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Joint attention effect on irrelevant stimuli resistance in high functional autism and neurotypical adults

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ABSTRACT

Background and objectives: Clinical practice reveals that individuals with autism characterized by the absence of cognitive impairment (High Functioning Autism-HFA) show difficulty in sharing attention with unfamiliar people. We hypothesized that this difficulty could affect cognitive control by selectively impairing stimulus-encoding or response-selection.

Methods: Twenty-one HFA and 23 neurotypical adults were involved in a two-phase study. The first phase was performed at home, through an online link; the second one was held four months later in our laboratory in the presence of two experimenters. A letter-flanker task was administered in both phases. In the Stimulus-Response (SR) conflict condition, the target and flankers were assigned to the same/different response keys. In the Stimulus-Stimulus (SS) conflict condition, the target and flankers were perceptually similar/dissimilar. Two mixed-ANOVAs were conducted on response times and accuracy with Phases (Home vs Lab), Groups (HFA, Neurotypical), SR conditions (congruent, incongruent, neutral) and SS conditions (congruent, incongruent) as factors.

Results: Results show that only HFAs' inhibition ability was negatively affected by the experimenters' presence compared to when they were alone, by reducing accuracy when dealing with an SS conflict.

Limitations: The differences between the home-phase and lab-phase sessions require further elaboration to understanding the nature of social interaction during the lab session.

Conclusions: These results suggest that, for HFA, the "at home" context, free from social and emotional pressure, allowed them to emphasize their detail-focused cognitive style.

Within the taxonomy of Autism Spectrum Disorder (ASD), some individuals are distinguished by the absence of cognitive disability and language impairments typically seen in autism (de Giambattista et al., 2019; Klin et al., 2005). Known as individuals with High-Functioning Autism (HFA), they often exhibit intact memory, language, and rule-learning abilities but face challenges in social domains, such as recognizing or responding appropriately to emotional or social cues (Liu et al., 2019). Additionally, HFA individuals may display repetitive or restrictive behaviors. Many of these social deficits align with Baron--Cohen's concept of "empathizing," which encompasses various social skills such as mind-reading, theory of mind, and empathy (Baron-Cohen & Belmonte, 2005). By contrast, Baron-Cohen introduces the "systemizing" concept, which describes cognitive strengths in understanding and analyzing the structure of objects and events through predictable rules (Baron-Cohen & Belmonte, 2005).

The empathizing-systemizing (E-S) model offers a framework to explain evidence showing that social interaction and communication difficulties in HFA adults may diminish in computer-mediated contexts, which likely reduce the social and emotional pressures of real-world interactions and provide a greater sense of control (Benford & Standen, 2009). Supporting this view, studies have found that HFA adults tend to prefer computer-mediated communication (CMC), as indicated by their higher PC usage and reported satisfaction with online social interactions (Van Der Aa et al., 2016).

Beyond the E-S model, recent research on Autism has concentrated on three major theories: Theory of Mind, Executive Dysfunction Theory, and Weak Central Coherence Theory (see Rajendran & Mitchell, 2007) for a review. These theories are considered to function independently in

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influencing different aspects of autism. For this paper, we focus specifically on Executive Dysfunction Theory and Weak Central Coherence Theory. The role of executive dysfunction in ASD has been extensively studied, as Rajendran and Mitchell proposed (Rajendran & Mitchell, 2007). Literature suggests that evidence for a single executive function deficit in autism remains inconclusive, as various executive components may be impaired depending on the autism subtype. Despite this, there is limited research examining how executive function impairments affect the daily functioning of adults with HFA. A recent meta-analysis highlighted consistent executive function impairments in adult HFA individuals compared to neurotypical controls, particularly in mental flexibility and planning (Xie et al., 2020).

Alternatively, the Weak Central Coherence (WCC) model offers another perspective on HFA-related dysfunctions (Frith, 1989, 2003; Frith & Happé, 1994; Happé, 1999). While typically developing individuals process information by integrating overall meaning, ASD individuals may exhibit a detail-focused cognitive style, characterized by a reduced drive for global coherence. Research suggests that individuals with autism often struggle to expand their focus of visual attention, due to overly focused attention that hinders the spread of visual attention in certain tasks (Mann & Walker, 2003). Baron-Cohen and Belmonte suggest that WCC plays a significant role in autism's behavioral manifestations due to difficulties in filtering general information from stimuli (Baron-Cohen & Belmonte, 2005).

In this context, research has explored the impact of anxiety and mood on performance, as well as their relationship with central coherence, primarily in children with HFA. Findings indicate that children with autism who experience high social stress may exhibit low WCC in linguistic performance, with evidence linking difficulties in using contextual information for language processing to social cognitive impairment (Burnette et al., 2005). In a study with young individuals with high-functioning autism, South and colleagues examined the relationship between executive functions, central coherence, and repetitive behaviors. Neuropsychological tests indicated a partial positive correlation between repetitive behaviors and executive performance but found no direct link between repetitive behaviors and central coherence (South et al., 2007). Given the current evidence, further research is needed to clarify how executive dysfunction and weak central coherence affect cognitive skills in HFA.

Additionally, the impact of social constraints and associated stress on cognitive ability in HFA individuals is an intriguing area of exploration. Building on Baron-Cohen's model and subsequent findings that social difficulties decrease in computer-mediated settings, we hypothesize that social context may differently influence cognitive performance compared to an isolated, computer-mediated setting.

This study aims to investigate which mechanisms—cognitive control or automatic perceptual processing—affect cognitive performance in HFA individuals under social constraints. To test the hypothesis that sharing attention with unfamiliar people in a social context could impact the cognitive skills of HFA adults, we employed a two-phase testing approach, comparing HFA adults with matched neurotypical controls on a cognitive task. In the first phase, participants completed a low-interaction task alone at home, considered a comfortable condition. The second phase involved a high-interaction task in the laboratory with two unfamiliar individuals, posing a more challenging social condition.

Cognitive performance was assessed using an Eriksen Flanker task (Brunetti et al., 2019). In this task, participants classify a target stimulus while ignoring irrelevant flankers. The relationship between the target and flankers can create S-S conflict (stimulus interference) and/or S-R conflict (response competition), both of which can slow response times or reduce accuracy (Brunetti et al., 2019; De Houwer, 2003; Zhang et al., 1999). Specifically, S-S conflict involves perceptual/attentional processes that require filtering out irrelevant stimuli, while S-R conflict engages executive functions, such as cognitive control, to inhibit inappropriate responses.

We hypothesize that HFA individuals will be more influenced by the social context than neurotypical adults. Additionally, we anticipate that examining the distinct effects of S-S conflict (perceptual processing) and S-R conflict (cognitive control) will illuminate the respective roles of global coherence and executive functions in HFAs' social behavior.

1. Methods

1.1. Participants

Twenty-one individuals with High-Functioning Autism -HFA- (11 females, 10 males; mean age = 27.05 years, SD = 8.39), and twenty-three Neurotypical Control (NTC) participants (13 females, 10 males; mean age = 26.48 years, SD = 8.36) were engaged in this study. The HFA participants were recruited through the Local Public Health Unit of Child and Adolescent Psychiatry ASL2 Abruzzo. Neurotypical controls were matched by age, gender, and education and were enrolled in the experiment among students from the d'Annunzio University.

Exclusion criteria were the following: current or lifetime diagnosis of organic mental disorder, schizophrenia, schizophreniform or other psychotic disorders, bipolar disorders, substance-related disorders, a current diagnosis of depressive disorder, uncontrolled or severe medical conditions, and any current or past psychopharmacological treatment.

A psychometric assessment has been performed to check the balance of relatively stable and task-relevant participant characteristics across the two groups. The assessment included: the Autism-Spectrum Quotient - AQ (Baron-Cohen et al., 2001); the Beck Depression Inventory – BDI (Beck et al., 1961); the Online Cognition Scale -OCS (Davis et al., 2002); the Internet Addiction Scale -IAT (Young, 1998); the Padua Inventory -PI (Sanavio, 1988); the State-Trait Anxiety Inventory Y- STAI Y, with subscales Y1 and Y2 (Spielberger, 2010), this scale has been administered in order to evaluate the stressing effects of the Lab phase; the Wechsler Adult Intelligence Scale – WAIS (Wechsler, 1939) limited Symbol Search (SS) and Coding (C) subscales (see Table 1).

All participants underwent the clinical examination carried out by expert psychiatrist and\or psychologist trained and certified in the use of the instruments and included provided written informed consent,

Table 1
Demographic and clinical characteristics of the two subject groups.

	HFA (n 21)	NTC (n 23)	
Demographic data			
Number of females	52 %	57%	
Age (ys) mean ± SD	27.05 (±8.4)	26.48 ± (8.4)	
Education (ys) mean ± SD	14.29 (±3.4)	15.61 ± (3.0)	
Clinical assessment data			Significant *t*-test results
AQ total score	33.19 (±7.0)	17.95 (±6.2)	p < .001
BDI total score	22.66 (±13.2)	13.69 (±10.4)	p = .016
OCS total score	121.14 (±47.5)	101.00 (±34.8)	
IAT total score	47.05 (±15.5)	40.26 (±11.2)	
PI total score	87.76 (±53.3)	59.69 (±32.5)	p = .036
STAI Y total score	46.66 (±12.2)	37.21 (±9.6)	p = .006
STAI Y-1	18.61 (±7.4)	15.48 (±5.4)	
STAI Y-2	20.05 (±6.7)	21.74 (±6.7)	p = .003
PS	98.52 (±17.3)	101.69 (±13.7)	

NOTE: AQ: Autism-Spectrum Quotient; BDI: Beck Depression Inventory; OCS: Online Cognition Scale; IAT: Internet Addiction Scale; PI: Padua Inventory; STAI Y, State-Trait Anxiety Inventory Y; PS: Processing Speeding score, based on the weighted score of Symbol Search and Coding WAIS subscales.

after receiving a complete description of the study and having the opportunity to ask questions.

1.2. Design and materials

Participants were involved in a two-phase study: The Home phase was performed by the participant in his\her home, through an online link to the experimental task, whereas the Lab phase was held four months later in our laboratory in the presence of two experimenters. We chose to introduce two experimenters during the Lab phase to enhance the demanding nature of the social context in this phase and thus to emphasize the difference between the two contexts by contrasting a socially comfortable condition (alone at home, no social interaction required), with a more demanding social context (in the laboratory, together with two unfamiliar people), assuming that, in HFA individuals, the more people number the more socially distress. The same experimental task was administered in both phases and consisted of a modified version of the Ericksen Flanker task (Brunetti et al., 2019). The two phases have been introduced as factor in a repeated measures design to minimize individual differences between the two testing modalities.

Stimuli consisted of a string of 7 letters, where the central letter represented the target, whereas the others 6 were distractors (flankers). The string of letters was displayed in the horizontal plane, 10 mm above a fixation cross (i.e., "+"), which was presented in the center of the screen. All stimuli were printed in upper case and dark color against a white background and were equidistant from each other. All stimuli subtended approximately .96° of visual angle in length and .64° in width when observer was seated 1 m far from the screen (required condition).

The target letters were H, S, K or C, whereas flankers were H, S, K, C, F, G, V or O. Stimuli were presented by means of Inquisit web 5.0 software.

Two conditions were created by manipulating the relationship between target and flankers: Stimulus-Response (S-R) conflict and Stimulus-Stimulus (S-S) conflict (Kornblum & Lee, 1995).

To manipulate the S-R relationship (see Fig. 1), three response conditions were constructed by varying target and flankers according to the answer keys associated to them. In the S-R congruent condition, target and flankers were associated with the same answer key; in the S-R incongruent condition, target and flankers were associated with two different answer keys. In the S-R neutral condition, flankers were not associated with any response keys.

Regarding to the S-S conflict (see Fig. 1), we manipulated the perceptual similarity between physical characteristics of target and flanker. In the S-S congruent condition, stimuli were perceptually similar, that is, all rounded (i.e., S, C, G, O) or edgy (i.e., H, K, F, V) letters; in the S-S incongruent condition, target and flankers were perceptually different letters, that is, the rounded target were presented with edgy flankers or vice versa.

A total of two hundred and forty stimuli were generated by crossing S-R and S-S conditions, in such a way that there were forty stimuli for each of the 6 conditions, thus respecting a one-to-one ratio between all experimental conditions.

S-S CONFLICT Target & Flankers are perceptually SIMILAR/DIFFERENT	S-R CONFLICT Target & Flankers are assigned to SAME/DIFFERENT answer keys		
	CONGRUENT	INCONGRUENT	NEUTRAL
CONGRUENT	H H H **H** H H H	K K K **H** K K K	F F F **H** F F F
INCONGRUENT	S S S **H** S S S	C C C **H** C C C	G G G **H** G G G

Fig. 1. Example of stimuli and conditions. Experimental conditions were Stimulus-Stimulus (S–S) conflict (2 levels) and Stimulus-Response (S–R) conflict (3 levels).

1.3. Procedure

In the first phase (Home phase), participants performed the experimental task in their home. They received the access to the experiment by means of a link sent via email. All participants were asked to carry out the experiment in an isolated and quiet place. Participants were required to perform the experiment using a desktop computer. After four months, the second experimental phase (Lab phase) was conducted. Participants repeated the same experimental procedure in the presence of two unknown experimenters, at the Laboratory of General Psychology of the local University. The Lab phase included the administration of assessing scales. The lab experimental setting included a desk and 3 chairs. The participant was asked to position himself in the central chair, in front of the computer and the two experimenters placed one on his right and one on his left, at 1 m of distance. In this way, the experimenters watched the participant perform the experiment.

For both phases, the following procedure has been applied.

Participants were preliminary instructed to press either the key "4" on the keyboard whether the target was H or S, or the key "9" whether it was K or C after each trial presentation. A practice block composed by 24 trials, that is, all the possible combinations of flankers and target, was firstly administered. The experimental blocks started when the participant reached 80% of accuracy in the practice; otherwise, he\she performed a further practice block. Subsequently, two experimental blocks were delivered, each containing 120 trials, for a total of 240 trials (10 repetitions for each combination). Trials in each block were presented in a randomized order. Each trial began with the presentation of a central fixation cross (i.e. "+") for 500 ms, followed by the stimuli. Each Stimulus remained on the screen until subject response, for up to 5 s. Intertrial interval (ITI) was 500 ms (see Fig. 2). Participants were instructed to respond as fast as they could while minimizing their mistakes.

1.4. Statistical analysis

The analyses were run on RTs of correct responses and on Accuracy (percentage of correct responses). Trials with RTs greater or smaller than 2 SD from each subject's mean were removed for the analysis. The mean percentage of correct responses was 96,38% and the filter applied on RTs removed 3,97% of the remaining correct trials.

Since the Home Phase always preceded the Lab Phase, a confounding learning effect was expected. To overcome and control for this confound, a learning index was calculated. This value was the percentage ratio between reaction times in the two phases [((Lab RT/Home RT) $\times$ 100-100)%] and was introduced as a continuous variable in an ANCOVA 3 $\times$ 2 $\times$ 2 $\times$ 2 design with Stimulus-Response (S-R)

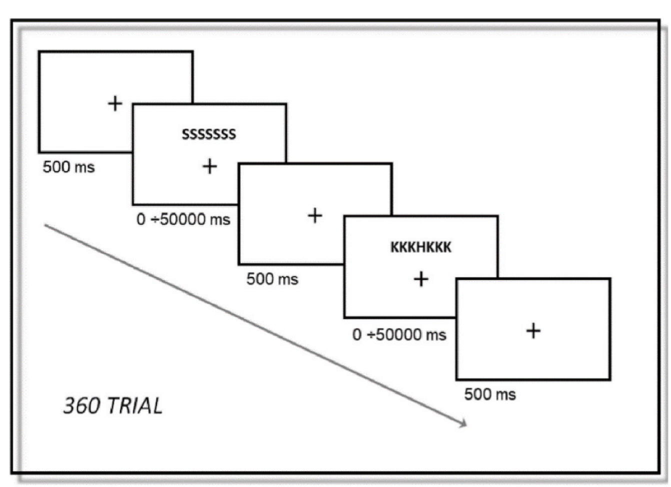

Fig. 2. Experimental procedure.

(congruent, incongruent, and neutral: hereafter C, I and N), Stimulus-Stimulus S-S (C and I) and Phase (Home and Lab) as within subject factors, and Group (HFA and NTC) as between factor. Corrected Reaction Time (RT) were used as dependent variable.

Furthermore, a mixed ANOVA were applied to correct responses percentage (CRp). A 3 × 2 × 2 × 2 design was carried out, with Stimulus-Response (S-R) (congruent, incongruent, and neutral: hereafter C, I and N), Stimulus- Stimulus S-S (C and I) and Phase (Home and Lab) as within subject factors, and Group (HFA and NTC) as between factor.

Finally, a further control analysis was made on the error scores by computing the Interference Error Score (IES) as a difference in performance between incongruent and congruent S-S trials (Adams & Jarrold, 2009). The IES was then used as the dependent variables in a 2 × 2 ANOVA with Phase (Home and Lab) as within factor and Group (HFA and NTC) as between factor.

2. Results

2.1. S-S and S-R conflict on reaction times

The ANCOVA analysis performed on corrected RT by means of a 3 × 2 × 2 × 2 design with S-R (C, I and N), S-S (C and I) and Phase (Home and Lab) as within subject factors, and Group (HFA and NTC) as between factors, and a learning index introduced as continuous variable, showed the following results.

A main effect of S-R [F (2, 82) = 15.52, $p < .001$; ηp2 = .274; observed power = .99] was found. Simple contrasts showed slower performance during incongruent than congruent ($p < .001$) and neutral ($p < .001$) trials in all participants (Fig. 3). Furthermore, a significant interaction between Phase, S-R and Group was observed [F (2, 82) = 4.66, p = .012; ηp2 = .102; observed power = .77]. Summarizing, Fisher LSD post hoc analysis revealed a significantly faster performance in laboratory than at home for all the three S-R conditions and for both groups ($p < .001$ for each simple contrasts).

2.2. S-S and S-R conflict on accuracy

Furthermore, a repeated measure ANOVA applied to correct responses percentage (CRp) following a 3 × 2 × 2 × 2 design indicated main effect and interaction between three factors. First, a significant main effect of S-R was found [F (2, 84) = 16.61, $p < .001$; ηp2 = .28; observed power = .99] (Fig. 4). Fisher LSD post hoc test for simple contrasts revealed that during incongruent S-R, performance was worse than the congruent and the neutral one ($p < .001$ for both simple contrasts). Second, a significant Phase x S-S x Group interaction [F (1, 42) = 14.38, $p < .001$; ηp2 = .25; observed power = .95] was observed. Fisher LSD post hoc test for simple contrasts shows that NTC performed worst S-S incongruent condition from their own house than in our laboratory (p = .008), contrarily to the HFA group, that performed the same trials better in their place than our lab (p = .041). Furthermore, HFA participants, when were at home, made fewer errors during S-S incongruent than S-S congruent trials (p = .004). Moreover, HFA group performed better S-S congruent trials in Lab than at home (p = .012).

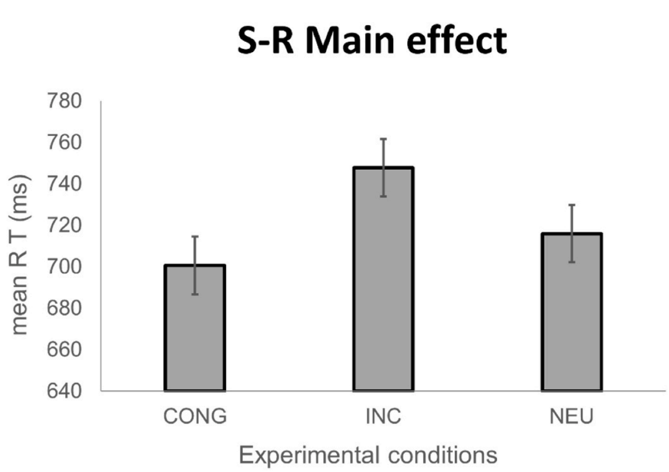

Fig. 3. Stimulus-Response (S–R) main effect for the whole sample: RT during Incongruent (INC) S-R were higher than those during Congruent (CONG) and Neutral (NEU).

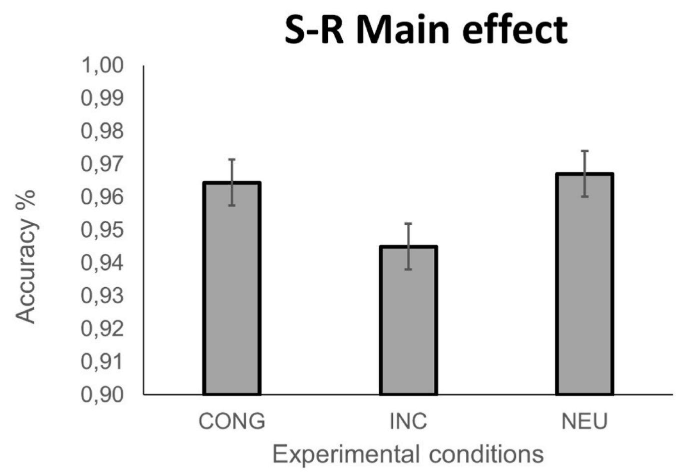

Fig. 4. Stimulus-Response (S–R) main effect for the whole sample: Accuracy percentage during Incongruent (INC) S-R was worse than during Congruent (CONG) and Neutral (NEU).

2.3. S-S conflict expressed as an interference measure

Finally, to better understand results from the last S-S x Phase × Group interaction, an ANOVA employing S-S Interference Error Size (incongruent—congruent error scores) was conducted with Phase (Home and Lab) as within factor and Group (HFA and NTC) as between factor. A significant interaction was observed between Phase and Group [F (1, 42) = 13.98, p = .001; ηp2 = .25; observed power = .95] (Fig. 5). Fisher LSD post hoc test for simple contrasts shows that for NTC the interference effect tended to be reduced when performed in our laboratory than in their own home (p = .057). Contrarily the HFA group demonstrated more interference in terms of S-S conflict during the lab than the home condition (p = .002). Furthermore, the interference effect on NTC participants at home was larger than those measured in HFA in the same phase (p = .005), while the opposite pattern was observable in lab phase, i.e., interference effect in HFA was significantly larger than

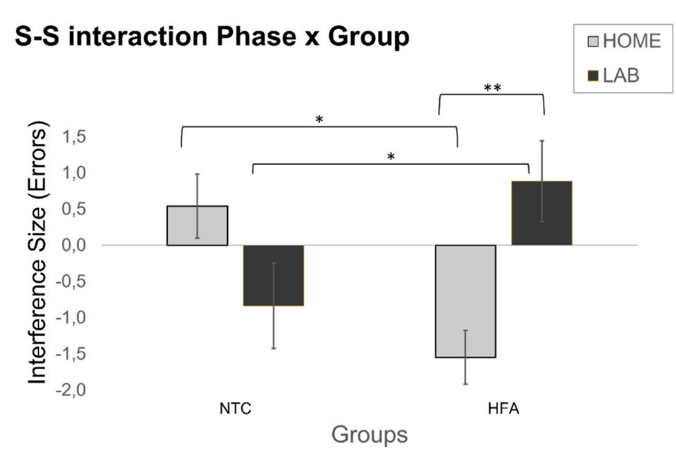

Fig. 5. Stimulus-Stimulus (S–S) Interference Error Size (incongruent—congruent error scores): Group × Phase interaction.

those in NTC (p = .020). No significant main effects were observed. Fig. 5 display these results.

3. Discussion

In the present study, we conducted a behavioral experiment to investigate the effects of both Stimulus-Stimulus (S-S) and Stimulus-Response (S-R) conflicts on target response in High-Functioning Autism (HFA) compared to neurotypical participants. Specifically, we sought to distinguish between the impact of short-term stimulus-response association interference and perceptual processing on target response. Our two-phase design also allowed us to test the hypothesis that different social contexts—namely, an "alone at home" setting versus a condition requiring attention-sharing with unfamiliar individuals—might differentially affect cognitive control skills in individuals with HFA.

Overall, our results revealed distinct effects of S-S and S-R conflicts on behavioral performance. Specifically, we observed a main effect in the S-R condition, where incongruent S-R stimulation slowed performance and reduced accuracy. No significant interactions emerged in reaction time or accuracy analyses, consistent with previous findings using the classic Flanker task (Brunetti et al., 2019; Eriksen & Eriksen, 1974; Sidarus & Haggard, 2016). This result suggests that short-term memory responses associated with flankers engage executive function skills, with the lack of interaction between the group factor indicating similar performance across both groups. This suggests that the inhibitory component of executive functions is preserved in adults with HFA compared to neurotypical counterparts.

Previous studies have yielded mixed results when examining inhibitory performance in individuals with autism using the Flanker task. For instance, Christ et al. found an inhibitory impairment in children with autism compared to controls (Christ et al., 2007), which contrasts with the findings of Iarocci and Burack (2004), who did not include an incongruent condition but instead focused on covert orienting responses. Additionally, in a study using an arrow Flanker task with EEG measures, Henderson et al. reported no differences between high-functioning children with autism and neurotypical controls, as all participants performed slower and less accurately on incompatible trials (Henderson et al., 2006). More recently, Adams and Jarrold (2012) sought to differentiate between two aspects of inhibitory processing in ASD: prepotent response inhibition and resistance to distractor interference. Using a stop-signal task and a modified Flanker task, they found that children with ASD performed similarly to matched controls in prepotent response inhibition but displayed impaired performance in the modified Flanker task's distractor interference condition. This result aligns with our S-R findings, where reaction times in the S-R conditions were comparable between groups.

Another key finding in our study was that context affected the performance of the two groups differently. Specifically, we examined whether sharing attention with unfamiliar people in the lab versus being alone at home would influence cognitive control abilities in HFA participants. Interestingly, our data suggest a general improvement in response speed in the "lab" condition compared to the "home" condition across S-R trials, indicating that a more socially demanding context might enhance performance by requiring a more focused approach.

Previous studies investigating inhibitory effects in the Flanker task have primarily focused on children and have not systematically examined adult populations with ASD, who may display different patterns of inhibitory function. Furthermore, few studies have considered the perceptual aspect of Flanker manipulations (i.e., S-S conflict). In a relevant study, Remington et al. used a Flanker task to examine perceptual load effects on selective attention in autism, finding that adults with autism required a higher perceptual load to ignore distracting stimuli, consistent with their detail-focused cognitive style (Remington et al., 2009). This model, known as Weak Central Coherence (WCC), suggests that individuals with autism perform best on tasks where analyzing individual details reduces errors or interference (Happé & Frith, 2006).

In our study, evidence supporting this model is found in the S-S manipulation, which involved two levels of perceptual load (high for incongruent and low for congruent trials). Our interaction data suggest that social context influenced S-S accuracy differently between HFA and neurotypical participants. Specifically, error interference analysis revealed that incongruent S-S trials led to more errors in HFA participants during the lab phase, while neurotypical controls showed a different pattern of interference across social contexts. This result suggests that, unlike their neurotypical peers, individuals with autism derive no benefit, in terms of error interference, from a "social" context, which otherwise appears to encourage a more focused approach in neurotypical participants. Consequently, our findings imply that adults with HFA show reduced resistance to distractors in a more socially demanding context.

According to Remington et al., individuals with HFA may require higher perceptual loads to ignore distractions, although this tendency appears to diminish in real-world settings where unfamiliar social presence requires additional engagement. Conversely, studies have suggested that social difficulties in HFA are alleviated during computer-mediated interactions, likely due to reduced social and emotional pressures and an increased sense of control (Benford & Standen, 2009).

In conclusion, this study directly compared the impact of executive control and perceptual conflict on the performance of HFA adults versus neurotypical controls, while also controlling for the effects of social context. Our results suggest that executive control in HFA adults is similar to that of neurotypical participants, indicating a preserved executive control capacity in HFA. However, the social context in which tasks were performed produced opposite outcomes for the two groups regarding perceptual conflict. For individuals with High-Functioning Autism, the "at home" setting provided a comfort zone free from social and emotional pressures, allowing them to emphasize a detail-focused cognitive style characterized by heightened resistance to perceptual interference.

CRediT authorship contribution statement

Brunetti Marcella: Writing – review & editing, Project administration, Methodology, Data curation, Conceptualization. **Alessandrelli Riccardo:** Writing – review & editing, Supervision, Conceptualization. **Ceci Franca:** Visualization, Investigation, Data curation. **D.'Andrea Antea:** Writing – review & editing, Visualization, Data curation. **Pettorruso Mauro:** Writing – review & editing, Supervision, Conceptualization. **Martinotti Giovanni:** Writing – review & editing, Supervision, Conceptualization. **Di Matteo Rosalia:** Writing – review & editing, Validation, Methodology, Formal analysis, Data curation, Conceptualization.

Statements and declarations

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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