatakis & Allman, 2015; Wallace et al., 2004) of adolescents with and without ASD with full scale IQ above 70 (M~12 years of age for both groups, age range: 8-17 years old, ASD diagnosis: autistic disorder, pervasive developmental disorder, Asperger's syndrome) and found that the ASD group experienced the illusion for a temporal window that was two times larger from that observed in the TD individuals. The authors attributed these findings to poor visual acuity given the tendency of the ASD group to report one flash in the 2 flash-0 beep conditions (Foss-Feig et al., 2010). However, no evaluation of visual acuity was conducted. In a subsequent study, Kwakye and colleagues (2011) replicated Foss-Feig et al.'s (2010) illusory findings in a group of high-functioning adolescents with ASD and in a group without ASD (M~12 years of age for both groups, age range: 8-17 years old, ASD diagnosis: autistic disorder, pervasive developmental disorder, Asperger's syndrome). They also defined unisensory temporal thresholds for each of their participants using a temporal order judgment (TOJ) task (i.e., participants had to report the order of presentation of the two sensory streams). Their results showed no differences in the visual TOJ task, but higher thresholds in the auditory TOJ task for the ASD group. They supported that these auditory timing

alterations could also influence multisensory processing and result in the wider temporal window of integration observed (Kwakye et al., 2011).

Given the association of ASD with social related impairments and potential abnormalities with complex stimulus processing (e.g., Dawson et al., 1998), recent studies have also experimented with audiovisual speech and non-speech stimuli (Bebko et al., 2006; de Boer-Schellekens et al., 2013; Foxe et al., 2013; Grossman et al., 2009; Stevenson et al., 2014). For instance, in Bebko et al.'s (2006) study, 4 to 6 year-old children (ASD diagnosis: autistic disorder, pervasive developmental disorder) were assessed using a preferential looking paradigm on looking time for identical audiovisual events (non-linguistic, simple linguistic, and complex linguistic stimuli) in or out of synchrony. Results showed that ASD children's looking time was similar to that of TD children for the non-linguistic stimuli, but significantly different for linguistic stimuli, implying ineffective multisensory processing of speech. They also assessed the looking away time for the three types of stimuli, showing that participants had the tendency to look away more frequently for the non-linguistic stimuli than for the simple linguistic. However, no group interaction was found. As for the asynchronous looking time, the ASD group did not show a clear preference either to synchronous or to asynchronous displays (Bebko et al., 2006).

Focusing on audiovisual speech (i.e., a woman telling everyday common phrases) and using an SJ task (i.e., participants had to report whether the presentation of two streams were in synchrony or not), Grossman et al. (2009) found no impairment of audiovisual integration in adolescents with high-functioning ASD (M~14,5 years old, age range: 12-16 years old, ASD diagnosis: autistic disorder). On the other hand, de Boer-Schellekens et al. (2013) reported impaired multisensory integration in ASD for both speech and non-speech stimuli. The latter study utilized an audiovisual TOJ task for three types of stimuli - a flash/beep, a handclap, and a person uttering syllables. The performance of the ASD group (M~19 years

old for both groups, age range: 16-22 years old, ASD diagnosis: autistic disorder, pervasive developmental disorder, Asperger's syndrome) was lower in sensitivity for all types of stimuli compared to the TD group, indicating a difficulty in judging the temporal order, which, in turn, lead to a wider temporal window of integration (de Boer-Schellekens et al., 2013). Utilizing three types of stimuli, Stevenson et al.'s (2014) study examined whether low-level multisensory temporal processing is correlated to impaired audiovisual speech integration in children with ASD. For this purpose, they first conducted SJs in order to assess the temporal window of integration for the different stimuli utilized (flashes/beeps, dynamic handheld tools, syllables utterances). Participant age varied from 6 to 18 years old (M~12 years old for both groups, ASD diagnosis: autistic disorder, pervasive developmental disorder, Asperger's syndrome). Analysis of the data revealed that individuals with ASD showed decreased temporal acuity compared to the TD group for speech stimuli, however, no difference was found for simple and non-speech stimuli. Subsequently, they examined the strength of the McGurk illusion (the influence of vision of audiovisual speech perception; McGurk & MacDonald, 1976) with all the sensory steams presented in synchrony. The ASD group was significantly less likely to report the McGurk illusion compared to the TD group (61 vs. 79%, respectively) with the tendency to report the auditory speech, suggesting weaker binding for audiovisual speech. The authors also measured unisensory temporal processing through a TOJ task for simple auditory and visual stimuli. These results showed unimpaired striking similarities between TD and ASD groups in auditory and visual temporal processing, strengthening the notion of ineffective multisensory processing rather than unisensory deficits. They also found significant correlations between the strength of McGurk effect with the temporal window of integration measured using flash-beeps in ASD group. According to these results, the authors concluded that as the temporal window of integration becomes longer, the integration of audiovisual speech becomes weaker, emphasizing also the strong

association of low-level multisensory processing and the strength of integration (Stevenson et al., 2014).

In an effort to investigate the developmental trajectory of multisensory speech integration in ASD, Foxe et al. (2013) assessed speech-in-noise abilities between 3 different aged-groups (7-9, 10-12, 13-15) with high-functioning ASD, utilizing 300 simple monosyllabic words spoken by a female woman in three conditions (auditory, visual, and audiovisual) and the participants had to report which word they heard or saw. The results showed not only that multisensory deficits in ASD were not due to unisensory capabilities but also that they are present at the initial stages of speech acquisition with higher severity in younger children. Interestingly, the differences between ASD and TD groups for 7-9 and 10-12 years of age were statistically significant in reporting the syllables, however there was no statistical significance for the 13-15 age group, showing a possible ASD catch up to the TD group and a steep increase of speech multisensory integration for individuals with ASD (Foxe et al., 2013).

Apart from the above empirical research, Marco et al.'s (2011) review pointed out the potential link between deficits in low-level multisensory processing and autistic symptoms. For this reason, Donohue et al. (2012) tested the association between ASD symptomatology (through a self-reported questionnaire) and low-level multisensory processing. Using the Autism Spectrum Quotient (ASQ; see Baron-Cohen et al., 2001) questionnaire they assessed a non-clinical group's scores (M~21 years of age, age range: 17-24 years old) in 5 skills (social skills, attentional switching, attention to detail, communication and imagination). After the completion of the questionnaire, the group participated in an SJ task with low-level multisensory stimuli (a black and white checkerboard pattern for the visual component and a 1200Hz tone for the auditory component). The participants had to judge whether the presentation of the stimulus was in synchrony or not. In order to assure that the ASD

symptomatology was linked to the SJ task and not to other parameters (e.g., attention), they also used another questionnaire on Attention deficit hyperactivity disorder (ADHD; see Jasper & Goldberg, 1993), as well as a video game playing habits (i.e., a video game created in order to measure participants' expertise in perceiving temporal asynchronies). Through the ADHD quotient and the video game participation, they wanted to eliminate the involvement of other symptoms that could affect multisensory processing. Their results indicated a correlation between high ASQ scores to auditory-first tendency in responding, indicating not only a relationship between autistic symptoms and multisensory processing but also a left shifted temporal window of integration (Donohue et al., 2012).

1.3 Limitations in multisensory research on ASD

The discordance across the previous research could be the result of several factors. One factor could be the participants' age-range. Several studies were conducted with the participation of a wide age-range of ASD participants (e.g., de Boer-Schellekens et al., 2013; Foss-Feig et al., 2010; Kwakye et a., 2011; Stevenson et al., 2014). However, recent empirical evidence has shown a developmental trajectory in multisensory processing during childhood (e.g., Foxe et al., 2013; Tremblay et al., 2007) that was not taken into account until recently (e.g., de Boer-Schellekens et al., 2013; Foss-Feig et al., 2010; Kwakye et a., 2011; Stevenson et al., 2014). Thus, these developmental differentiations could have led to the different findings noted in previous research (Vatakis et al., 2015). Another factor could be the wide variety of autistic symptoms in ASD population. The lack of homogeneity in ASD individuals' symptoms entails difficulties in drawing reliable conclusions as long as the wide variety of symptoms in many skills can affect different cognitive functions (Donohue et al., 2012). Furthermore, in many cases there is a co-occurrence of ASD and other disorders (comorbidity) that affects participants' performance. For this reason, it is difficult to reach concrete conclusions given that it is not clear whether participants' performance is due to

ASD or due to other disorders (e.g., ADHD; see Craig et al., 2016). An additional factor could also be the different type of tasks used (preferential looking, verbal reporting, TOJ, SJ; see Vatakis & Allman, 2015). For instance, previous work has shown that TOJ and SJ tasks have differential sensitivity for the just noticeable difference (JND) and the point of subjective simultaneity (PSS; Vatakis et al., 2008). Thus, the convergence of estimates of the temporal window of integration through SJ and TOJ is poor (Vroomen et al., 2010). Finally, it remains unresolved whether multisensory processing impairment or alteration in ASD is due to timing or integration attributes (Vatakis et al., 2015). Freeman et al. (2013) through a case study indicated that optimal integration does not depend on achieving subjective synchrony; a consensus view that is taken for granted in most of the research in multisensory processing. According to evidence that mechanisms that underlie perception of synchrony and multisensory integration are distinct rather than common (Freeman et al., 2013; Tsilionis et al., 2016), it may be the case that timing alone but not integration per se is impaired in ASD (Vatakis & Allman, 2015), and thus, further examination of these two processes is necessary.

1.4 Current study

The aim of our study is to further examine the nature of the potential timing and integration deficits in ASD and, specifically, whether these deficits are the result of ineffective integration or impaired timing. We designed an experiment using two different tasks (RT and SJ task) but identical stimuli in order to examine the capacity of ASD participants in multisensory integration through the RT task and the perception of synchrony through the SJ task. ASD participants took part in both tasks and their performance was compared to corresponding TD individuals.

In the RT task, we utilized the ideas posed by the “unity effect”, where informational relatedness leads to a difficulty to separate in time multisensory events along with the ideas of multisensory processing (Laurienti et al., 2004; Vatakis et al., 2007). Specifically, we

modulated Laurienti et al.'s design who demonstrated that semantically congruent audiovisual stimuli result in enhanced behavioral performance, whereas semantically incongruent do not. Moreover, we took advantage of Vatakis et al.'s findings about the strength of integration without a timing component. In particular, using a TOJ task, Vatakis et al. provided evidence that individuals find it harder to judge whether audition precedes or follows when presenting audiovisual matching stimuli in different SOAs than in mismatching conditions. The RT task provided evidence whether ASD participants are impaired in integration (without a timing component), while comparing their RTs to a TD group. It was also expected that semantically audiovisual mismatching conditions will show greater response latencies compared to the audiovisual matching conditions. Analysing their RTs to the unimodal conditions, this task also provided further information on unisensory vs. multisensory processing in ASD in comparison to the control group. In the SJ task, using several SOAs we tested ASD participants' timing sensitivity in matching and mismatching conditions (see also Grossman et al., 2009). Through the SJ task, we examined whether ASD participants exhibit abnormalities in perceiving temporal asynchronies within and out of the temporal window of integration or not. We also tested whether ASD individuals are capable of binding audiovisual information by comparing their responses in matching and mismatching conditions. Finally, we collected additional information via questionnaires to the participants' parents. The questionnaires were used in order to obtain demographical data, autistic behavioral data (ASQ; see Baron-Cohen et al., 2001), and ADHD related behaviors (see Jasper & Goldberg 1993). Combining the questionnaires' data with the participants' performance, we aimed to provided further information about the relationship of specific subscales of ASQ and ADHD quotient scores and participants' performance in both tasks.

2. Experiment 1

Methods

Participants

Participants included 6 ASD (5 male and 1 female) and 6 TD (4 male and 2 female) age-matched individuals (age range: 8-15 years of age). All of the participants reported normal hearing and normal or corrected-to-normal visual acuity.

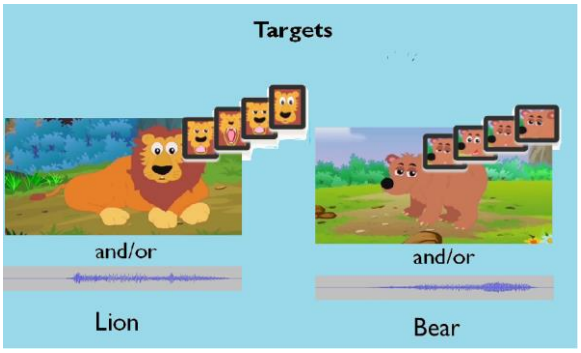
Apparatus and materials

The procedure took place for each participant in a quiet and familiar room. The visual stimuli were presented on a 15.6-inch (39.62 cm) Dell Latitude laptop monitor (1366 x 768 pixel resolution; 60-Hz refresh rate) controlled by Presentation software (Version 0.70, Neurobehavioral Systems Inc., CA). The screen was placed at eye level, approximately 60 cm in front of the participants. The auditory stimuli were presented via the laptop's speakers. The video clips (640 x 480 pixels, ACC stereo sound at 48000 Hz) were processed using Adobe Premier Pro. The clips were composed of the following stimuli: (a) a bear, (b) a lion (c) a goat (see Figure 1). All stimuli were presented in synchrony either unimodally (visual or auditory presentation of each stimulus) or multimodally. All clips had a duration of 1.14 s. That is, the duration of all the stimuli was the same so as to avoid potential confounds due to stimulus duration differences. All of the video clips were recorded under the same conditions with the mouth starting and ending in a closed position.

Design

On each trial, participants were presented with the visual stimulus alone, the auditory stimulus alone or the combined visual/auditory stimulus in a matching or mismatching format (see Figure 1). After each stimulus display, a fixation cross was presented in the middle of the screen for 4000 ms or until participant response. If no response was given within 4000 ms, a miss response was recorded and the experiment continued to the next trial. Each block consisted of two targets (bear and lion) and an irrelevant stimulus (goat) that participants had to ignore. Specifically, the bear and the lion were the task targets, where the participants had

to respond by pressing two different buttons of the keyboard corresponding to each animal whether presented unmodally or multimodally. They had to press the B key for the bear and the L key for the lion. The goat was set as the irrelevant stimulus, where the participants were instructed not to press any button. The matching conditions consisted of the same animal's streams (e.g., visual and auditory bear) and the mismatching conditions consisted of a target's stream and an irrelevant stimulus' stream (e.g., visual goat and auditory bear). In the mismatching conditions, the participants still had to press the corresponding button for the target (lion or bear). The above setup is an adaptation of Laurienti et al.'s (2004) work. The total number of conditions was 13 presented randomly 4 times in each block. All blocks were 3 in total (156 trials in total).

a) 

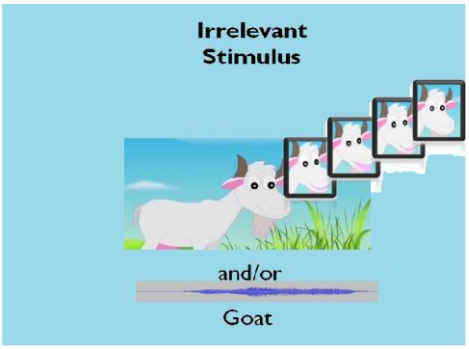
b) 

Figure 1. Stimuli presented audiovisually, visually or auditorily in the RT task: a) The lion and the bear were the targets of the task, while b) the goat was the irrelevant stimulus that participants had to ignore.

Procedure

Before participating in the experiment, participants' parents were asked to complete a questionnaire, which was composed of three different parts (see Appendix I). The first part referred to participants' general information such as date of birth, specific diagnosis, intelligence score testing etc. The second part was the ASQ – children's version (Baron-Cohen et al., 2001) translated in Greek that is used as a screening measure for symptoms of

autism (e.g., Donohue et al., 2012). This was completed in order to compare the differences between participants' behavior and disorder symptomatology (e.g., social skills, attention switching, communication, imagination, attention to detail; Baron-Cohen et al., 2001). The third and final part referred to the potential presence of attention-deficit hyperactivity symptoms through the Attention-Deficit Hyperactivity Disorder questionnaire (ADHD quiz; Grohol, 2016) translated in Greek. The ADHD questionnaire's scores were used to test the potential relationship between participants' ADHD symptoms and their behavioural performance. This questionnaire was used so as to compare the differences on the ADHD symptomatology within the participants and between the ASD and TD groups given that behaviour may be confounded by potential ADHD symptomatology.

The participants were informed that they would be presented with a series of videos of three animals. They were asked to press the "B" key in any case they see, hear or see and hear the bear, the "L" key in any case they see, hear or see and hear the lion, and no key in any case they see, hear or see and hear the goat. In the cases where the goat appeared combined with the targets' components, the participants had to press the corresponding target button. In the beginning, the participants underwent a practice block of 8 trials before the main experiment, ensuring that the participants have understood the instructions. Whenever needed, the practice block was presented more than once. After the practice block, 3 blocks followed and each block was separated in two parts by a break, so that participants did not get tired.

Results

RT data analysis

Two measures were extracted from the participants' data: mean accuracy and RT. Accuracy denoted the percentage of participants' correct responses and RT denoted the interval needed to correctly press the key after the presentation of each stimulus.

Accuracy responses

We ran a mixed design analysis of variance (mixed ANOVA) with the within-subjects factors of Stimulus Type (bear, lion) and Match (matching, mismatching) and the between-subjects variable of Group (ASD, TD). In all analyses of variances Bonferroni corrected t-tests were used. The analysis revealed a significant main effect of Match [$F(1,10) = 5.76$, $p = 0.037$, $\eta^2 = 0.37$; Greenhouse-Geisser correction], where participants were more accurate in the matching condition ($M = 0.96$) than in the mismatching condition ($M = 0.81$; see Figure 2). There was no main effect of Stimulus Type [$F(1,10) = 0.13$, $p = 0.725$, $\eta^2 = 0.01$] and Group [$F(1, 10) = 1.39$, $p = 0.266$, $\eta^2 = 0.12$] or interaction of Match and Group [$F(1,10) = 0.26$, $p = 0.625$, $\eta^2 = 0.03$], Stimulus Type and Group [$F(1,10) = 0.13$, $p = 0.729$, $\eta^2 = 0.01$], and Match, Group, and Stimulus type [$F(1,10) = 0.42$, $p = 0.531$, $\eta^2 = 0.04$].

We also ran a mixed design analysis of variance (mixed ANOVA) with the within-subject factors of Stimulus Type (bear, lion), Modality (AV, A, V), and the between-subject factor of Group (ASD, TD). The main effects of Modality [$F(2,20) = 3.61$, $p = 0.061$, $\eta^2 = 0.27$], Stimulus Type [$F(1,10) = 0.63$, $p = 0.444$, $\eta^2 = 0.6$], and Group [$F(1,10) = 3.54$, $p = 0.09$, $\eta^2 = 0.22$], and the interactions of Stimulus Type and Group [$F(1,10) = 0.39$, $p = 0.546$, $\eta^2 = 0.004$], Modality and Group [$F(2,20) = 1.43$, $p = 0.264$, $\eta^2 = 0.013$], and Stimulus Type, Modality and Group [$F(2,20) = 0.12$, $p = 0.804$, $\eta^2 = 0.01$] were not significant.

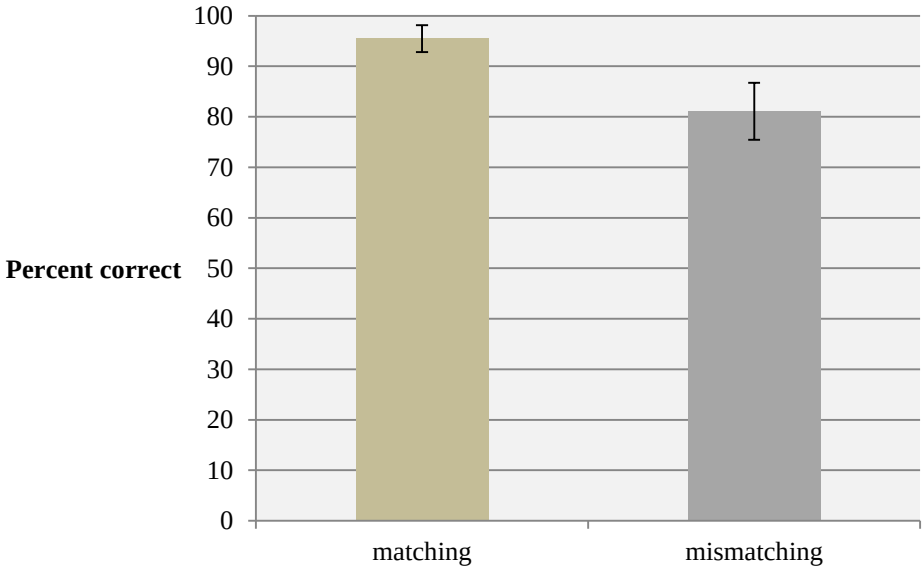


Figure 2. The mean percentage of correct responses in matching and mismatching conditions showing that participants overall were more accurate in the matching than in the mismatching condition.

RT responses

We ran a mixed design analysis of variance (mixed ANOVA) with the within-subjects factors of Stimulus Type (bear, lion) and Match (matching, mismatching) and the between-subject factor of Group (ASD, TD). The between-subjects factor of Group was significant [$F(1,10) = 7.99$, $p = 0.018$, $\eta^2 = 0.44$; Greenhouse-Geisser correction], revealing that the ASD ($M = 1851.7$ ms) group was slower in responding than the TD group ($M = 1245.94$ ms; see Figure 3). The main effects of Stimulus Type [$F(1,10) = 0.00$, $p = 0.97$, $\eta^2 = 0$] and Match [$F(1,10) = 1.57$, $p = 0.238$, $\eta^2 = 0.14$] as well as the interactions of Stimulus Type and Group [$F(1,10) = 1.89$, $p = 0.199$, $\eta^2 = 0$], Match and Group [$F(1,10) = 0.01$, $p = 0.937$, $\eta^2 = 0.001$], and Stimulus Type, Match, and Group [$F(1,10) = 4.42$, $p = 0.062$, $\eta^2 = 0.31$] were not significant.

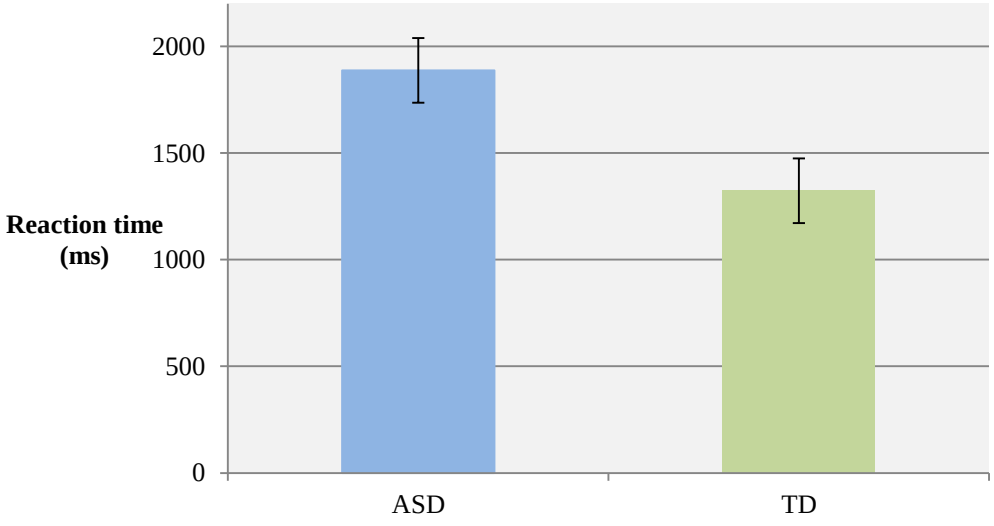


Figure 3. The mean RTs of the ASD and TD group for both matching and mismatching conditions for all stimulus types (bear and lion), showing ASD individuals to be slowed in responding than the TD group.

We also ran a mixed design analysis of variance (mixed ANOVA) with the within-subjects variables of Stimulus Type (bear, lion), Modality (AV, A, and V), and the between-group variable of Group (ASD, TD). The analysis revealed a marginally significant effect of Modality [$F(2,20) = 4.47$, $p = 0.054$, $\eta^2 = 0.31$; Greenhouse-Geisser correction], with participants' responses in AV condition being faster (M = 1473.5 ms) than in A (M = 1761.99 ms) and in V (M = 1539.43 ms) conditions (see Figure 4). A significant main effect of Group [$F(1,10) = 7.98$, $p = 0.018$, $\eta^2 = 0.45$; Greenhouse-Geisser correction] was also obtained, where the TD group (M = 1317.59 ms) was significantly faster than the ASD group (M = 1865.69 ms; see Figure 5). The main effects of Stimulus Type [$F(1,10) = 0.07$, $p = 0.798$, $\eta^2 = 0.01$] as well as the interactions of Stimulus Type and Group [$F(1,10) = 1.6$, $p = 0.234$, $\eta^2 = 0.14$], Modality and Group [$F(2,20) = 1.82$, $p = 0.206$, $\eta^2 = 0.15$], and Stimulus Type, Modality, and Group [$F(2,20) = 0.86$, $p = 0.394$, $\eta^2 = 0.08$] were not significant.

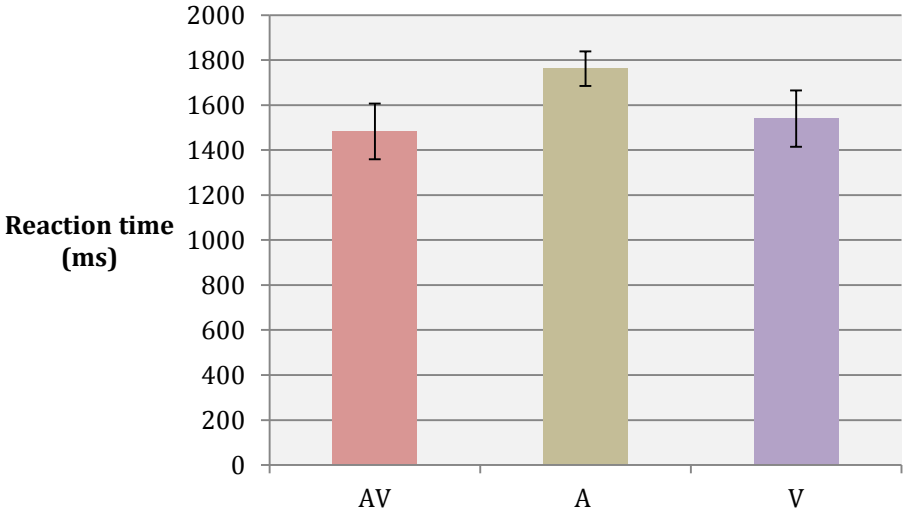


Figure 4. Participants RT responses in audiovisual (AV), auditory (A) and visual (V) conditions, showing that participants overall were faster in audiovisual responses than in auditory and the visual alone.

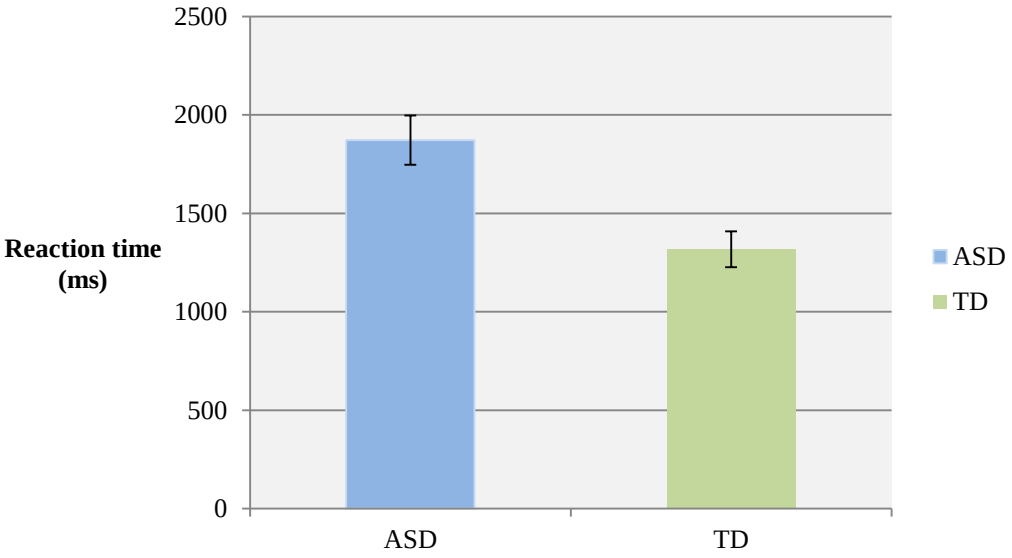


Figure 5. ASD and TD participants mean RT for bimodal and unimodal conditions, showing that ASD participants were slower in responding for both bimodal and unimodal conditions than TD participants.

3. Experiment 2

Methods

Participants, Apparatus, and Materials

The same group of ASD and TD participants took part in Experiment 2. The apparatus and the location of the experiment were exactly the same as in Exp. 1. For the SJ task, the stimuli of the lion and the bear and their corresponding animal calls were presented under various stimulus onset asynchronies in a matched and mismatched format. The duration of all stimuli was the same as in Exp. 1.

Design

All of the stimuli were presented audiovisually in synchrony or out-of-synchrony. Each stimulus (animal) was presented either with its corresponding sound or with the other's stimulus (animal) sound. In particular, the lion's video was presented either with the lion's or the bear's call and vice versa; that is, 4 combinations in total. There were 13 different SOAs between the auditory and the visual component for each audiovisual stimulus. The SOAs were selected based on previous research (e.g., similar to Foss-Feig et al., 2010) and were at 0, ±100, 170, 230, 330, 470, 600 ms for all the congruent and the incongruent conditions. Negative SOAs signify that the auditory component of the stimuli preceded the visual component. According to previous research (e.g., Foss-Feig et al., 2010; Grossman et al., 2009), the SOAs were chosen to be inside and outside the temporal window of integration of a typical and a non-typical participant. The experiment consisted of three blocks and in each block, every condition appeared once with a total of three repetitions.

Procedure

The participants were informed that they would be presented with just the audiovisual target-animals of the lion and the bear. However, in some of the trials the animals will be

presented with the call of the other animal (visual bear/auditory lion or visual lion/auditory bear). In each trial, they had to judge whether the presentation of the visual and the audio were in synchrony or out of synchrony by pressing two buttons, the "Z" key for synchrony and the "M" key for asynchrony. Before the beginning of the experiment, a familiarization block of 8 practice trials took place. Whenever needed, the familiarization block was shown more than once but no more than three times. Three blocks followed the practice block and each block was separated in two parts by a break.

Results

SJ results

All participants' responses were transformed into proportion of synchrony responses for all 13 SOAs in matching versus mismatching conditions of the two different stimulus types (bear, lion). We attempted to extract the PSS (the point where observers are maximally unsure about the asynchrony presented; see Keetels et al., 2011), however, because of the large PSS obtained in the clinical group, we ran an analysis on the participants' actual performance scores. We ran a mixed design analysis of the within-subject factors of Stimulus Type (bear, lion), Match (matching, mismatching), and SOA (0, ±100, 170, 230, 330, 470, and 600 ms) and the between subjects factor of Group (ASD, TD). The analysis revealed a main effect of SOA [$F(12,120) = 10.3$, $p < 0.001$, $\eta^2 = 0.51$; Greenhouse–Geisser correction], where participants' synchrony reports in the SOAs ±100 ms (M = 0.69 and 0.70, the latter refers to the positive SOA) and 0 ms (M = 0.67) were higher as compared to ±600 ms (M = 0.31 and 0.32, the latter for the positive SOA) and -470 ms (M = 0.40). Similarly, participants' synchrony responses in -230 ms (M = 0.65) and -170 ms (M = 0.69) were higher than those for -470 ms (M = 0.40), and synchrony responses in +600 ms (M = 0.32) were lower than those in -170 ms (M = 0.69). Participants also reported higher synchrony responses in -170 ms (M = 0.69) and 0 ms (M = 0.67) as compared to +470 ms (M = 0.35). Furthermore,

a significant interaction of Match and Stimulus Type [$F(1,10) = 5.4$, $p = 0.042$, $\eta^2 = 0.35$] was obtained with participant' synchrony responses for the bear stimulus in matching condition ($M = 0.64$) being significantly higher for synchrony as compared to matching for lion ($M = 0.46$; $p = 0.02$). Moreover, a significant interaction of SOA and Group [$F(12,120) = 8.23$, $p < 0.001$, $\eta^2 = 0.45$; Greenhouse-Geisser correction] was obtained. Specifically, ASD' proportion of synchrony responses in SOAs ±600 ms ($M = 0.51$ and .50, latter for positive SOA) and ±470 ms ($M = 0.56$ and 0.49, latter for positive SOA) was higher than that noted for the TD group ($M = 0.11$, 0.21, 0.25, and 0.14, respectively). Moreover, in the conditions of ±100 and 0 ms the ASD group had lower reports in synchrony ($M = 0.57$, 0.57, and 0.46, respectively) as compared to the TD group ($M = 0.81$, 0.83, and 0.88, respectively; see Figure 6).

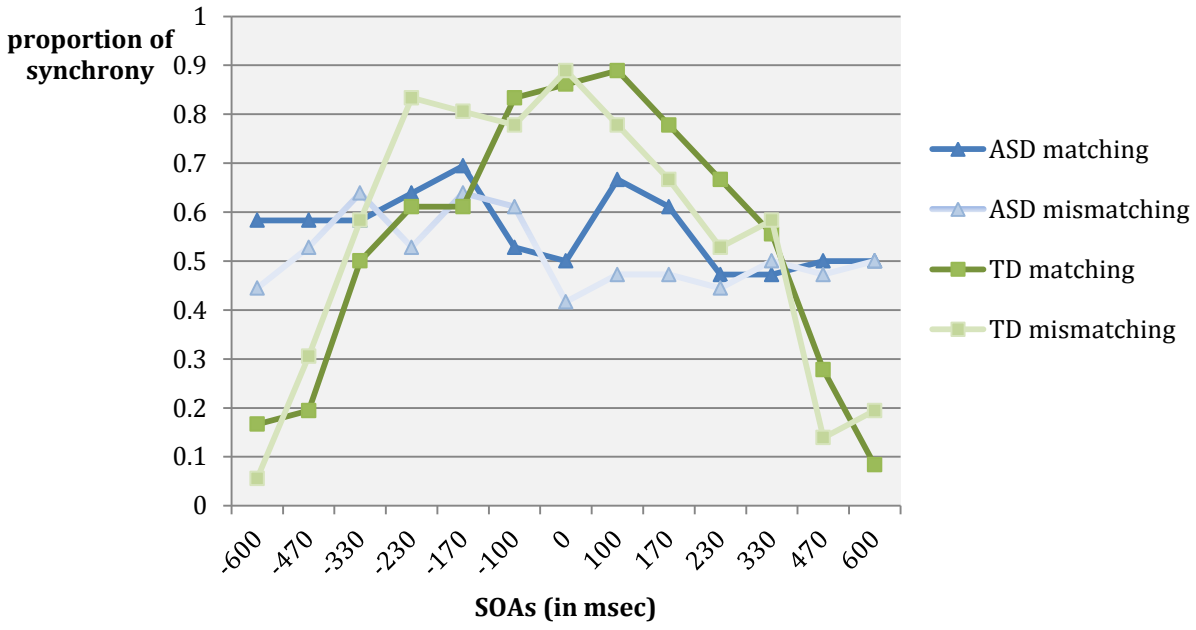


Figure 6. ASD and TD participants' proportion of synchrony in SOAs -600 to 600 ms for matching and mismatching conditions. ASD participants responded for synchrony higher than TD participants in SOAs -600, -470, +600, and +600 ms, and lower in SOAs -100, 0, and +100 ms for both matching and mismatching conditions.

No significant main effects were obtained for Stimulus Type [$F(1,10) = 2.41$, $p = 0.152$, $\eta^2 = 0.19$], Group [$F(1,10) = 0.01$, $p = 0.92$, $\eta^2 = 0.001$], and Match [$F(1,10) = 0.11$, $p = 0.748$, $\eta^2 = 0.11$]. Similarly, all the other interactions were not significant (Stimulus Type and Group [$F(1,10) = 2.03$, $p = 0.185$, $\eta^2 = 0.17$], Match and Group [$F(1,10) = 0.21$, $p = 0.654$, $\eta^2 = 0.02$], Match and SOA [$F(12,120) = 1.24$, $p = 0.308$, $\eta^2 = 0.11$], Stimulus Type and SOA [$F(12,120) = 0.77$, $p = 0.592$, $\eta^2 = 0.07$], Stimulus Type, Match, and Group [$F(1,10) = 0.64$, $p = 0.442$, $\eta^2 = 0.06$], Stimulus Type, SOA, and Group [$F(12,120) = 1.35$, $p = 0.254$, $\eta^2 = 0.11$], Match, SOA, and Group [$F(12,120) = 0.89$, $p = 0.492$, $\eta^2 = 0.08$], Stimulus Type, Match, and SOA [$F(12,120) = 1.45$, $p = 0.216$, $\eta^2 = 0.13$], Stimulus Type, Match, SOA, and Group [$F(12,120) = 0.88$, $p = 0.507$, $\eta^2 = 0.08$]).

4. Correlations

All the participants' individual scores on ASQ ranged from 7 to 41 and on the ADHD quotient scored from 0 to 43. The mean ASQ score was 9.67 for TD and 34 for ASD group and the mean ADHD score was 8.67 and 31.67, respectively. The higher the score, the more autistic and ADHD symptoms parent reported for their children.

RT and autistic symptoms

The RT for audiovisual matching conditions were significantly correlated with the scores on the ASQ ($R = 0.457$, $p = 0.022$). Specifically, as participants ASQ scores increased their RT responses were slower. ASQ contains five subscales (attention switching, attention to detail, social skill, communication, imagination) and to further examine the relationship between symptoms of autism and RT responses, we correlated the subscales of attention switching and attention to detail with the RT responses. Attention switching and Attention to detail to RT ($R = 0.55$, $p = 0.009$) was significantly correlated to RT, indicating that the

greater response latencies as individual's score on each of these subscales increased (see Table 1).

Correlations					
		ASQ	**Attention switching**	**Attention to detail**	**RT**
ASQ	Correlation Coefficient	1	**.790**	**.706**	**.457**
Attention switching	Correlation Coefficient	**.790**	1	**.552**	**.420**
Attention to detail	Correlation Coefficient	**.706**	**.552**	1	**.550**
RT	Correlation Coefficient	**.457**	**.420**	**.550**	1

Table 1. Positive correlations between ASQ, the ASQ's subscales (Attention switching and Attention to detail), and RT. Statistical significance is highlighted in bold.

RT and ADHD symptoms

Similarly, RT responses were significantly correlated with the participants' scores on ADHD quotient ($R = 0.431$, $p = 0.027$). That is, the higher the participants' score to ADHD quotient the more time they needed to respond to the RT task. ADHD quotient includes two subscales (Inattention, Hyperactivity). Further examination revealed positive significant correlation in the relationship between Inattention and RT ($R = 0.4$, $p = 0.037$) and between Hyperactivity and RT ($R = 0.438$, $p = 0.026$; see Table 2). That is, the higher participants' scores in the two subscales, the more time it took them to respond.

Correlations					
		ADHD	**Inattention**	**Hyperactivity**	**RT**
ADHD	Correlation Coefficient	1	**.953**	**.968**	**.431**

Inattention	Correlation Coefficient	**.953**	1	**.905**	**.400**
Hyperactivity	Correlation Coefficient	**.968**	**.905**	1	**.438**
RT	Correlation Coefficient	**.431**	**.400**	**.438**	1

Table 2. Positive correlations between ADHD, the subscales of ADHD (Inattention and Hyperactivity) and mean RT. Statistical significance is highlighted in bold.

SJ and autistic symptoms

We correlated the perception of synchrony responses in the SOAs were the differences between the TD group and the ASD were reported significant (i.e., ±600, 470, 100, and 0 ms) with the ASQ particpants' scores. ASQ scores were significantly correlated to -600 ms (R = 0.689, p = 0.002) and to -470 ms (0.538, p = 0.012), while all the other correlations were not significant. That is, the higher the ASQ scores were the higher the perception of synchrony for the SOAs of -600 and -470 ms. Further examination of the relationship between the ASQ and these SOAs revealed significant correlation between SOA -600 and -470 and the subscales of Attention switching and Attention to detail. Specifically, Attention switching and Attention to detail were significant correlated to -600 ms (R = 0.639, p = 0.003 and R = 0.454, p = 0.028, respectively) and to -470 ms (R = 0.552, p = 0.011 and R = 0.517, p = 0.007).

SJ and ADHD symptoms

We finally correlated participants' ADHD scores to the SOAs mentioned above and similarly, there were significant correlations between ADHD scores with the SOAs of -600 (R = 0.624, p = 0.003) and -470 ms (R = 0.574, p = 0.007). That is, participants that scored higher in ADHD quotient tend to respond higher for synchrony in -600 and -470 ms. Correlating the ADHD subscales for these SOAs, Inattention was significantly correlated for

both –600 ms (0.592, p = 0.005) and -470 ms (0.574, p = 0.007) and Hyperactivity was significantly correlated for both -600 ms (0.634, p = 0.003) and -470 ms (R = 0.550, p = 0.01). That is, the higher participants scored for both ADHD subscales, the higher they tended to respond for synchrony in -600 and -460 ms.

5. Discussion

In the present study, we examined, for the first time, whether potential multisensory processing impairments in ASD are the result of impaired integration or timing processes instead. The RT data showed that ASD participants could integrate multisensory stimuli just as TD participants, and both groups were less accurate in the mismatching stimulation. Moreover, ASD participants were slower in responding as compared to the healthy participants. These effects could be driven by attention impairments as correlations with the attentional subscales of ASQ revealed. The SJ analysis revealed, timing abnormalities in the ASD group as compared to the TD group with the former group being unable to detect synchrony in the smaller and larger SOAs tested. These results demonstrate that although the ASD group can integrate multisensory stimuli, their timing appears to be impaired, which, in turn, can impair one's integration capabilities.

In the RT task, the lack of any significant interaction of match and group, and modality and group signifies the similar pattern of responding in both groups. ASD participants are capable of integrating audiovisual information for non-speech stimuli. These results are consistent with previous findings examining multisensory integration utilizing basic low-level and non-speech stimuli (e.g., Stevenson et al., 2014) and inconsistent with findings claiming different and less effective multisensory integration (e.g., Brandwein et al., 2013). Moreover, ASD participants were slower in RT task as compared to TD group for all conditions, demonstrating that ASD individuals need more time to process multisensory or unisensory information and as a result more time to integrate multisensory events. These

results are in accordance with previous findings demonstrating slower multisensory integration (e.g., Brandwein et al., 2013). This outcome could be explained according to previous findings of ASD individuals' potential deficits in shifting attention between auditory and visual modalities and deficits in the coordination of different sources of information from different modalities (see Iarocci & McDonald, 2006, for a review), and also through the positive relationship between attention switching scores of ASQ questionnaire and RT task that the correlation analysis revealed. The high scores in specific skills according to our results appears to affect the time ASD individuals need to process multisensory information. As for the measurement of the relationship between the skills of Attention Switching and Attention to detail (ASQ subscales) and the RT task, the higher participants scored in the two subscales of ASQ, the more time they needed to respond. These results indicate an association between autistic symptoms and a slower multisensory integration. Our finding could be useful for future research and intervention in ASD as long as multisensory integration is essential for the development of perception. It was also found an association between ADHD quotient's scores (for both inattention and hyperactivity subscales) and RT task. However, the fact that the clinical group managed to complete with not many differentiations from the typical group the RT task could be an index of clinical group's capacity in focusing and completing the task regardless their potential ADHD behavior.

In the SJ task, no PSS or JND measures were extracted and, thus, failed to measure the temporal window of integration for the clinical and the typical group. This could be due to the task's difficulty. The given instructions of responding (synchrony vs. asynchrony) could have confounded participants' comprehension as long as both groups showed such difficulty. Furthermore, this could also be due to the small number of trials for each condition (3 in total). Specifically, attempting to detect ASD participants' wider temporal window of integration according to previous research (e.g., Foss-Feig et al., 2010; Kawkye et al., 2011)

and in order to avoid participants' tiredness, we decided to utilize a wide range of SOA with few repetitions. Analyses of the proportion of synchrony responses, however, showed that for SOAs that were outside the temporal window of integration, ASD participants responded for synchrony in higher rates as compared to typical participants. By contrast, in SOAs that lied within the temporal window of integration and it was expected that participants would perform high for synchrony responses, they performed low. ASD participants' performance was similar whether the stimuli were presented in a matching or mismatching form regardless of any semantic relationship between the audio and the visual, indicating not only timing but also integration deficits. Timing deficits in ASD have not always been demonstrated by previous studies and our results are in contrast to previous findings about unimpaired multisensory temporal processing (Bebko et al., 2006; van der Smagt et al., 2007; Stevenson et al., 2014). Moreover, according to our results ASD individuals appear to have an impaired temporal window of integration, however, previous studies have demonstrated a wider temporal window of integration (e.g., de Boer-Schellekens et al., 2013; Foss-Feig et al., 2010, Kwakye et al., 2011) and lower temporal multisensory sensitivity than typical individuals (de Boer-Schellekens et al., 2013). Furthermore, a relationship between participants' ASQ quotient scores and SJ responses was found, indicating that the more the difficulties they faced in attention switching and in attention to detail, the more they tended to select synchrony when the audio preceded the visual. However, such a relationship was not detected when the visual stream preceded the audio. These results are in agreement with previous research, claiming for ASD individuals' tendency to respond for audio-first (Vatakis & Allman, 2015), revealing a left shifted temporal window of integration and thus, showing that autistic symptoms could be an index for an altered multisensory processing in ASD (e.g., Donohue et al., 2012; Russo et al., 2012). However, it should not be ignored that all ASD participants scored high in ADHD quotient as for the inattention and hyperactivity. Through

the extraction of participants' ADHD scores, we attempted to eliminate any link between participants' task performance and possible inattentive or hyperactive behaviors. However, the fact that participants were capable of completing the RT task, provide evidence that possible ADHD did not affect participants' performance. However, the SJ task always followed RT task, and it makes it unclear whether ASD participants' performance in SJ was due to their potential inattention and hyperactivity behavior, their difficulties in attention switching (from task to task) and attention to detail or a partly involvement of all these parameters.

The age of the population that participated in our study was between 10-15 years old, while previous studies tested different age groups (e.g., Bebko et al., 2006; van der Smagt et al., 2014). For example, in Bebko et al.'s study, they used a group of 4-6 years old and in van der Smagt's et al. study, they used a group of adults and concluded that ASD individuals are not impaired in multisensory integration. Our results are discordant to these results and these differences could potentially be explained in terms of the different age groups (e.g., Foxe et al., 2013; Tremblay et al., 2007). Previous findings having demonstrated a developmental multisensory trajectory in typical individuals (e.g., Tremblay et al., 2007) and in ASD population (e.g., Foxe et al., 2013), prove the different multisensory integration capacities across ages (e.g., Foxe et al., 2013; Tremblay et al., 2007). Thus, comparisons between specific age groups are important as long as the grade of multisensory integration differs until adolescence.

Previous research took for granted that perception of synchrony and multisensory integration are synonymous, and thus timing attributes were utilized in order for multisensory integration to be tested (e.g., Bebko et al., 2006; de Boer-Schellekens et al., 2013; Foss-Feig et al., 2010; Kwakye et al., 2011; van der Smagt et al., 2007). Recent studies provided an alternative constant: that the mechanisms of perception of synchrony and integration are two

distinct processes (e.g., Freeman et al., 2013; Martin et al., 2013). Our results confirm this notion. In particular, in the RT task, tapping the integration process per se (without any timing attributes), ASD individuals were found capable of integrating audiovisual information. In the SJ task, tapping multisensory integration and timing processes, we demonstrated that timing and integration is impaired in ASD. We concluded that although through RT task appears integration to be unimpaired; through SJ task timing impairments appear to affect integration capacity (e.g., Stevenson et al., 2014). These mechanisms are rather different than the same (e.g., Tsilionis et al., 2016), however, they are interconnected.

The present study managed to isolate the timing and integration attributes of multisensory processing in ASD. The data demonstrated that ASD individuals are capable of integrating multisensory information, while they have deficits in timing. These timing deficits can affect the integration mechanisms. Future research should take into account all the mentioned parameters that could affect participants' performance like the type of task, the age-range of the participants, the stimulus types and, more importantly, the different processes of the timing and integration that we demonstrated in the present study by using two different tasks; each one tapping different processes (the RT and the SJ; see also Freeman et al., 2013). We faced difficulties in finding a big number of ASD participants, and thus, future research should aim for larger participant numbers as well as on strict groupings regarding the symptomatology (e.g., Donohue et al., 2012) and developmental trajectory (Foxe et al., 2013; Tremblay et al., 2007).

References

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders-IV-TR*. Washington, DC: APA.

Baron-Cohen, S. (2001). Autism-Spectrum Quotient [PsycTESTS Dataset]. Retrieved from http://dx.doi.org/10.1037/t00350-000.

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The autism-spectrum quotient (AQ): Evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. *Journal of Autism and Developmental Disorders, 31*, 603–603.

Bebko, J., Weiss, J., Demark, J., & Gomez, P. (2006). Discrimination of temporal synchrony in intermodal events by children with autism and children with developmental disabilities without autism. *Journal Child Psychology and Psychiatry, 47*, 88-98.

Brandwein, A., Foxe, J., Butler, J., Russo, N., Altschuler, T., Gomes, H., & Molholm, S. (2013). The development of multisensory integration in high-functioning autism: High-density electrical mapping and psychophysical measures reveal impairments in the processing of audiovisual inputs. *Cerebral Cortex, 23*, 1329–1341.

Cholemkery, H., Medda, J., Lempp, T., & Freitag, C. (2016). Classifying Autism Spectrum Disorders by ADI-R: Subtypes or Severity Gradient? *Journal of Autism and Developmental Disorders, 46,* 2327-2339.

Craig, F., Margari, F., Legrottaglie, A., Palumbi, R., de Giambattista, C., Margari, L. (2016). A review of executive function deficits in autism spectrum disorder and attention-deficit/hyperactivity disorder. Neuropsychiatric Disease and Treatment, 12, 1191-1202.

Dawson, G., Meltzoff, A., Osterling, J., Rinaldi, J., & Brown, E. (1998). Children with autism fail to orient to naturally occurring social stimuli. *Journal of Autism and Developmental Disorders, 28*, 479-485.

de Boer-Schellekens, L., Eussen, M., & Vroomen, J. (2013). Diminished sensitivity of audiovisual temporal order in autism spectrum disorders. *Frontiers in Integrative Neuroscience, 7*, 8.

Donohue, S., Woldorff, M., & Mitroff, S. (2010). Video game players show more precise multisensory temporal processing abilities. *Attention, Perception, & Psychophysics, 72*, 1120-1129.

Donohue, S., Darling, E., & Mitroff, S. (2012). Links between multisensory processing and autism. *Experimental Brain Research, 222*, 377-387.

Foss-Feig, J., Kwakye, L., Cascio, C., Burnette, C., Kadivar, H., Stone, W., & Wallace, M. (2010). An extended multisensory temporal binding window in autism spectrum disorders. *Experimental Brain Research, 203*, 381-389.

Foxe, J., Molholm, S., del Bene, V., Frey, H., Russo, N., Blanco, D., Saint-Amour, D., & Ross, L. (2013). Severe multisensory speech integration deficits in high-functioning school-aged children with autism spectrum disorders and their resolution during early adolescence. *Cerebral Cortex, 25*, 289-302.

Freeman, E., Ipser, A., Palmbaha, A., Paunoiu, D., Brown, P., Lambert, C., Leff, A., & Driver, J. (2013). Sight and sound out of synch: Fragmentation and renormalization of audiovisual integration and subjective timing. *Cortex, 49*, 2875-2887.

Iarocci, G., & McDonald, J. (2006). Sensory integration and the perceptual experience of persons with autism. *Journal of Autism and Developmental Disorders, 36*, 77–90.

Kwakye, D., Foss-Feig, J., Cascio, C., Stone, W., & Wallace, M. (2011). Altered auditory and multisensory temporal processing in autism spectrum disorders. *Frontiers in Integrative Neuroscience, 4*, 129.

Laurienti, P., Kraft, R., Maldjian, J., Burdette, J., & Wallace, M. (2004). Semantic congruence is a critical factor in behavioral performance. *Experimental Brain Research, 158*, 405-414.

Marco, E., Hinkley, L., Hill, S., & Nagarajan, S. (2011). Sensory processing in Autism: A review of neurophysiologic findings. *Pediatric Research, 69,* 48-54.

Martin, B., Giersch, A., Huron, C., & van Wassenhove, V. (2013). Temporal event structure and timing in schizophrenia: Preserved binding in a longer "now." *Neuropsychologia, 51,* 358–371.

McGurk, H., & MacDonald, J. (1976). Hearing lips and seeing voices. *Nature,* 264, 746-748.

Shams, L., Kamitani, Y., Shimojo, S. (2000). Illusions. What you see is what you hear. *Nature, 408,* 788.

Stevenson, R., Siemann, J., Schneider, B., Eberly, H., Woynaroski, T., Camarata, S., & Wallace, M. (2014). Multisensory temporal integration in autism spectrum disorders. *Journal of Neuroscience, 34,* 691-697.

Tremblay, C., Champoux, F., Voss, P., Bacon, B. A., Lepore, F., & Théoret, H. (2007). Speech and non-speech audio-visual illusions: A developmental study. *Public Library of Science One, 15,* 742.

Tsilionis, E., & Vatakis, A. (2016). Multisensory binding: is the contribution of synchrony and semantic congruency obligatory? *Current Opinion in Behavioral Sciences, 8,* 7–13.

van der Smagt, M., Van Engeland, H., & Kemner, C. (2007). Brief report: Can you see what is not there? Low-level auditory-visual integration in autism spectrum disorder. *Journal of Autism and Developmental Disorders, 37,* 2014-2019.

Vatakis, A., & Spence, C. (2007). Crossmodal binding: Evaluating the 'unity assumption' using audiovisual speech stimuli. *Perception & Psychophysics, 69,* 744-756.

Vatakis, A., Navarra, J., Soto-Faraco, S., & Spence, C. (2008). Audiovisual temporal adaption of speech: Temporal order versus simultaneity judgments. *Experimental Brain Research, 185,* 521-529.

Vatakis, A., & Allman, M. (2015). *Time Distortions in Mind: Temporal processing in clinical populations.* Brill: Leiden, The Netherlands.

Vroomen, J., & Keetels, M. (2010). Perception of intersensory synchrony: A tutorial review. *Attention, Perception, & Psychophysics, 72*, 871–884.

Wallace, M., Perrault, J., Hairstone, D., & Stein, B. (2004). Visual experience is necessary for the development of multisensory integration. *The Journal of Neuroscience, 24*, 9580-9584.

Appendix 1

Ενημερωτικό Έρευνας

Αγαπητέ γονέα,

Με αυτή την επιστολή ζητάμε τη συμμετοχή του παιδιού σας σε έρευνα για την πολυαισθητηριακή λειτουργία παιδιών με διαταραχές αυτιστικού φάσματος (ΔΑΦ).

Συγκεκριμένα, στο πλαίσιο εκπόνησης διπλωματικής εργασίας στο Πρόγραμμα Μεταπτυχιακών Σπουδών (ΠΜΣ) «Βασική και Εφαρμοσμένη Γνωσιακή Επιστήμη» του Πανεπιστημίου Αθηνών, μελετάμε την οπτικοακουστική ενοποίηση σε άτομα με ΔΑΦ. Σύμφωνα με έρευνες από τη διεθνή βιβλιογραφία, υπάρχουν ενδείξεις άτυπης επεξεργασίας οπτικοακουστικών συμβάντων από άτομα με ΔΑΦ. Ωστόσο, δεν έχει διευκρινιστεί αν υπάρχουν ελλείμματα και ποια ακριβώς είναι αυτά, λόγω αντικρουόμενων ευρημάτων. Η αβεβαιότητα αυτή αντανακλάται στο διαγνωστικό και στατιστικό εγχειρίδιο (DSM) της Αμερικανικής Ψυχιατρικής Εταιρίας, όπου η μη τυπική αισθητηριακή επεξεργασία αποτελούσε χαρακτηριστικό των ατόμων με Διάχυτες Αναπτυξιακές Διαταραχές μέχρι και το DSM-II, αφαιρέθηκε στα DSM-III και DSM-IV και επανήλθε στο DSM-V στις ΔΑΦ.

Επειδή η πολυαισθητηριακή ενοποίηση είναι πολύ σημαντική για την ομαλή γνωστική ανάπτυξη έχουμε σχεδιάσει μία ερευνητική διαδικασία για να διερευνήσουμε συστηματικά τις χρονικές παραμέτρους της ενοποίησης.

Στην ερευνητική διαδικασία το παιδί θα συμμετάσχει σε δύο δραστηριότητες μέγιστης διάρκειας 5 λεπτών η κάθε μία. Και στις δύο δραστηριότητες θα παρουσιάζονται σε οθόνη υπολογιστή κάποια ζώα σε μορφή κινουμένων σχεδίων (είτε οπτικά, είτε ακουστικά, είτε οπτικοακουστικά). Το παιδί θα αποκρίνεται πατώντας πλήκτρα σύμφωνα με τις οδηγίες που θα λάβει. Η ερευνήτρια θα είναι μαζί με τον συμμετέχοντα για καθοδήγηση και υποστήριξη.

Ως προς τα δεδομένα της έρευνας θα τηρηθεί απόλυτη εχεμύθεια και δεν θα υπάρξει καμία ονομαστική αναφορά στα άτομα που θα συμμετάσχουν. Μετά την επεξεργασία των δεδομένων θα μπορείτε να ενημερωθείτε σχετικά με τα αποτελέσματα της έρευνας. Για περαιτέρω πληροφορίες ή απορίες μπορείτε να επικοινωνήσετε μαζί μας είτε με e-mail στο argiro.vatakis@gmail.com είτε τηλεφωνικά στο 6981598786.

Αργυρώ Βατάκη
Ερευνήτρια στο Cognitive Systems Research Institute (CSRI)
Συνεργαζόμενη καθηγήτρια στο ΠΜΣ. «Βασική και Εφαρμοσμένη Γνωσιακή Επιστήμη»
www.argirovatakis.com
argiro.vatakis@gmail.com

Βενετία Μπακιρτζή
Εκπαιδευτικός Ειδικής Αγωγής στο Ειδικό Πειραματικό Νηπιαγωγείο ΜΔΔΕ «Ρόζα Ιμβριώτη»
Μεταπτυχιακή φοιτήτρια στο ΠΜΣ. «Βασική και Εφαρμοσμένη Γνωσιακή Επιστήμη»
venetia.bakirtzi@gmail.com

ΕΡΩΤΗΜΑΤΟΛΟΓΙΟ

Οδηγίες συμπλήρωσης ερωτηματολογίου

Το παρόν ερωτηματόλόγιο αποτελείται από τρία μέρη: το πρώτο μέρος περιλαμβάνει μία φόρμα συμπλήρωσης γενικών στοιχείων του συμμετέχοντος, το δεύτερο μέρος περιλαμβάνει ερωτήσεις σχετικές με τις κοινωνικές δεξιότητες του συμμετέχοντος και το τρίτο μέρος περιλαμβάνει ερωτήσεις σχετικές με την διάσπαση προσοχής του συμμετέχοντος. Είναι πολύ σημαντικό να συμπληρωθούν όλες οι ερωτήσεις. Καθε ερώτηση επιδέχεται μόνο μία απάντηση.

Το ερωτηματολόγιο μπορείτε να το έχετε μαζί σας την ημέρα διεξαγωγής της ερευνητικής διαδικασίας. Κατά την διάρκεια της διαδικασίας μπορείτε εάν το επιθυμείτε να παρευρίσκεστε μαζί με το παιδί σας. Η διαδικασία θα πραγματοποιηθεί στο κέντρο ΕΡΕΙΣΜΑ στην Αγία Παρασκευή στην διεύθυνση Αιγαίου Πελάγους 2Β την ημέρα που σας εξυπηρετεί, μετά από συνεννόηση με το προσωπικό του κέντρου.

Η διαδικασία αποτελείται από δύο δραστηριότητες:

Στην πρώτη δραστηριότητα θα εμφανίζονται στην οθόνη ενός φορητού υπολογιστή 3 ζώα σε μορφή κινούμενων σχεδίων: μία αρκούδα, ένα λιοντάρι και μία κατσίκα. Τα ζώα θα παρουσιάζονται είτε οπτικά (μόνο εικόνα), είτε ακουστικά (μόνο ο ήχος), είτε οπτικοακουστικά (ήχος και εικόνα μαζί). Το παιδί θα κληθεί να πατάει το πλήκτρο Α του πληκτρολογίου κάθε φορά που βλέπει, ακούει ή βλέπει και ακούει την αρκούδα, και το πλήκτρο Λ κάθε φορά που βλέπει, ακούει ή βλέπει και ακούει το λιοντάρι. Η κατσίκα σε όλες τις δοκιμασίες παραβλέπεται, οπότε το παιδί δεν αποκρίνεται με κάποιο πλήκτρο ως προς αυτό το ζώο. Παρόλα αυτά, σε κάποιες δοκιμές, θα παρουσιάζεται η κατσίκα (είτε οπτικά είτε ακουστικά) σε συνδυασμό με την εικόνα ή τον ήχο των άλλων δύο ζώων (λιοντάρι και αρκούδα). Σε αυτές τις δοκιμές, το παιδί πάλι θα πρέπει να αποκρίνεται ως προς τον ήχο ή την εικονα του λιονταριού ή της αρκούδας (ανάλογα με την δοκιμή) πατώντας τα αντίστοιχα πλήκτρα.

Στην δεύτερη δραστηριότητα θα εμφανίζονται στην οθόνη του ίδιου φορητού υπολογιστή μόνο οι οπτικοακουστικές δοκιμές του λιονταριού και της αρκούδας. Το λιοντάρι θα παρουσιάζεται στην οθόνη είτε με την δική του φωνή είτε με την φωνή της αρκούδας, και η αρκούδα θα παρουσιάζεται είτε με την δικής της φωνή είτε με την φωνή του λιονταριού. Το παιδί θα κληθεί να πατάει το πλήκτρο Ζ κάθε φορά που βλέπει ότι το άνοιγμα του στόματος του ζώου είναι ταυτόχρονο με την φωνή του ζώου που παρουσιάζεται στην κάθε δοκιμή, και το πλήκτρο Μ κάθε φορά που βλέπει ότι το άνοιγμα του στόματος του ζώου δεν είναι ταυτόχρονο (δηλαδή δεν συμβαδίζει εικόνα και ήχος) με την αντίστοιχη φωνή.

Η συμμετοχή σας μας είναι πολύτιμη. Σας ευχαριστούμε πολύ για την συμμετοχή σας, την βοήθεια σας και τον χρόνο σας σε αυτήν την τόσο σημαντική για μας ερευνητική διαδικασία.

Με εκτίμηση,

Αργυρώ Βατάκη

Βενετία Μπακιρτζή

Γενικά στοιχεία συμμετέχοντος

Έτος Γέννησης: …….....

Φύλο: …….....**....**

Τάξη: …….....

Διάγνωση: …….....

Τεστ αξιολόγησης: …….....

Δείκτης νοημοσύνης: …….....

Τεστ δείκτη νοημοσύνης: …….

Αισθητηριακές προτιμήσεις:.....

Άλλες προτιμήσεις/ρουτίνες:.....**...**

Δείκτης Επικοινωνίας

1. Προτιμά να κάνει δραστηριότητες με άλλους παρά μόνος/η του/της.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

2. Προτιμά να κάνει πράγματα με τον ίδιο τρόπο ξανά και ξανά.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

3. Όταν προσπαθεί να φανταστεί κάτι, του/της φαίνεται ιδιαίτερα εύκολο να δημιουργήσει μία νοητή εικόνα.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

4. Συχνά απορροφάται ιδιαίτερα από ένα πράγμα με αποτέλεσμα να χάνει την εστίαση του/της με άλλα πράγματα.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

5. Συχνά παρατηρεί ιδιαίτερους ήχους που οι άλλοι δεν μπορούν.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

6. Συχνά παρατηρεί αριθμούς διευθύνσεων σπιτιών ή παρόμοιες πληροφορίες.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

7. Έχει δυσκολία στην κατανόηση κανόνων καλής συμπεριφοράς.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

8. Μπορεί έυκολα να φανταστεί πως θα μπορούσαν να μοιάζουν οι χαρακτήρες, μιας ιστορίας που διαβάζει.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

9. Τον/την συναρπάζουν οι ημερομηνίες.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

10. Σε μία κοινωνική συνάθροιση, μπορεί εύκολα να παρακολουθήσει διαφορετικές συζητήσεις των συνομιλητών.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

11. Το βρίσκει εύκολο να συμμετάσχει σε καταστάσεις κοινωνικής αλληλεπίδρασης.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

12. Τείνει να παρατηρεί λεπτομέρειες που οι άλλοι παραλείπουν.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

13. Προτιμά να πάει σε μία βιβλιοθήκη παρά να πάει σε ένα πάρτι γενεθλίων.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

14. Του/της είναι εύκολο να δημιουργήσει ιστορίες.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

15. Τον/την ελκύουν πιο πολύ οι άνθρωποι παρά τα πράγματα.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

16. Τείνει να έχει δυνατά ενδιαφέροντα και αναστατώνεται όταν δεν μπορεί να τα συνεχίσει.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

17. Απολαμβάνει την κοινωνική κουβέντα.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

18. Όταν μιλάει, δεν είναι εύκολο για τους άλλους να πάρουν τον λόγο επειδή μιλάει διαρκώς και γρήγορα.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

19. Τον/την συναρπάζουν οι αριθμοί.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

20. Όταν διαβάζει μια ιστορία, του/της φαίνεται ιδιαίτερα δύσκολο να καταλάβει τις προθέσεις ή τα συναισθήματα των χαρακτήρων.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

21. Δεν του/της αρέσουν ιδιαίτερα οι ιστορίες φαντασίας.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

22. Έχει δυσκολίες στο να κάνει καινούριους φίλους.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

23. Παρατηρεί συνεχώς μοτίβα σε πράγματα.

Συμφωνώ Απόλυτα ☐ Συμφωνώ λίγο ☐ Διαφωνώ λίγο ☐ Διαφωνώ απόλυτα ☐

24. Θα προτιμούσε να πάει στον κινηματογράφο παρά σε ένα μουσείο.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

25. Δεν αναστατώνεται όταν η καθημερινή του/της ρουτίνα διαταραχθεί.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

26. Δεν ξέρει πώς να κρατήσει την ροή μίας συζήτησης με τους συνομήλικους του/της.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

27. Του/της φαίνεται εύκολο να αντιληφθεί τα υπονοούμενα μίας συζήτησης.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

28. Συνήθως συγκεντρώνεται περισσότερο στη γενική εικόνα παρά στις μικρές λεπτομέρειες.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

29. Δεν είναι πολύ καλός/ή στο να θυμάται αριθμούς τηλεφώνων.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

30. Συνήθως δεν παρατηρεί μικρές διαφοροποιήσεις σε μία κατάσταση ή στην εμφάνιση κάποιου.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

31. Καταλαβαίνει όταν ο συνομιλητής/τρια του/της χάνει το ενδιαφέρον του/της.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

32. Του/της φαίνεται εύκολο όταν αμφιταλαντεύεται μεταξύ δραστηριοτήτων.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

33. Όταν μιλάει στο τηλέφωνο, δεν γνωρίζει πότε είναι η σειρά του/της να μιλήσει.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

34. Διασκεδάζει να κάνει πράγματα αυθόρμητα.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

35. Συνήθως είναι ο/η τελευταίος/α που καταλαβαίνει πότε κάτι είναι αστείο.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

36. Του/της φαίνεται εύκολο να καταλάβει τι σκέφτεται ή αισθάνεται κάποιος απλώς κοιτώντας το πρόσωπό του.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

37. Σε περίπτωση που υπάρξει μία διακοπή δραστηριότητας, μπορεί γρήγορα να επανέλθει σε αυτήν.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

38. Είναι καλός/ή στην κοινωνική κουβέντα.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

39. Συχνά του /της λένε ότι κάνει διαρκώς το ίδιο πράγμα.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

40. Όταν ήταν στο νηπιαγωγείο, του/της άρεσε να παίζει παιχνίδια ρόλων με τα άλλα παιδιά.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

41. Του/της αρέσει να συλλέγει πληροφορίες από κατηγορίες πραγμάτων (π.χ. είδη αυτοκινήτων, είδη πουλιών, τύπους τρένων, είδη φυτών κ.α.).

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

42. Του/της φαίνεται δύσκολο να φανταστεί πώς θα ήταν να είναι κάποιος/α άλλος/η.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

43. Του/της αρέσει να οργανώνει προσεκτικά οποιαδήποτε δραστηριότητα στην οποία συμμετέχει.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

44. Του /της αρέσουν οι κοινωνικές συναναστροφές.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

45. Του/της φαίνεται δύσκολο να καταλάβει τις προθέσεις των άλλων.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

46. Οι νέες καταστάσεις του/της προκαλούν αναστάτωση.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

47. Του/της αρέσει να γνωρίζει καινούριους ανθρώπους.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ απόλυτα
☐	☐	☐	☐

48. Είναι καλός/ή στο να προσέχει και να μην πληγώνει τα συναισθήματα των άλλων.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ Απόλυτα
☐	☐	☐	☐

49. Δεν είναι πολύ καλός/ή στο να θυμάται τις ημερομηνίες γέννησης των άλλων.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ Απόλυτα
☐	☐	☐	☐

50. Του/της φαίνεται ιδιαίτερα εύκολο να παίζει με τα άλλα παιδιά παιχνίδια ρόλων.

Συμφωνώ Απόλυτα	Συμφωνώ λίγο	Διαφωνώ Λίγο	Διαφωνώ Απόλυτα
☐	☐	☐	☐

Δείκτης Διαταραχής Ελλειμματικής Προσοχής-Υπερκινητικότητα

1. **Πόσο συχνά το παιδί σας αντιμετωπίζει δυσκολίες στο να διατηρήσει την προσοχή ου ενώ κάνει μία εργασία, στο σχολείο, κατά τη διάρκει ενός χόμπι ή μίας διασκεδαστικής δραστηριότητας (π.χ. να παραμείνει συγκεντρωμένος κατά την διάρκεια διαλέξεων, μακροσκελούς διαβάσματος ή συζητήσεων);**
   Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐
2. **Πόσο συχνά διασπάται η προσοχή του παιδιού σας από εξωτερικά ερεθίσματα, όπως για παράδειγμα από ήχους ή άλλες συζητήσεις του περιβάλλοντος;**
   Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐
3. **Πόσο συχνά το παιδί σας αποφεύγει, αντιπαθεί, ή διστάζει να εμπλακεί σε εργασίες που απαιτούν διατήρηση νοητικής προσπάθειας ή σκέψης;**
   Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐
4. **Πόσο συχνά προβληματίζει το παιδί σας να ακούσει κάποιον, ακόμη και όταν του μιλάνε άμεσα, και είναι σαν να βρίσκεται το μυαλό του κάπου αλλού;**
   Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐
5. **Πόσο συχνά το παιδί σας αντιμετωπίζει δυσκολίες στην οργάνωση μίας δραστηριότητας ή στην περάτωση μίας εργασίας (π.χ. μειωμένη ικανότητα διαχείρισης χρόνου, αποτυχία να τηρεί τις προθεσμίες, δυσκολία στην οργάνωση διαδοχικών εργασιών, ακατάστατη και ανοργάνωτη δουλειά);**
   Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐
6. **Πόσο συχνά το παιδί σας αποτυγχάνει να προσέξει τις λεπτομέρειες ή κάνει απρόσεκτα λάθη σε σχολικές εργασίες ή κατά τη διάρκεια άλλων δραστηριοτήτων;**
   Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐
7. **Πόσο συχνά το παιδί σας ξεχνάει να κάνει κάτι το οποίο συμβαίνει καθημερινά, όπως για παράδειγμα την ημέρα παιχνιδιού, την πρακτική του ή ξεχνάει το μεσημεριανό του φαγητό;**

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

8. Πόσο συχνά το παιδί σας χάνει, παραπετά ή χαλάει κάτι που χρειάζεται προκειμένου να διεκπεραιώσει αυτά που πρέπει (π.χ. σχολικό υλικό, μολύβια, βιβλία, εργαλεία κ.λ.π.);

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

9. Πόσο συχνά δυσκολεύεται το παιδί σας να ακολουθήσει οδηγίες ή αποτυγχάνει να τελειώσει τις σχολικές εργασίες, δουλειές σπιτιού ή άλλες υποχρεώσεις (π.χ. αρχίζει μία δουλειά, αλλά γρήγορα χάνει την συγκέντρωση του και ασχολείται με κάτι άλλο);

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

10. Πόσο συχνά το παιδί σας δεν είναι σε θέση να παίξει ή να εμπλακεί σε άλλες δραστηριότητες ήσυχα;

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

11. Πόσο συχνά αντιμετωπίζει το παιδί σας δυσκολίες στο να περιμένει την σειρά του, όπως για παράδειγμα να περιμένει σε μία ουρά;

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

12. Πόσο συχνά το παιδί σας τρέχει τριγύρω ή σκαρφαλώνει σε περιστάσεις που είναι ανάρμοστο;

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

13. Πόσο συχνά το παιδί σας κινείται νευρικά ή χτυπάει/κουνάει χέρια ή πόδια ή κουνιέται στην καρέκλα του;

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

14. Πόσο συχνά το παιδί σας πετάει αυθόρμητα μία απάντηση πριν να έχει ολοκληρωθεί η ερώτηση;

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

15. Πόσο συχνά το παιδί σας αισθάνεται ανήσυχο, αεικίνητο ή συμπεριφέρεται σαν μηχανή με μπαταρίες που λειτουργεί συνεχώς (π.χ. δεν μπορεί να μείνει ακίνητο σε μία θέση για μεγάλο χρονικό διάστημα)

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

16. Πόσο συχνά το παιδί σας αφήνει την θέση του σε περιστάσεις όπου αναμένεται να μείνει καθισμένο (π.χ. στην τάξη);

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

17. Πόσο συχνά θεωρείτε ότι το παιδί σας μιλάει υπερβολικά πολύ;

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

18. Πόσο συχνά το παιδί σας διακόπτει ή παρεμβαίνει σε άλλους (π.χ. χώνεται/πετάγεται σε συζητήσεις, παιχνίδια, ή δραστηριότητες, μπορεί να ξεκινήσει να χρησιμοποιεί πράγματα των άλλων χωρίς να ρωτήσει ή χωρίς να πάρει άδεια);

Ποτέ ☐ Σπανίως ☐ Κάποιες φορές ☐ Συχνά ☐

19. Υπήρχαν αρκετά από τα συμπτώματα σε ηλικία κάτω των 12 ετών;

Όχι ☐ **Ναι** ☐

20. Εμφανίζονται τα συμπτώματα αυτά σε τουλάχιστον δύο ή περισσότερα πλαίσια (π.χ. στο σπίτι και στο σχολείο);

☐ **Όχι** ☐ **Ναι**