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Salience and Context: Interpretation of Metaphorical and Literal Language by Young Adults Diagnosed with Asperger's Syndrome

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Asperger's Syndrome (AS) involves difficulties in social communication but no delays in language or cognitive development. According to the received view, individuals with AS are biased toward the literal and are insensitive to contextual cues. According to the graded salience hypothesis (Giora, 1997, 2003), participants with AS and controls would be sensitive to both context and degree of salience rather than to degree of nonliterality. Our results show that while individuals with AS generally performed worse than controls, their overall pattern of response was similar to that of controls: both groups performed worse on novel than on familiar expressions, whether literal or metaphorical; both groups benefited from context, which reduced response times and error rates on novel but not on familiar metaphors; both groups rated negative utterances as more metaphoric than their affirmative counterparts. Individuals with AS, then, are sensitive to context and degree of salience and are not biased toward the literal.

Asperger's Syndrome (AS) is an autism spectrum disorder (ASD) in the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 1994; Frith, 1991) that does not involve low verbal IQ or any general delay in language or cognitive development seen in typical autism. However, in keeping with other individuals diagnosed with autism, individuals with AS exhibit restricted patterns of behavior and interests (Frith, 1991), experience difficulties in social interaction and communication, and score low on empathy and theory of mind—the ability to "read" another's mind (and consequently another's behavior) and view it as different from one's own (see Baron-Cohen, Leslie, & Frith, 1985; Happé, 1993; Kaland et al., 2002; for a review, see Hamilton, 2009; for a different view, see Gernsbacher & Frymiare, 2005; Hamilton, 2009; but see Hobson, 1990, 1991, this issue). These deficits are often thought to

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account for the difficulties of participants with AS to incorporate contextual information into their mental representation (see "Contextual Information" subsection) and make sense of nonliteral language (see "Nonliteral Language"). In this paper we propose to consider the graded salience hypothesis (Giora, 1997, 1999, 2003) as an alternative account according to which it is degree of salience that matters rather than degree of literality (see "Graded Salience").

Contextual Information

The received view with regard to language comprehension and communication maintains that individuals diagnosed with AS do not benefit from contextual information such as background event knowledge, intonation, or facial expression (Baron-Cohen, 1988; Frith, 1989, 1991; Frith & Snowling, 1983; Happé, 1993; Kaland et al., 2002; Jolliffe & Baron-Cohen, 1999; Tager-Flusberg, 1981; Tager-Flusberg & Anderson, 1991; Tantam, 1991). Instead of considering pieces of information as parts of a comprehensive whole and, as such, dependent on contextual cues for their appropriate interpretation, individuals with AS tend to view information items as isolated, discrete units (Frith, 1989; Jolliffe & Baron-Cohen, 1999; Martin & McDonald, 2003, 2004; Schindele, Lüdtke, & Kaup, 2008). This strategy allows them to excel in memory for surface-structure information but seems to be a drawback when memory for a coherent "gist" is at stake (Jolliffe & Baron-Cohen, 1999; but see Martin & McDonald, 2004, for some counter evidence). This failure to integrate information from various sources and forge it into a coherent meaningful whole is termed "weak central coherence" (Frith, 1989; Frith & Happé, 1994; Happé, 1997; but see Beaumont & Sofronoff, 2008; Hoy, Hatton, & Hare 2004).

Weak central coherence, however, cannot explain all the findings concerning context effects. For instance, López and Leekam (2003), who tested context sensitivity among 15 16-year-old autistic individuals and matched peers, showed that, on the whole, the autistic participants benefited from contextual information; they failed, however, to rely on it only when they were tested on homographs (*lead*, *tear*), whose multiple meanings might not be familiar to them. Similarly, Norbury (2005) showed that only those autistic individuals with concomitant language impairments failed to benefit from contextual information. In this respect they were not different from non-autistic peers with the same language deficits. Using ERPs measures, Pijnacker, Geurts, van Lambalgen, Buitelaar, and Hagoort (2010) also showed that both individuals with and without AS exhibited same sensitivity to contextual information, demonstrating a typical N400 effect and a late positive component. This pattern of results, however, was not found for high-functioning adults with autistic disorder.

In addition, looking into language skills further rendered both groups similar in how they demonstrated contextual facilitation. Thus, using eye tracking, Brock, Norbury, Einav, and Nation (2008) showed that listening to contextual information failed to facilitate understanding only among those individuals with relatively poor language skills, regardless of autism. This may be taken to suggest that autism on its own may not account for the failure to recruit contextual information while processing linguistic stimuli.

Nonliteral Language

The received view with regard to nonliteral language maintains that individuals with AS are biased toward the literal and fail to make sense of nonliteral utterances (Adachi et al., 2004;

Baron-Cohen, 1997; Cohen & Rémillard, 2006; Happé, 1993, 1994, 1995; Kaland et al., 2002; Martin & McDonald, 2004; Ozonoff & Miller; 1996; Tantam, 1991 among others. For a review, see Kasari & Rotheram-Fuller, 2005). For instance, using pictorial probes, Dennis, Lazenby, and Lockyer (2001) tested metaphor interpretation among eight 10-year-olds diagnosed with AS. Results showed reduced ability of the experimental group to make sense of familiar metaphors compared to oral definitions of literals (and even compared to identifying the multiple meanings of ambiguities). Similarly, Nikolaenko (2003) compared understanding of unfamiliar metaphors among nine 12- to 15-year olds diagnosed with AS and two comparison (control) groups without AS including 55 7- to 16-year olds and 60 adults. Results showed that individuals diagnosed with AS failed to interpret metaphors compared to individuals without AS.

However, these findings are challenged by results from other studies that have considered variables such as familiarity and novelty. For instance, inconsistent with the received view, when familiar and unfamiliar metaphors were compared, it was novelty rather than metaphoricity that mattered. Thus, in an offline task, Gunter, Ghaziuddin, and Ellis (2002) compared understanding of familiar and novel metaphors and literals among eight 10- to 41-year olds diagnosed with AS and 8 age and verbal IQ matched controls. Results showed that while the experimental group fared similarly to the control group on literals and familiar metaphors, they fared worse than the latter on novel metaphors. Similarly, Jolliffe and Baron-Cohen (1999) tested the ability of 17 individuals with AS to understand familiar and less familiar meanings of homophones (*drew*) embedded in a biasing context (*John went to his art class. He drew a gun*). Results showed that, whereas both the experimental and the comparison groups fared similarly well on the familiar meaning of the homophones, the experimental group erred more frequently on less familiar meanings which also took them longer to interpret.

Some of these inconsistent findings can be explained by the exclusion of critical variables such as degree of familiarity or novelty of experimental items. Others may be explained by the small number of participants with AS and by their heterogeneity in terms of age, IQ, and diagnosis (varying between high and low functioning autism to AS). Alternatively, however, it is possible that these inconsistencies are due to focusing on the traditional literal/nonliteral divide. These could be resolved by exploring, instead, the importance of degree of meaning salience rather than of degree of (non)literality (Giora, 1997, 1999, 2003; for a similar view see Gunter et al., 2002; Jolliffe & Baron-Cohen, 1999).

Graded Salience

What is graded salience and how does it affect processing? A meaning of a stimulus is salient if it is coded in the mental lexicon and enjoys prominence due to factors such as experiential familiarity, frequency, conventionality, or prototypicality; a meaning is less-salient if it is coded but enjoys less prominence due to, for example, reduced exposure or low typicality; a meaning is nonsalient if it is not coded; that is, if it is novel or derivable. Meaning salience, then, is a matter of degree, ranging from coded meanings foremost on our mind to non-coded novel meanings.

According to the graded salience hypothesis, meaning salience rather than (non)literality governs processing: salient meanings are processed faster than less salient ones, regardless of context bias or (non)literality. Rich contextual information can be predictive of a stimulus' meaning; it can also be supportive and facilitative when later interpretive processes are concerned, but it cannot preempt activation of salient meanings even when inappropriate (Peleg & Eviatar, 2008, 2009; Peleg & Giora, 2011; Peleg, Giora & Fein, 2008).

Given that AS does not involve low verbal IQ or any general delay in language or cognitive abilities, the graded salience hypothesis need not posit specific assumptions about individuals diagnosed with AS when relevant variables such as degree of salience and context are concerned. However, AS is also known for social deficits; this means that people with AS may, on average, experience less or more narrow social interactions and thus be less exposed to verbal stimuli compared to typically developing (TD) individuals. They might, for instance, perform worse than the control group in terms of both RTs and error rates (see Gold & Faust, 2010, this issue; Gold, Faust, & Goldstein, 2010); without, however, exhibiting different patterns of behavior (as shown for familiar and novel metaphors in Gold & Faust, 2010 and in Gold et al., 2010).[1]

Based on the graded salience hypothesis (Giora, 1997, 1999, 2003), we therefore propose that (a) both, individuals with AS and matched controls are sensitive to degree of salience rather than degree of (non)literality; that (b) both, individuals with AS and matched controls can benefit from supportive contextual information; that (c) for both groups this information advantages interpretation of novel, nonsalient stimuli rather than nonliteral ones; and that (d) individuals with AS will perform worse than controls, but in essence, will exhibit similar patterns of sensitivities.

To test the predictions falling out of the graded salience hypothesis, we designed 3 experiments. In Experiments 1–2, the task was meaningfulness judgments and the measures were response times and response accuracy. In Experiment 3, the task involved rating the appropriateness of items' interpretations displayed at each end of a 7-point (non)literality scale.

All the experiments were run in Hebrew. They were approved by the ethical committee of Tel Aviv University and were also authorized by the Research Division, Ministry of Social Affairs, Israel.

In Experiment 1 we test the hypothesis that both young adults with AS and typically developing controls will exhibit sensitivity to degree of salience rather than to degree of metaphoricity. We thus expect both populations to perform better on familiar than on novel items, regardless of metaphoricity. Specifically, interpreting novel items should be costly and error-prone compared to interpreting familiar ones, whether literal or metaphoric.

In Experiment 2, we test the hypothesis that both young adults with AS and typically developing controls will be sensitive to (a) degree of salience rather than degree of (non)literality and (b) profit from supportive contextual information which, however, (c) will benefit novel items to a greater extent than familiar ones, regardless of metaphoricity. We thus expect both populations to perform better on familiar than on novel items, regardless of metaphoricity. Specifically, we expect interpreting novel items to be costly and error-prone compared to interpreting familiar items, whether literal or metaphoric.

Experiment 3 aims to further contest the received view that individuals with AS are biased toward the literal and consequently fail to make sense of metaphors. Since the metaphoric items in Experiments 1–2 involve semantic anomalies and can thus trigger derivation of a metaphoric

[1]In Gold and her colleagues' studies relative familiarity was established only for metaphors.

interpretation (Beardsley, 1958; Grice, 1975), the stimuli in Experiment 3 are semantically felicitous. Participants are presented statements such as *I am/am not your maid*, which, outside of a specific context, are potentially susceptible to both literal and nonliteral interpretations. However, based on previous findings (Giora, Fein, Metuki, & Stern, 2010), we do not expect such statements to encourage readers with AS to invariably opt for the literal interpretation, as would be predicted by the received view. Instead, given that the negative version of such items is frequently used metaphorically whereas the affirmative version is often used literally, which is also true of novel instances (see Giora et al., 2010), we expect individuals with and without AS to assign the negative version a nonliteral interpretation to a greater extent than the affirmative version.

Participants

The experimental participants of our studies were diagnosed with Asperger's syndrome by at least 2 board-certified psychiatrists using *DSM–IV* (1994) criteria on the basis of information ascertained using the ADI-R (Autism Diagnostic Interview–Revised; see Lord, Rutter, & Le Couteur, 1994), ADOS (Autism Diagnostic Observation Schedule; see Lord et al., 2000; Lord, Rutter, & Goode et al., 1989), and the ASDS (Asperger's Syndrome Diagnostic Scale; see Myles, Bock, & Simpson, 2001). Their dossiers, however, did not include IQ scores. The diagnoses were recognized by the Israeli Social Security (on the basis of which such individuals are allocated allowances).

Participants of Experiments 1–2 were 28 young adults diagnosed with AS and 28 controls, matched for age, sex, and education, without a history of a mental disorder, AS, or neurological impairment and without a history of drug or alcohol abuse (see Appendix A). They participated in both experiments but they never saw the same item twice. The two experiments were the same except for the context, which was neutral and uninformative in the first, and supportive but nonpriming in the second. Participants of Experiment 3 were 20 young adults diagnosed with AS (as in Experiments 1–2) and 20 (age and education) matched controls without AS. All the participants were native speakers of Hebrew. Written informed consent was obtained from all participants.

EXPERIMENT 1

The aim of Experiment 1 was to show that both young adults with and without AS are sensitive to degree of salience rather than to degree of metaphoricity.

Method

Design

A 2 × 2 × 2 mixed design was used with literality
(Metaphor/Literal) and Familiarity (Familiar/Novel) as within-subjects factors, and type of group (AS/Control) as a between-subjects factor.

Participants

Initially participants included 62 young adults divided into experimental (30 participants) and comparison (32 participants) groups. However, of the 30 experimental participants, 2 were discarded for having reading problems and lack of cooperation; of the 32 control participants, 3 were discarded for having ADD and 1 was discarded for having PTSD and depression. The experimental group thus ended up with 28 individuals (26 men, 2 women) aged 17–34 ($M = 23.1$, $SD = 3.6$), with ~12 years of schooling, all functioning socially and living in the community. Ten participants reported of having learning disabilities and 15 reported of taking psychiatric drugs on a regular basis. Seven were left-handed. (For more specific information, look up participants 1–28 on Table A1, Appendix A). The comparison group ended up with 28 individuals not diagnosed with AS, matched for gender (24 men, 4 women), age ($M = 22.9$, $SD = 1.5$), and (12 years of) schooling. They had no history of a mental disorder or neurological impairment, and no administering of psychiatric drugs was reported (see Table A2, Appendix A).

All the participants either volunteered to take part in the experiment or received a pay equivalent to $7. They all signed an informed consent form prior to the experimental session.[2]

Materials

Materials included 128 experimental word-pairs divided into 4 categories (32 word-pairs in each) and 16 meaningless fillers (see 1a–5a, and see also Appendix B; for the full list of the Hebrew items, see http://www.tau.ac.il/~giorar/materials.html). The experimental categories included 32 familiar metaphors (FM) such as *flower bed*, 32 novel metaphors (NM) such as *Dying Star*, 32 familiar literals (FL) such as *wooden table*, and 32 novel literals (NL) such as *Tverian horse*.[3] The novel (NM, NL) items were all optimal innovations, involving a salient but incompatible meaning in addition to the compatible non-salient one. (On novel metaphors and novel literals as optimal innovations involving similar processes, see Giora et al., 2004.) Thus, on top of their novel meaning, NM items (such as *Dying Star*) involved at least one salient/familiar literal or metaphoric meaning ("A Born Star"—a popular Israeli TV show); similarly, on top of their novel meaning, NL items (*Tverian horse*) also involved at least one familiar meaning ("Trojan horse") associated with it (Tveria—Hebrew for Tiberias—is an Israeli city). In this sense, NM and NL items are structurally equivalent. (On literals having a "metaphoric" structure, see also Coulson & Van Petten, 2002).

In this experiment, all the experimental word-pairs and the fillers were provided a neutral two-word context (e.g., "I saw"):

1a. I saw a *flower bed*. (FM)
2a. I saw a *Dying Star*. (NM)
3a. I saw a *wooden table*. (FL)
4a. I saw a *Tverian horse*. (NL)
5a. I saw a *bunny laundry*. (Meaningless)[4]

[2]Given the nosological debate surrounding Asperger's syndrome, our findings reported later need not necessarily generalize to other ASD individuals.

[3]Some metaphoric items were taken from Mashal, Faust, & Hendler (2005).

[4]Note that in Hebrew there are neither indefinite articles nor capital letters.

Four booklets were prepared so that each participant saw 32 experimental items (8 of each of the 1a–4a types) and another 26 items which were identical for all booklets—16 meaningless filler items (5a), 5 training items, 4 buffers, and 1 example. All the experimental phrases were matched for number of syllabi, and no word appeared more than once in each booklet. Occasionally, the meaningful items were followed by a comprehension question, 8 per booklet. For example, following (2a) participants were presented with the question: "Does the sentence mention a good thing?"; following (4a) they were presented with another question: "Does the sentence mention an animal?"

Three pretests were run to control for (a) the familiarity of the individual words that make up the target word-pairs, (b) the familiarity of the target word-pairs, and (c) the aptness of the novel items. For lack of participants with AS, all pretests involved only participants without AS:

Pretest 1: Familiarity of the individual words. To make sure that all the individual words making up the items are of similar familiarity/salience, we ran a familiarity pretest. Thirty participants without disabilities aged 19–35 ($M = 27.6$, $SD = 5.4$), who did not participate in the main experiments, were presented about 450 words (each group of 10 participants saw approximately 150 words) and were asked to rate them on a 7-point familiarity scale (where 1 = *least familiar* and 7 = *most familiar*). The words selected for the experimental and Meaningless word-pairs were *highly familiar*, scoring 5 and above ($M = 6.36$, $SD = 0.47$).

Pretest 2: Familiarity of the word-pairs. To compile familiar and novel word-pairs, another 10 participants without disabilities aged 20–27 ($M = 23.2$, $SD = 2.2$), who did not participate in the main experiments, were presented word-pairs which they were asked to rate on a 7-point familiarity scale (where 1 = *least familiar* and 7 = *most familiar*). The word-pairs selected for the experiments either scored 5 and above ($M = 6.6$, $SD = 0.54$) (and made up the familiar items) or 3 and below ($M = 1.5$, $SD = 0.51$) (and made up the novel items) and were evenly divided between metaphoric (1a–2a) and literal (3a–4a) targets. (On familiar, conventionalized metaphors being indeed metaphors, see, e.g., Gibbs, 1994; Glucksberg & Keysar, 1990; Lakoff & Johnson, 1980).

Pretest 3: Aptness of the novel items. Whereas processing of familiar items is not affected by degree of aptness, the aptness of novel items is (Blasko & Connine, 1993; Thibodeau & Durgin, 2011) and needs to be established. We therefore presented 5 experts without disabilities (a copywriter, a translator, and 3 teachers of Hebrew), aged 31–35 ($M = 32$, $SD = 2$) the novel items and asked them to rate them on a 7-point aptness scale (where 1 = *least apt* and 7 = *most apt*). The aptness mean of NL items was 4.96 ($SD = 1.09$); the aptness mean of the NM items was 4.26 ($SD = 0.76$). The difference between them was statistically significant, $t(62) = 2.99$, $p < .005$.

Procedure

Participants were tested individually. Each participant was seated in a quiet room in front of a computer screen (Presario 2700, Compaq) and was instructed (orally and in writing) to read the sentences and make a meaningfulness decision by pressing the "yes" or the "no" key. The "yes" key was assigned to the participant's dominant hand. Occasionally, a meaningful item was followed by a comprehension question. There was a training session and the experiment started only after the experimenter was sure the participant understood the task.

The task involved advancing the text gradually by pressing the space key: first the participant was presented the stem-context ("I saw a"). Pressing the key displayed the target word-pairs (and hence, the whole sentence). At this point, the participant had to decide whether the sentence made sense or not by pressing the "yes" or "no" key. Following the pressing of the key, a blank screen was displayed and by the next pressing of a key, at the participant's own pace, the next item was displayed. In this way, participants advanced the items at their own natural pace. The items' order of presentation was random.

Response times—between the display of a word-pair and the pressing of a key—and response accuracy were recorded by the computer.

Results and Discussion

Error Rates

Results of the comparison group are presented in Table 1 and illustrated by the left panel of Figure 1. Results of the experimental (AS) group are presented in Table 2 and illustrated by the right panel of Figure 1.

A 3-way ANOVA was run with Group (AS/Control) as a between subject variable, and Familiarity (Familiar/Novel) and Literality (Literal/Metaphoric) as within subject variables. It showed that both groups exhibited similar patterns of behavior. Specifically, significant effects of Group, $F(1, 54) = 12.26$, $p < .001$ (control participants performed better than participants with AS), Familiarity, $F(1, 54) = 114.50$, $p < .0001$ (familiar word-pairs made more sense than novel ones), and Literality, $F(1, 54) = 26.43$, $p < .0001$ (literal items seemed more sensible than metaphoric ones) were found. However, there were no 2-way or 3-way significant interactions – participants with AS and controls showed the same pattern of results (see Figure 1).

Response Times

Outliers above 2 *SD* from the mean of each participant were discarded from the analyses. Overall, 87 out of 1792 RTs (4.8%) were removed (45 from the experimental group and 42 from

TABLE 1
Mean Error Rates in All Experimental Conditions for the Control Group: Experiment 1 (*SD* in Parentheses)

	Familiar	*Novel*	*Mean*
Literal	0.067 (0.138)	0.406 (0.263)	0.237
Metaphoric	0.174 (0.175)	0.478 (0.268)	0.326
Mean	0.121	0.442	

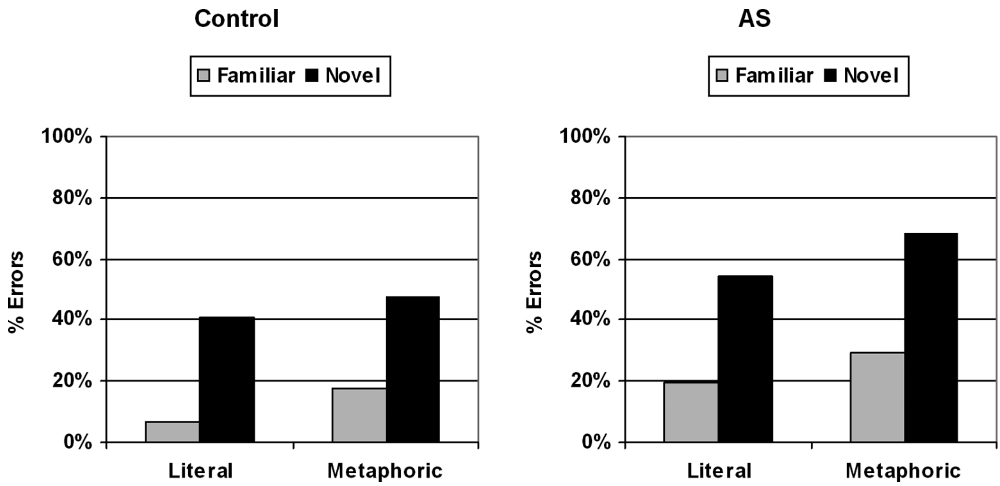

FIGURE 1 Mean percentage of errors for familiar and novel (metaphoric and literal) items, for control and AS groups (Experiment 1).

TABLE 2
Mean Error Rates in All Experimental Conditions for the AS Group: Experiment 1 (*SD* in Parentheses)

	Familiar	*Novel*	*Mean*
Literal	0.196 (0.200)	0.545 (0.273)	0.371
Metaphoric	0.295 (0.224)	0.683 (0.244)	0.489
Mean	0.246	0.614	

TABLE 3
Mean RTs for Correct Responses to All Experimental Conditions for the Control Group: Experiment 1 (*SD* in Parentheses)

	Familiar	*Novel*	*Mean*
Literal	2370 (1357)	2993 (1372)	2681
Metaphoric	2374 (823)	3198 (1618)	2786
Mean	2372	3095	

the control group). The basic data for the analyses were mean RTs of correct responses. In cases in which there was no correct response in a cell, or only one RT (out of 8), the participant's overall mean was taken instead. Overall, 20 out of 224 means were imputed (14 from the experimental group and 6 from the control group). Results of the control group are presented in Table 3 and illustrated by the left panel of Figure 2. Results of the experimental (AS) group are presented in Table 4 and illustrated by the right panel of Figure 2.

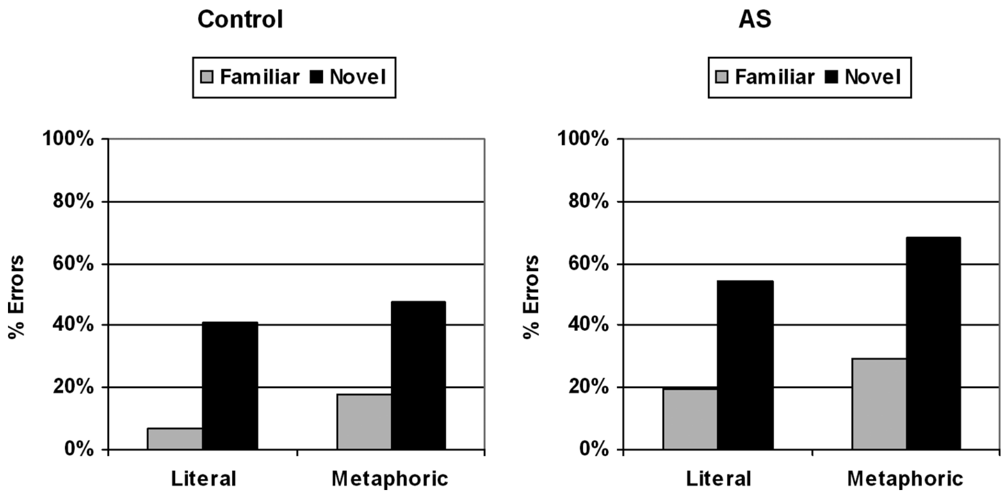

FIGURE 2 Mean RTs for correct responses to familiar and novel (metaphoric and literal) items, for control and AS groups (Experiment 1).

TABLE 4
Mean RTs for Correct Responses to All Experimental Conditions for the AS Group: Experiment 1 (*SD* in Parentheses)

	Familiar	*Novel*	*Mean*
Literal	3089 (1536)	4167 (2173)	3628
Metaphoric	3699 (2122)	3601 (1640)	3650
Mean	3394	3884	

A 3-way ANOVA was run with Group (AS/Control) as a between subject variable, and Familiarity (Familiar/Novel) and Literality (Literal/Metaphoric) as within subject variables. It showed significant effects of Group, $F(1, 54) = 5.15$, $p < .05$, Familiarity, $F(1, 54) = 35.25$, $p < .0001$, Familiarity × Literality, $F(1, 54) = 5.41$, $p < .05$, and a significant 3-way interaction (Group × Familiarity × Literality), $F(1, 54) = 10.77$, $p < .005$.

Since a 3-way interaction is hard to interpret, we ran separate 2-way ANOVAs (with the variables of Familiarity and Literality), one for each group. As predicted, the control group showed sensitivity to degree of novelty rather than to degree of metaphoricity. Novel items took longer to respond to than familiar ones, $F(1, 27) = 31.18$, $p < .0001$, but there was no effect of Literality, $F(1, 27) < 1$, n.s., and no Familiarity × Literality interaction, $F(1, 27) < 1$, n.s.

The pattern of result was somewhat different for the experimental group. Again, we found a Familiarity effect, $F(1, 27) = 9.60$, $p < .005$, and no Literality effect, $F(1, 27) < 1$, n.s., but this time the Familiarity × Literality interaction was significant, $F(1, 27) = 15.83$, $p < .0005$. The interaction can be seen in the right panel of Figure 2. Indeed, as predicted, novel literals took longer to respond to compared to familiar literals. However, for the metaphors—degree of novelty did not matter: novel metaphors took approximately the same time to respond to compared to familiar ones.[5]

Taken together, especially accuracy but also reading times show that both populations *understood* familiar stimuli better than novel ones, regardless of metaphoricity. Specifically, the comparison group erred less on familiar items compared to novel ones and was faster to read the familiar items compared to the novel ones, regardless of metaphoricity; individuals with AS also erred less on familiar items compared to novel ones, regardless of metaphoricity. They were also faster to read familiar literal items than novel literal items. However, they did not take longer to read novel metaphors compared to familiar ones.

Findings of Experiment 1, then, are all straightforward except for the experimental participants' irreconcilable results concerning the novel metaphors. Whereas error rates indicate lack of understanding of novel metaphors, as predicted, response times do not disclose specific difficulties with novel compared to conventional metaphors.[6] Indeed, fast reading times need not always attest to ease of processing, as shown by Budiu and Anderson (2008, p. 358). (In their study, nonsensical nonliteral sentences were faster to read than sensible nonliteral ones). If, indeed, our experimental group's fast reading times of novel metaphors are a consequence of speed–accuracy trade-off (e.g., Ratcliff & Rouder, 1998), then this suggests that, without contextual support, for the AS group, novel metaphors were more difficult to interpret than novel literals, as might be predicted from their lower aptness rates. (On aptness as contributing to metaphoric interpretation, see, e.g., Chiappe & Kennedy, 1999; Jones & Estes, 2005). Furnishing the items of Experiment 1 with contextual support might, therefore, be particularly instrumental in affecting the comprehensibility and aptness of the low apt figurative expressions (as shown by, e.g., Chiappe, Kennedy, & Chiappe, 2003; Gibbs, 1994). Such support may thus encourage deeper processing, allowing a more accurate insight into the nature of processing of novel expressions receptive to amelioration. Will the experimental group, then, be sensitive to such contextual information? Will it improve its performance? Experiment 2 was designed to test the hypothesis that both individuals with and without AS will benefit from contextual information which will improve their performance on low salience low apt items.

EXPERIMENT 2

Experiment 2 aimed at disclosing the effect of contextual information on interpretation. It tested the predictions falling out of the graded salience hypothesis that, although individuals with AS will perform worse than controls, both groups will be sensitive to supportive contextual information which, however, will benefit novel items to a greater extent than familiar ones, regardless

[5]Running the analyses on all the responses, the incorrect ones included, produced the same results.

[6]This is also the case when all the responses are included in the analysis or when participants, who made either 7 or 8 errors in one of the conditions, are discarded from the analysis.

of metaphoricity (thus clarifying the unresolved issues in Experiment 1). The experiment thus included the same targets (word-pairs) as in Experiment 1, which this time were furnished with a 2-sentence, supportive (but non-priming) context.

Method

Design

Same as in Experiment 1.

Participants

Same as in Experiment 1.

Materials

Same as in Experiment 1. However, this time, the targets (word-pairs) were embedded in 2-sentence, supportive (but non-priming) contexts (see also Appendix B; for the full list of the Hebrew items, see http://www.tau.ac.il/~giorar/materials.html). Needless to say, no participant has seen the same items s/he had been presented with in Experiment 1:

1b. It was raining heavily when I got out of the car. Trying to escape the puddle, I landed on a *flower bed*. (FM)
2b. I bought a CD which cost me 100 shekels. When I got home I realized it was that of A *Dying Star*. (NM)
3b. Yasmin and Yaron moved to a new flat. They ordered a new TV set and a *wooden table*. (FL)
4b. The policeman from Nahariya was driving his police car. Suddenly on the road there appeared a *Tverian horse*. (NL)

To make sure that contextual information was indeed supportive but non-priming, a pretest was conducted. Ten participants without disabilities aged 17–26 ($M = 20.1$, $SD = 3.3$) were presented the contexts without the word-pairs ("Yasmin and Yaron moved into a new flat. They ordered a new TV set and a") and were asked to complete them with one or two words that came to mind first. Contexts completed by the designated or similar in meaning word-pairs by more than one person were excluded from the experimental materials.

Procedure

Similar to Experiment 1. Initially, though, each participant was presented the first sentence of the two-sentence context ("Yasmin and Yaron moved into a new flat"). Pressing the key displayed the beginning of the second sentence. From that point on, the procedure was the same as in Experiment 1.

Results and Discussion

Error rates. Results of the control group are presented in Table 5 and illustrated by the left panel of Figure 3. Results of the experimental group are presented in Table 6 and illustrated by the right panel of Figure 3.

A 3-way ANOVA was run with Group (AS/Control) as a between-subject variable, and Familiarity (Familiar/Novel) and Literality (Literal/Metaphoric) as within subject variables. It showed significant effects of Group, $F(1, 54) = 9.90$, $p < .005$ (control participants performed

TABLE 5
Mean Error Rates in All Experimental Conditions for the Control Group: Experiment 2 (*SD* in Parentheses)

	Familiar	*Novel*	*Mean*
Literal	0.076 (0.120)	0.371 (0.251)	0.223
Metaphoric	0.107 (0.121)	0.263 (0.219)	0.185
Mean	0.092	0.317	

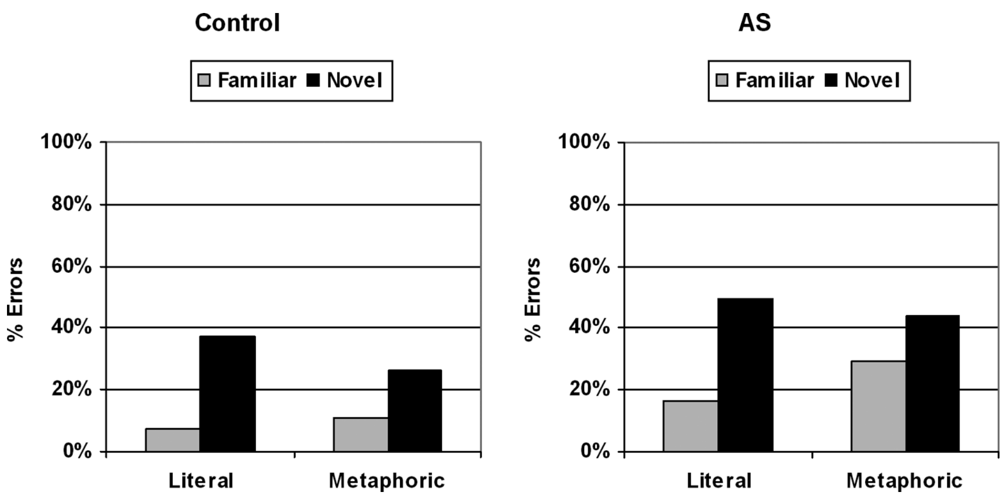

FIGURE 3 Mean percentage of errors for familiar and novel (metaphoric and literal) items, for control and AS groups (Experiment 2).

TABLE 6
Mean Error Rates in All Experimental Conditions for the AS Group: Experiment 2 (*SD* in Parentheses)

	Familiar	*Novel*	*Mean*
Literal	0.165 (0.190)	0.491 (0.289)	0.328
Metaphoric	0.290 (0.204)	0.438 (0.303)	0.364
Mean	0.228	0.464	

better than participants with AS), Familiarity, $F(1, 54) = 80.48$, $p < .0001$ (familiar word-pairs made more sense than novel ones), and a Familiarity × Literality interaction, $F(1, 54) = 15.41$, $p < .0005$. This interaction, which can be seen in Figure 3, implies that for both experimental and the comparison group, the difference between making sense of novel and familiar items was larger in literals as compared to metaphors. There were no other significant interactions. Notably, there were no interactions with Group—the pattern of results was identical for both the experimental and the comparison group.

Response times. Outliers above 2 *SD* from the mean of each participant were discarded from the analyses. Overall, 103 out of 1792 RTs (5.7%) were removed (51 from the experimental group and 52 from the control group). As in experiment 1, the basic data for the analyses were the mean RTs of correct responses. Eleven out of 216 means were imputed (10 from the experimental group and 1 from the comparison group). Results of the comparison group are presented in Table 7 and illustrated by the left panel of Figure 4. Results of the experimental group are presented in Table 8 and illustrated by the right panel of Figure 4.

A 3-way ANOVA was run with Group (AS/Control) as a between subject variable, and Familiarity (Familiar/Novel) and Literality (Literal/Metaphoric) as within subject variables.

TABLE 7
Mean RTs for Correct Responses to All Experimental Conditions for the Control Group: Experiment 2 (*SD* in Parentheses)

	Familiar	*Novel*	*Mean*
Literal	2263 (1214)	2901 (1242)	2582
Metaphoric	2109 (860)	2550 (1181)	2329
Mean	2186	2725	

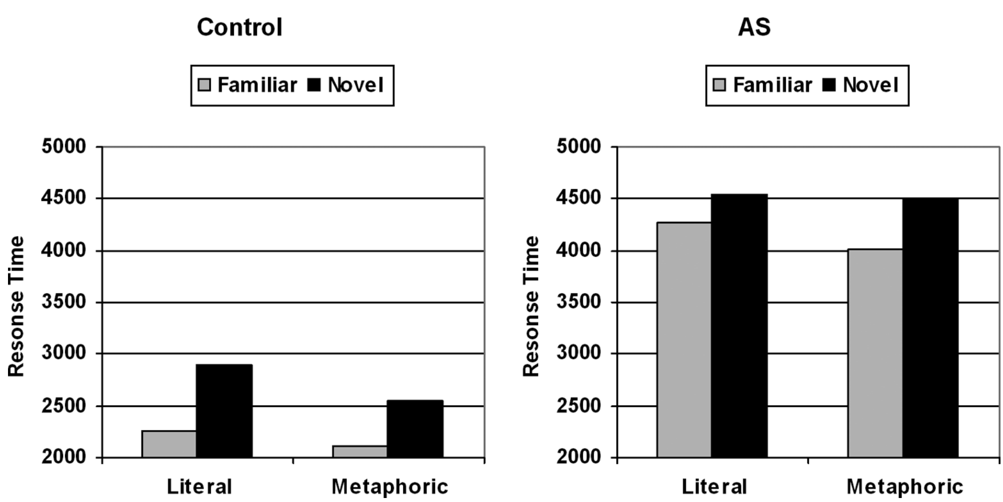

FIGURE 4 Mean RTs for correct responses to familiar and novel (metaphoric and literal) items, for control and AS groups (Experiment 2).

TABLE 8
Mean RTs for Correct Responses to All Experimental Conditions for the AS Group: Experiment 2 (*SD* in Parentheses)

	Familiar	*Novel*	*Mean*
Literal	4262 (2455)	4550 (2203)	4406
Metaphoric	4021 (2188)	4479 (2722)	4250
Mean	4142	4515	

It showed significant main effects of Group, $F(1, 54) = 17.77$, $p < .0001$ (control participants responded faster than participants with AS) and Familiarity, $F(1, 54) = 11.64$, $p < .005$ (participants responded faster to familiar items than to novel ones), but no literality effect (participants' responses to literal and metaphoric items were similar). None of the interactions were significant.

Experiment 1 versus Experiment 2: Outside/Inside a Supportive Context

To allow a more accurate evaluation of context effects on the experimental items, analyses of the results outside (Experiment 1) and inside (Experiment 2) a supportive context were attempted. Separate analyses were run for the control and the AS group.

Control Group

Error rates. A 3-way ANOVA was run with Context (−/+ Context), Familiarity (Familiar/Novel), and Literality (Literal/Metaphoric) as within subject variables. It resulted in significant effects of Context, $F(1, 27) = 9.51$, $p < .005$, Familiarity, $F(1, 27) = 61.23$, $p < .0001$, and interaction effects of Context × Familiarity, $F(1, 27) = 6.78$, $p < .05$ (namely, context benefited novel items, but not familiar ones), Context × Literality, $F(1, 27) = 14.44$, $p < .001$ (namely, context benefited metaphors, but not literals), and Familiarity × Literality, $F(1, 27) = 4.44$, $p < .05$.

Response times. The same 3-way ANOVA was run with Context (−/+ Context), Familiarity (Familiar/Novel), and Literality (Literal/Metaphoric) as within subject variables. It showed a significant effect of Context, $F(1, 27) = 7.58$, $p < .05$, Familiarity, $F(1, 27) = 47.74$, $p < .0001$, and an interaction effect of Context × Literality, $F(1, 27) = 11.39$, $p < .005$ (namely, context benefited metaphors but not literals). Other effects were not significant.

AS Group

Error rates. A 3-way ANOVA was run with Context (−/+ Context), Familiarity (Familiar/Novel), and Literality (Literal/Metaphoric) as within subject variables. It resulted in significant effects of Context, $F(1, 27) = 9.68$, $p < .005$, Familiarity, $F(1, 27) = 64.96$, $p < .0001$, and Literality, $F(1, 27) = 9.13$, $p < .01$, as well as in Context × Familiarity interaction, $F(1, 27) = 9.97$, $p < .005$, and Context × Literality interaction, $F(1, 27) = 5.41$, $p < .05$. The 3-way Context × Familiarity × Literality interaction was also significant, $F(1, 27) = 5.42$, $p < .05$. This interaction is a result of the 2-way interaction (Familiarity × Literality) found in Experiment 2 (caused by the difference between error rates for novel and familiar items which was larger in literals as compared to metaphors) and lack of it in Experiment 1. (For evidence, compare the right panel of Figure 1 to the right panel of Figure 3).

Response times. The same 3-way ANOVA was run with Context (−/+ Context), Familiarity (Familiar/Novel), and Literality (Literal/Metaphoric) as within subject variables. It showed a significant effect of Context, $F(1, 27) = 4.71$, $p < .05$, and a significant effect of Familiarity, $F(1, 27) = 11.43$, $p < .005$. Importantly, there was a significant 3-way interaction (Context × Familiarity × Literality), $F(1, 27) = 6.35$, $p < .05$. This interaction was caused by the difference between the 2-way interaction (Familiarity × Literality) for the AS group, reported earlier in Experiment 1, and lack of it in Experiment 2. (For evidence, compare the right panel of Figure 2 to the right panel of Figure 4).

Contra the received view, then, but in line with the graded salience hypothesis (Giora, 1997, 2003), results show that both typically developed individuals and individuals with AS exhibit same patterns of sensitivity to degree of meaning salience. Results from error rates, but also response latencies, show that for individuals with AS it is not metaphor that is difficult to understand, but, rather, the *novelty* of a metaphoric expression. Likewise, for individuals with AS, it is not literal language that is easy to interpret; it is familiar language that is. It is not figurativeness, then, that matters, but degree of salience (see Giora, 1997, 2003).

Similarly, the claim that individuals with AS ignore contextual information is also not warranted by our findings. Rather, our results show that context matters significantly; in fact, it is supportive contextual information that allowed participants with AS to make sense of novel metaphors which were dismissed as meaningless in the absence of such context (Experiment 1). In this respect too, participants with AS did not differ from typically developing controls.

Overall, then, although the comparison group outperformed the AS group, in essence, the pattern of results of the two groups mostly was the same, as predicted by the graded salience hypothesis. Thus, our claim that the relevant distinction, for both groups, is not degree of (non)literality but degree of salience has gained support. In addition, our anticipation that contextual information will benefit nonsalient novel items to a greater extent than salient familiar ones has also gained support here.

To better illustrate the effect of context on novel items compared to familiar ones, we weighed the amount of incorrect responses to familiar and novel items in neutral (Experiment 1) compared to supportive context (Experiment 2). As shown by Figure 5, context had no effect on familiar items (whether literal or metaphoric)—it did not result in any reduction of the amount of incorrect responses to these items. In contrast, its effect on novel metaphors was pronounced. Specific contrasts show that whereas high apt novel literals did not benefited from context, $F(1, 55) = 1.67$, $p = .20$, low apt novel metaphors did $F(1, 55) = 38.51$, $p < .0001$.

How does degree of (non)literality affect the results, then? Has the experimental group fared worse on metaphors than on literals compared to the comparison group? Outside a supportive context (Experiment 1) error rates indicate difficulties with metaphors, novel metaphors in particular; this however is true of both groups. In contrast, when allowed access to supportive contextual information (Experiment 2), novel metaphors are facilitated. It is possible that, in the absence of supportive contextual information, low apt items (i.e., the novel metaphors) were more difficult to understand than high apt items (i.e., the novel literals). Low apt items were therefore more receptive to facilitative effects of supportive contextual information when this was made

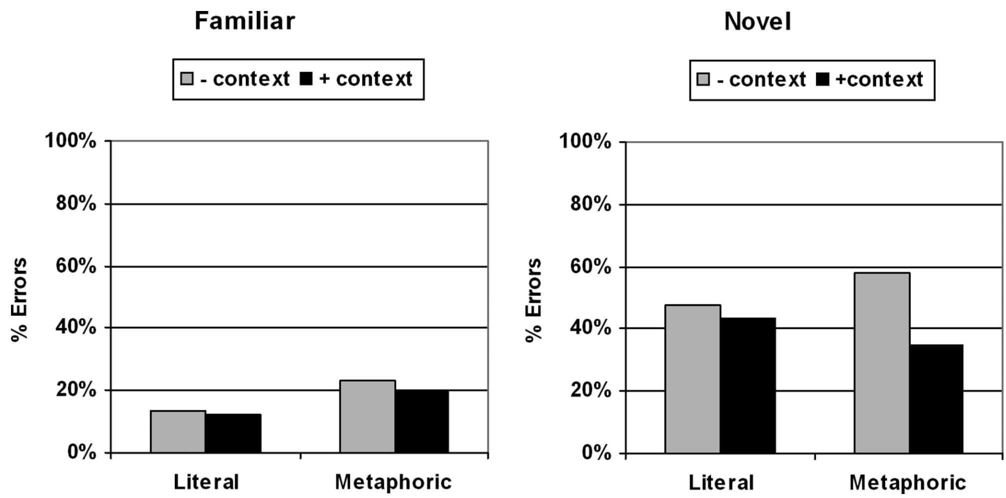

FIGURE 5 Mean percentage of errors for familiar and novel (metaphoric and literal) items outside and inside context, for all participants (Experiments 1 and 2).

available (see Chiappe et al., 2003; Gibbs, 1994). Importantly, however, this pattern of results was true of both groups.

In sum, for both groups, the variable that mattered was degree of salience rather than degree of (non)literality. In addition, both groups benefited from contextual information which affected novel low apt items.

EXPERIMENT 3

To further challenge the view that individuals with AS are biased toward the literal and find metaphors hard to understand, we ran Experiment 3. Whereas the metaphoric items of Experiments 1–2 involve semantic anomaly (known to trigger metaphoricity, see, e.g., Beardsley, 1958), the items of Experiment 3 do not. They are also presented in isolation so as to block contextual effects on their literal or nonliteral interpretation.

In Experiment 3, 20 young adults diagnosed with AS and 20 matched individuals without AS were presented negative statements and their affirmative counterparts. The negative statements (*I am not your maid*; *You are not my boss*) are potentially susceptible to both a literal interpretation ("I am not an employed woman hired to attend to your needs"; "I don't work for you and you don't pay me for that work") as well as a metaphoric interpretation ("I'm not someone that you can lay your demands on all of the of time"; "don't tell me what to do"). However, as shown in Giora et al. (2010), they are mostly interpreted metaphorically rather than literally even outside a specific context. Similarly, the affirmative versions (*I am your maid; You are my boss*) may also be interpreted either literally ("I am paid to attend to your needs"; "I work for you and you pay me for that work") or metaphorically ("I will serve you like a maid"; "please let me know what you want me to do). Still, as shown in Giora et al. (2010), they tend to be interpreted literally even in specific contexts.

Unlike the items used in Experiments 1–2, neither version depends on any breach of (literal) truth to encourage a nonliteral interpretation (Grice, 1975) which, potentially, is as optional as the literal alternative. Thus, if individuals with AS are indeed biased toward the literal, they will opt for that interpretation, regardless of whether the items are negative or affirmative. However, if they are not, then they will discriminate between the negative and affirmative items.

Given the findings of Experiments 1–2, we expect both individuals with and without AS to opt for a more metaphoric interpretation when encountering a negative statement than when encountering an affirmative alternative.

Method

Participants. Participants included 20 young adults (13 men, 7 women) aged 21–39 ($M = 25.2$, $SD = 5.2$), with 12–15 years of schooling, who were diagnosed with AS (as in Experiments 1–2). They were all functioning socially and living in the community. Four participants reported of having other disabilities (OCD, ADHD, motor difficulties and behavioral problems, and epilepsy) and 7 reported of taking psychiatric drugs on a regular basis. (For more specific information, see the asterisked numbers marked on the Demographic Table A1, Appendix A). In addition, there were 20 (age and education) matched controls without disabilities (12 women, 7 men, and another subject who failed to specify gender), aged 19–38 ($M = 24.1$, $SD = 4.5$), with 12–15 years of schooling, except for one who was a lecturer.

Materials. Materials included 16 items involving a negative modifier (*You are not my boss*) and their affirmative counterparts (*You are my boss*). Two booklets were prepared so that each participant would be presented only one item of a pair. Each booklet included 8 affirmative items, 8 negative items, and 7 similar filler items. Each item was followed by a 7-point scale which featured two different interpretations—either literal or metaphoric—presented randomly at each end of the scale (Figure 6).

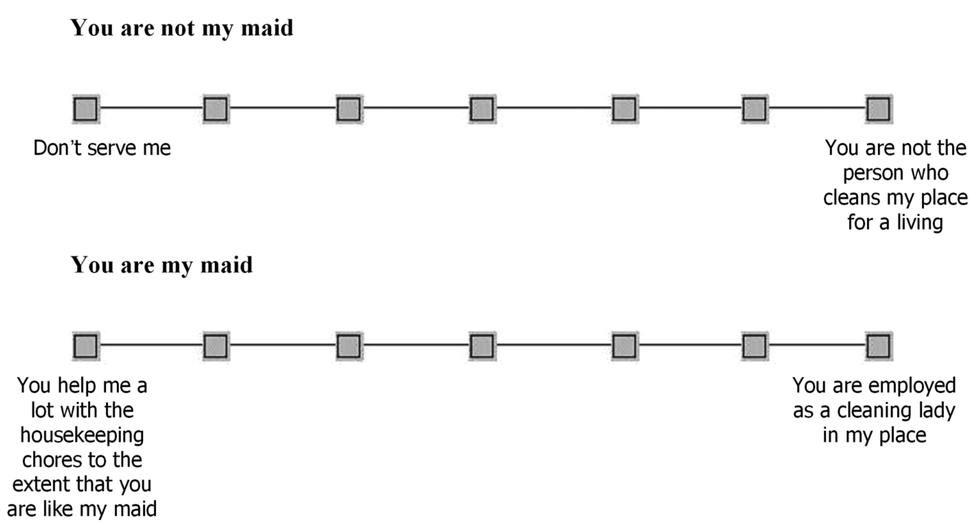

FIGURE 6 7-point nonliterality scales.

Procedure. Participants were presented a booklet and were asked to specify, on a 7-point scale whose ends instantiated either a literal (= 1) or a metaphoric (= 7) interpretation, the proximity of the interpretation of the item to any of those instantiations at the scale's ends. In case they did not agree with any of the interpretations, they were allowed to come up with an interpretation of their own.

Results and Discussion

Since there were only 22 cases out of 640 (3.4%) in which participant offered their own interpretations, we did not include those cases in the analysis. Results are presented in Table 9. Two 2-way ANOVAs (subject and item analyses) were performed, with Group (AS/control) as a between-subject variable, and Sentence-type (Affirmative/Negative) as a within-subject variable.

Both ANOVAs showed a significant main effect of Group, $F_1(1, 38) = 5.70$, $p < .05$, $F_2(1, 15) = 10.13$, $p < .01$ (control participants gave higher metaphoricity ratings than participants with AS), and a significant main effect of Sentence-type, $F_1(1, 38) = 37.99$, $p < .0001$, $F_2(1, 15) = 16.59$, $p < .0001$ (negative items were rated as more metaphoric than their affirmative counterparts), but no interaction effect $F_1(1, 38) < 1$, n.s., $F_2(1, 15) < 1$, n.s. This lack of interaction means that both groups behaved similarly: Both found negative items to be more metaphoric than their affirmative counterparts, and to the same extent. And although control participants gave higher metaphoricity ratings than participants with AS, which might be interpreted as the latter's bias toward the literal, comparing the experimental group's ratings of the negative items (5.29) to the scale mid-point (4) demonstrates that they performed above chance level, $t(19) = 8.96$, $p < .001$. Such results support the view that individuals with AS may opt for a nonliteral interpretation even when a literal alternative is available.

Since the two groups differed in proportions of women and men, we ran another analysis, adding gender as another independent variable. Results, however, show that the same main effects were obtained: gender had no main effect, nor did it interact with any of the other variables.

In sum, both groups opted for a metaphoric interpretation when it came to making sense of negative items, and were less inclined to do so when it came to making sense of affirmative alternatives. Although, in all, grades of all the items of typically developing participants were higher than those of the experimental group, the overall picture was the same. Both groups exhibited the same pattern of behavior, assigning negative items a higher degree of metaphoricity than affirmative items, as found for typically developing individuals (see Giora et al., 2010). Given that neither version was biased in favor of either the literal or the nonliteral interpretation, these results question the view that individuals with AS are biased toward the literal.

TABLE 9
Mean Ratings for Affirmative and Negative Statements for the AS and Control Group: Experiment 3 (*SD* in Parentheses)

	Affirmative	*Negative*	*Mean*
AS	3.69 (0.89)	5.29 (1.00)	4.49
Control	4.42 (1.23)	5.60 (0.80)	5.01
Mean	4.06	5.44	

GENERAL DISCUSSION

In this study we tested the hypothesis that, across the board, individuals diagnosed with Asperger's syndrome (AS) will perform worse than typically developing (matched) controls, but will, nonetheless, exhibit patterns of linguistic behavior similar to that of controls. Although AS is one of the autism spectrum disorders, it differs from classical autism in that it does not involve low verbal IQ or any general delay in language or cognitive development. Given that AS is also associated with lack of empathy and theory of mind (see Baron-Cohen et al., 1985; Happé, 1993; but see Hobson, 1990, 1991, this issue) and with restricted and repetitive patterns of behavior and interests (Frith, 1991), one could suspect that these deficits and routines might reduce exposure to social interaction and communication. As a result, individuals with AS might be less skilled communicators and consequently less adept than typically developing individuals at deriving the appropriate interpretation of utterances (for a similar view, see Du Bois, Hobson, & Hobson, in press). This, however, would lead to expect an overall worse performance for people with AS, rather than a pattern that would differ systematically from what is seen in typically developing individuals.[7]

Expecting similar patterns of linguistic behavior between individuals with AS and typically developed individuals diverges from the received view of AS, according to which individuals diagnosed with AS differ from typically developing individuals in various specific respects. For instance, it is widely acknowledged that they do not benefit from contextual information and therefore can only establish "weak central coherence" (Baron-Cohen, 1988; Frith, 1989, 1991; Frith & Snowling, 1983; Happé, 1993; Jolliffe & Baron-Cohen, 1999; Schindele, Lüdtke, & Kaup, 2008; Tager-Flusberg, 1981; Tantam, 1991). In addition, it is widely assumed that they are biased toward the literal in that they fail to make sense of nonliteral language (Adachi et al., 2004; Gold and Faust, 2010, this issue; Gold, Faust & Goldstein, 2010; Happé, 1993, 1994, 1995; Martin & McDonald, 2004; Ozonoff & Miller; 1996; Tantam, 1999).

Departing from the received view, we propose an alternative approach based on the graded salience hypothesis (Giora, 1997, 1999, 2003). Recall that according to the graded salience hypothesis, degree of meaning salience rather than (non)literality affects processing: Salient (coded and prominent) meanings are always activated regardless of (non)literality and context (see also Giora et al., 2007; Giora & Stringaris, 2010). Although supportive contextual information may be highly effective, it cannot preempt salient albeit incompatible meanings (see also Peleg & Eviatar, 2008, 2009; Peleg & Giora, 2011; Peleg et al., 2008). Such information, however, is instrumental in predicting the appropriate meaning and in revisiting early inappropriate outputs, especially when novel (re)interpretations are concerned (see introductory paragraph).

The graded salience hypothesis thus predicts that, although individuals with AS will perform worse than the comparison group, for both groups interpreting novel items will be costly and error-prone compared to interpreting familiar ones, regardless of (non)literality and contextual information. In addition, both groups will profit from contextual information, which will benefit novel items to a greater extent than familiar ones, regardless of (non)literality. (These

[7]Although several of the participants with AS were receiving medication and this may have affected the results of this study, it seems, however, that the most likely effect would be towards diminishing their performance (for example through sedation); this may have influenced the strength but not the direction of the study's results.

predictions apply to individuals diagnosed with AS, given their overall typical history of language development. They, however, need not apply to individuals diagnosed with other forms of ASD with a history of delayed or atypical language development and/or intellectual impairment.)

To test these predictions, we designed three experiments, two of which were identical in every respect except for contextual information which was neutral and uninformative in the first ("I saw a *Tverian horse*") and non-priming but supportive in the second ("The policeman from Nahariya was driving his police car. Suddenly on the road there appeared a *Tverian horse*"). In these experiments, 28 young adults diagnosed with AS and 28 matched controls without disabilities had to make meaningfulness judgments to 5 types of word-pairs. Stimuli included familiar metaphors (FM) such as *flower bed*, familiar literals (FL) such as *wooden table*, novel metaphors (NM) such as *Dying Star*, novel literals (NL) such as *Tverian horse*, the latter are structurally equivalent to NM, and Meaningless items such as *bunny laundry*.

In Experiment 1, in which no biasing context was provided, results from both, error rates and response times, support the graded salience hypothesis. They show that novel items were more difficult to understand than familiar ones, regardless of (non)literality. And although the comparison group outperformed the experimental group, this pattern of results was true for both groups, with one exception, though: Unlike typically developing adults, adults with AS did not take longer to respond to novel metaphors than to familiar ones. However, as shown by Experiment 2, it is possible that, outside a supportive context, participants with AS did not invest in processing novel metaphors but rather dismissed them as meaningless, thus demonstrating their difficulty with these items under such circumstances. Indeed, their high error rates on this variable suggest speed–accuracy tradeoff.

In Experiment 2, in which a supportive context was provided, results from both, error rates and response times, provide further support for the view that degree of salience matters: Novel items were more difficult to understand than familiar ones, regardless of (non)literality. And although the comparison group outperformed the experimental group, this pattern of results was uniformly true of both groups. And, as predicted by the graded salience hypothesis, results further demonstrate that both groups benefited from contextual information. The comparison group erred less and responded faster than in Experiment 1. And although the experimental participants did not respond faster than in Experiment 1, they responded faster to familiar than to novel items and erred less on all these items, thus suggesting that the effort incurred by contextual information benefited performance, particularly on response accuracy. Importantly, for both groups, context benefited novel metaphors to a greater extent than novel literals, thus questioning the claim that, unlike typically developing individuals, individuals with AS are biased toward the literal.

In sum, results from the first two experiments support the view that participants with AS performed worse than matched controls across the board in that they made more errors and took longer to make meaningfulness judgments. This is best illustrated by specific contrasts performed on the familiar literal items of Experiment 1, which show that participants with AS made significantly more errors on these items $F(1, 54) = 7.96$, $p < .01$, and took longer to make correct responses to them than the comparison group, $F(1, 54) = 3.44$, $p = .069$. Nonetheless, with the exception of the experimental group's failure to invest in making sense of novel metaphors outside of a supportive context, in all, both groups exhibited similar patterns of behavior. As predicted by the graded salience hypothesis, both, young adults with AS and matched typically developing individuals, experienced difficulties with novel items rather than with nonliteral ones and ease of processing of familiar items rather than of literal ones (for similar results involving typically developed young adults, see Giora et al., 2004). Both groups further profited from supportive contextual information, which benefited novel metaphor. For both groups contextual support improved performance on novel metaphors probably because it could compensate for their lower aptness (see Gibbs, 1994).

To further question the claim that, unlike individuals without AS, individuals with AS are biased toward the literal, we devised Experiment 3. In this experiment, young adults diagnosed with AS and a comparison group without AS were presented affirmative and negative versions of items, which could potentially be ambiguous between literal and metaphoric interpretation. Previous research however has shown that while the affirmative version tends to give rise to a literal interpretation, the negative version induces a metaphoric interpretation (Giora et al., 2010). If individuals with AS are not biased toward the literal, then they will opt for interpretations that discriminate the affirmatives from the negatives. If, however, they are biased toward the literal, they will opt for literal interpretations indiscriminately.

Results show that both groups exhibited similar patterns of behavior. Although participants without AS generally opted for higher grades for all the items, in essence, both groups attributed more nonliteral interpretations to negative than to affirmative statements.

Taken together, then, our studies, demonstrate similar patterns of behavior for both individuals with and without AS.[8] In the first two experiments this proved particularly true of response accuracy, which, for individuals with AS, seemed to constitute the more sensitive measure, reflecting understanding better than response latencies (for a similar view, see Sartory, Heine, Müller, & Elvermann-Hallner, 2002; Wyer & Radvansky, 1999). The third experiment complements the first two in that it allows participants to opt for either a literal or a nonliteral interpretation. Nonetheless, both groups perceived negative statements as more nonliteral than affirmative counterparts, as found earlier for typically developing individuals (Giora et al., 2010).

At this stage, we can look more closely at the variables discussed:

(Non)literality

Do individuals with AS find metaphors more difficult to understand than literals compared to individuals without disabilities? That is, are they biased toward the literal? Judging from their accuracy scores, individuals with AS performed worse than controls across the board. Compared to the comparison group, they erred more on literals, familiar literals included; they erred more on metaphors, familiar metaphors included (Experiments 1–2); in Experiment 1, they erred more on metaphors compared to literals, which, however, was also the pattern of results among the matched controls; in Experiment 2, they erred more on literals compared to metaphors, which, however, was also the pattern of results among the matched controls. Individuals with AS, then, are not more biased toward the literal than typically developing individuals.

[8]One should note that all the pretests controlling for our items were run on individuals without AS (for the scarcity of individuals with AS). While both groups were matched for age, sex, and education, verbal IQ scores were not collected.

Degree of Salience

Are individuals with AS sensitive to degree of salience rather than to degree of (non)literality compared to matched controls? Judging from their accuracy scores, individuals with AS fared better on familiar than on novel items regardless of (nonliterality), which was also the pattern of results among the controls. And although they fared worst on novel metaphors in Experiment 1, they fared worst on novel literals in Experiment 2. This, however, was precisely the pattern of results among the comparison group. Based on error rates, then, individuals with AS preformed worse than controls overall. Regardless, they exhibited same sensitivities as did individuals without AS to degree of salience rather than to degree of (non)literality.

Context Effects

Can individuals with AS profit from supportive contextual information compared to matched controls? Based on accuracy scores, it is obvious that both groups benefited from a supportive context in the same way: context improved performance on those items which, outside a specific context, were most difficult to understand. Thus, novel metaphors, which, compared to novel literals, were also less apt, were found by both groups to be the most difficult items to make sense of outside a supportive context (Experiment 1). They were therefore most amenable to contextual support. Indeed, both groups gained from supportive contextual information which rendered these items even less difficult to understand than novel literals. However, whereas for the comparison group, this improvement was coupled with a reduction in response times, for the experimental group, context effects resulted in an increase in processing times.

Our finding demonstrating similar patterns of sensitivities and influences are not entirely unprecedented. Similar patterns of results of both individuals with and without AS have also been recorded by some previous studies. Consider, for instance, Gunter et al. (2002), who showed that the variable that matters when comparing both groups is the degree of salience rather than the degree of metaphoricity. In an offline task, Gunter et al. compared understanding of familiar metaphors, novel metaphors, and (presumably familiar) literals. Results showed that while the experimental and the comparison groups fared similarly well on literals and familiar metaphors, the former fared worse on novel metaphors. Along the same lines, Jolliffe and Baron-Cohen (1999) showed that both participants with AS and typically developing participants performed similarly well on familiar meanings of homophones. However, the experimental group erred more frequently on less familiar meanings, which also took them longer to activate.

Consider, further, Dapretto and colleagues who looked into irony interpretation. For instance, Wang, Lee, Sigman, and Dapretto (2006) showed that, although typically developing children outperformed children with autism spectrum disorders (ASD) in that they made sense of ironic utterances in a less effortful and more accurate manner, both groups performed above chance level and activated quite similar neural bases. Additionally, looking at how heavily participants rely on contextual information for the interpretation of irony further reveals certain similarities. For typically children, contexts involving multiple supportive cues, such as background event knowledge and prosodic cues, improved accuracy to a greater extent than less supportive contexts, involving either background event knowledge or prosodic cues only. For the experimental group too, multiple cues improved accuracy compared to contexts which were less supportive, featuring background event knowledge only. Only when prosodic cues on their own were provided, did performance not differ from that on the multiple cues condition.[9]

Wang, Lee, Sigman, and Dapretto (2007) further showed that when processing irony, children with ASD benefited from additional contextual factors such as explicit instructions to attend to facial expression and tone of voice. This information increased activity in the medial prefrontal cortex—a network important for understanding the intentions of others. Thus, like the findings reported in our studies, these results suggest that differences in processing difficulties need not reflect differences in patterns of behavior; children with and without ASD may share similar behavioral profiles. (For other results revealing no specific language impairments, see Hamilton, 2009; Williams, Botting, & Boucher, 2008).

This has become particularly obvious in Colich et al. (this issue). In Colich et al., both children and adolescents with ASD and matched typically developing controls took longer to respond to ironic than to sincere remarks, with the experimental group performing faster than controls, overall. And although enhanced activity in the left hemisphere (LH) was observed in both groups for scenarios ending in ironic compared to sincere remarks (with greater activity observed in the typically developing children), only the experimental group exhibited a bilateral activation profile, showing greater activity than the control group in right fronto-temporal-parietal regions and MPFC). The authors have interpreted this finding as suggesting compensatory mechanisms. (On bilateral activation profile suggesting compensatory mechanisms, working, though, in the opposite direction, see also Gold & Faust, this issue.)

Similar patterns of behavior obtaining between young adults diagnosed with AS and matched controls were also found for metaphors, rated as either novel or familiar, and presented in isolation (Gold & Faust, 2010, this issue; Gold et al., 2010). Although, as in our study, Gold and colleagues' control group outperformed the experimental group in that their RTs were faster (Gold & Faust, 2010, this issue; Gold et al., 2010) and their error rates—lower (Gold & Faust, 2010), the patterns of behavior of both groups were the same: Both groups erred more on novel than on familiar metaphors; in addition, both groups took longer to read novel than familiar metaphors. This was true despite the fact that the two groups differed in terms of the hemispheric division of labor. Whereas the control group processed novel metaphors faster when presented to the left visual field/right hemisphere (LVF/RH) than to the right visual field/left hemisphere (RVF/LH; as also demonstrated in Mashal et al., 2005, 2007; Faust & Mashal, 2007), individuals with AS exhibited no significant RH advantage for novel metaphors compared to the LH (Gold & Faust, 2010, this issue). Interestingly, Wang et al. (2007) too demonstrate that while the experimental and the control groups exhibited similar behavioral profiles, important differences were observed in the neural networks subserving such similar performance (i.e., children with ASD did not automatically recruit the medial prefrontal cortex when inferring a speaker's communicative intent; they only did so when explicitly instructed to pay attention to facial cues and tone of voice).

[9]Specifically, when provided with two types of cues—event knowledge and prosodic cues—participants with ASD were marginally more accurate than when provided with one cue—event knowledge—only, $F(1, 17 = 3.9, p = .06$ (Mirella Dapretto, personal communication, June 24, 2009).

Given previous findings, what, then, are the specific contributions of our study? First, our study teases apart familiar from novel items—both literal and nonliteral. Our items, then, comprised both familiar metaphors and familiar literals on the one hand, and novel metaphors and novel literals, on the other. Note that with regard to participants with AS, novel literals have never been tested before, while the familiarity of literals has, for the most part, been only assumed rather than established. In this respect our study is pioneering, especially with regard to its ability to test the received view which assumes that, compared to controls, individuals with AS are inclined toward the literal. This has been borne out by the results of all the experiments, not least Experiment 3, which is particularly revealing in that it allowed readers to choose between two equally affordable and viable (literal and metaphoric) interpretations.

Additionally, our study is pioneering in that it tapped interpretation processes of the same stimuli both in neutral and supportive contexts. Indeed, testing the same targets inside and outside supportive contexts allows a better insight into the nature of language understanding among both, individuals with AS and matched controls. As expected, it shows that, contra the received view, both groups benefit from contextual information in the same way.

Our findings show that adults diagnosed with Asperger's syndrome can understand metaphors, especially familiar metaphors. Adults diagnosed with Asperger's syndrome can integrate contextual information into the mental representation of the utterances they process. And when contextual information is supportive of the intended meaning, adults diagnosed with Asperger's syndrome utilize it, thus improving their understanding of novel, low apt metaphors. And even in the absence of cues triggering nonliteral interpretation, such as semantic anomaly or rule violation, adults diagnosed with Asperger's syndrome can assign such unbiased items a nonliteral interpretation. Contra the received view, then, in a pattern that is qualitatively similar to typically developing controls, individuals with Asperger's syndrome are not insensitive to contextual information. Neither are they biased toward the literal; instead, they are sensitive to degree of salience.

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REFERENCES

Adachi, T., Koeda, T., Hirabayashi, S., Maeoka, Y., Shiota, M., Wright, C. E., & Wada, A. (2004). The metaphor and sarcasm scenario test: a new instrument to help differentiate high functioning pervasive developmental disorder from attention deficit/hyperactivity disorder. *Brain & Development*, *26*, 301–306.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Baron-Cohen, S. (1988). Social and pragmatic deficits in autism: Cognitive or affective? *Journal of Autism and Developmental Disorders*, *18*, 379–402.

Baron-Cohen, S. (1997). Hey! It was just a joke! Understanding propositions and propositional attitudes by normally developing children and children with autism. *Israel Journal of Psychiatry & Related Sciences*, *34*(3), 174–178.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a 'theory of mind'? *Cognition*, *21*, (pp. 37–46).

Beardsley, M. C. (1958). *Aesthetics*. New York, NY: Harcourt, Brace and World.

Beaumont, B., & Sofronoff, K. (2008). A new computerised advanced theory of mind measure for children with Asperger syndrome: The ATOMIC. *Journal of Autism and Developmental Disorders*, *38*(2), 249–260.

Blasko, G. D. & Connine, C. (1993). Effects of familiarity and aptness on metaphor processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *19*(2), 295–308.

Brock, J., Norbury, C., Einav, S., & Nation, K. (2008). Do individuals with autism process words in context? Evidence from language-mediated eye-movements. *Cognition*, *108*, 896–904.

Budiu, R., & Anderson, J. R. (2008). Negation in nonliteral sentences. Retrieved from http://repository.cmu.edu/psychology/67

Chiappe, D. L., & Kennedy, J. M. (1999). Aptness predicts preference for metaphors or similes, as well as recall bias. *Psychonomic Bulletin & Review*, *6*, 668–676.

Chiappe, D. L., Kennedy, J. M., & Chiappe, P. (2003). Aptness is more important than comprehensibility in preference for metaphors and similes. *Poetics*, *31*, 51–68.

Cohen, H., & Rémillard, S. (2006). Autism and Asperger Syndrome: A spectrum of disability. In K. Brown (Ed.), *Encyclopedia of Language and Linguistics* (2nd ed., pp. 617–621). Oxford, UK: Elsevier.

Coulson, S. & Van Petten, C. (2002). Conceptual integration and metaphor: An event-related brain potential study. *Memory and Cognition*, *30*, 958–968.

Dennis, M., Lazenby, A. L. & Lockyer, L. (2001). Inferential language in high-function children with autism. *Journal of Autism and Developmental Disorders*, *31*(1), 47–54.

Du Bois, J., Hobson, R. P., & Hobson, J. (in press). Dialogic resonance in autism. *Cognitive Linguistics*.

Frith, U. (1989). *Autism: Explaining the enigma*. Oxford, UK: Basil Blackwell.

Frith, U. (1991). Translation and annotation of "Autistic psychopathy" in childhood, by H. Asperger. In U. Frith (Ed.), *Autism and Asperger syndrome* (pp. 37–92). Cambridge, UK: Cambridge University Press.

Frith, U., & Happé, F. G. E. (1994). Autism: Beyond theory of mind. *Cognition*, *50*, 115–132.

Frith, U., & Snowling, M. (1983). Reading for meaning and reading for sound in autistic and dyslexic children. *British Journal of Developmental Psychology*, 1, 329–342.

Gernsbacher, M. A., & Frymiare, J. L. (2005). Does the autistic brain lack core modules? *Journal of Developmental and Learning Disorders*, *9*, 3–16.

Gibbs, R. W., Jr. (1994). *The poetics of mind*. Cambridge, UK: Cambridge University Press.

Giora, R. (1997). Understanding figurative and literal language: The graded salience hypothesis. *Cognitive Linguistics*, *7*(1), 183–206.

Giora, R. (1999). On the priority of salient meanings: Studies of literal and figurative language. *Journal of Pragmatics*, *31*, 919–929.

Giora, R. (2003). *On our mind: Salience, context and figurative language*. New York, NY: Oxford University Press.

Giora, R., Fein, O., Kronrod, A., Elnatan, I., Shuval, N., & Zur, A. (2004). Weapons of mass distraction: Optimal Innovation and Pleasure Ratings. *Metaphor and Symbol*, *19*, 115–141.

Giora, R., Fein, O., Laadan, D., Wolfson, J., Zeituny, M., Kidron, R., Kaufman, R., & Shaham, R. (2007). Expecting irony: context vs. salience-based effects. *Metaphor and Symbol*, *22*, 119–146.

Giora, R., Fein, O., Metuki, N., & Stern, P. (2010). Negation as a metaphor-inducing operator. In W. Klein & S. Levinson (Series Eds.), *The expression of cognitive categories: Vol. 4. The expression of negation* (pp. 225–256). Berlin, Germany/New York, NY: Mouton de Gruyter.

Giora, R., & Stringaris, A. (2010). Neural substrates of metaphor. In P. Hogan (Ed.), *The Cambridge encyclopedia of the language sciences* (pp. 489–492). New York, NY: Cambridge University Press.

Glucksberg, S., & Keysar, B. (1990). Understanding metaphorical comparisons: Beyond similarity. *Psychological Review*, *97*, 3–18.

Gold, R., & Faust, M. (2010). Right hemisphere dysfunction and metaphor comprehension in young adults with Asperger syndrome. *Journal of Autism and Developmental Disorders*, *40*, 800–811.

Gold, R., & Faust, M., & Goldstein, A. (2010). Semantic integration during metaphor comprehension in Asperger syndrome. *Brain and Language*, *113*(3), 124–134

Grice, H. P. (1975). Logic and conversation. In P. Cole & J. Morgan (Eds.), *Speech acts: Syntax and semantics*, Vol. 3 (pp. 41–58). New York, NY: Academic Press.

Gunter, H. L., Ghaziuddin, M., & Ellis, H. D. (2002). Asperger syndrome: Tests of right hemisphere functioning and interhemispheric communication. *Journal of Autism and Developmental Disorders*, *32*(4), 263–281.

Hamilton, A. F. (2009). Research review: Goals, intentions and mental states: Challenges for theories of autism. *Journal of Child Psychology and Psychiatry*, *50*, 881–892.

Happé, F. G. E. (1993). Communicative competence and theory of mind in autism: A test of relevance theory. *Cognition*, *48*, 101–119.

Happé, F. G. E. (1994). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. *Journal of Autism and Developmental Disorders*, *24*, 129–154.

Happé, F. G. E. (1995). The role of age and verbal ability in the theory of mind task performance of subjects with autism. *Child Development*, *66*, 843–855.

Happé, F. G. E. (1997). Central coherence and theory of mind in autism: Reading homographs in context. *British Journal of Developmental Psychology*, *15*(1), 1–12.

Hobson, R. P. (1990). On acquiring knowledge about people and the capacity to pretend: Response to Leslie (1987). *Psychological Review*, *97*, 114–121.

Hobson, R. P. (1991). Against the theory of "Theory of Mind." *British Journal of Developmental Psychology*, *9*, 33–51.

Hoy, A. J., Hatton, C., & Hare, D. (2004). Weak central coherence: A cross-domain phenomenon specific to autism? *Autism*, *8*, 267–281.

Kaland, N., Møller-Nielsen, A., Callesen, K., Mortensen, E. L., Gottlieb, D., & Smith, L. (2002). An 'advanced' test of theory of mind: Evidence from children and adolescents with Asperger syndrome. *Journal of Child Psychology and Psychiatry*, *43*, 517–528.

Kasari, C., & Rotheram-Fuller, E. (2005). Current trends in psychological research on children with high-functioning autism and Asperger disorder. *Current Opinion in Psychiatry*, *18*, 497–501.

Jolliffe, J., & Baron-Cohen, S. (1999). A test of central coherence theory: Linguistic processing in high-functioning adults with autism or Asperger syndrome: Is local coherence impaired? *Cognition*, *71*, 149–185.

Jones, L. L., & Estes, Z. (2005). Metaphor comprehension as attributive categorization. *Journal of Memory and Language*, *53*(1), 110–124.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago, IL: University of Chicago Press.

López, B., & Leekam, S. (2003). Do children with autism fail to process information in context. *Journal of Child Psychology and Psychiatry*, *44*, 285–300.

Lord, C., Risi, S., Lembrecht, L., Cook, E. H., Leventhal, B. L., DiLavore, P. C., Pickles, A., & Rutter, M. (2000). The Autism Diagnostic Observation Schedule—Generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders*, *30*, 205–223.

Lord, C., Rutter, M., Goode, S., Heemsbergen, J., Jordan, H., Mawhood, L., & Schopler, E. (1989). Autism diagnostic observation schedule: a standardized observation of communicative and social behavior. *Journal of Autism and Developmental Disorders*, *19*(2), 185–212.

Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism Diagnostic Interview–Revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders*, *24*, 659–685.

Martin, I., & McDonald, S. (2003). Weak coherence, no theory of mind, or executive dysfunction? Solving the puzzle of pragmatic language disorders. *Brain and Language*, *85*, 451–466.

Martin, I., & McDonald, S. (2004). An exploration of causes of non-literal language problems in individuals with Asperger syndrome. *Journal of Autism and Developmental Disorders*, *34*, 311–328.

Mashal, N., Faust, M., & Hendler, T. (2005). The role of the right hemisphere in processing nonsalient metaphorical meanings: Application of principal components analysis to fMRI data. *Neuropsychologia*, *43*, 2084–2100.

Mashal, N., Faust, M., Hendler, T., & Jung-Beeman, M. (2007). An fMRI investigation of the neural correlates underlying the processing of novel metaphoric expressions. *Brain and Language*, *100*, 115–126.

Myles, B., Bock, S., & Simpson, R. (2001). *Asperger Syndrome Diagnostic Scale*. Austin, TX: Pro-Ed.

Nikolaenko, N. N. (2003). Study of metaphoric and associative thinking in children of different age groups and in patients with childhood autism. *Journal of Evolutionary Biochemistry and Physiology*, *39*(1), 77–83.

Norbury, C. F. (2005). Barking up the wrong tree? Lexical ambiguity resolution in children with language impairments and autistic spectrum disorders. *Journal of Experimental Child Psychology*, *90*, 142–171.

Ozonoff, S., & Miller, J. N. (1996). An exploration of right-hemisphere contribution to the pragmatic impairments of autism. *Brain and Language*, *52*, 411–434.

Peleg, O., & Eviatar Z. (2008). Hemispheric sensitivities to lexical and contextual information: Evidence from lexical ambiguity resolution. *Brain and Language*, *105*(2), 71–82.

Peleg, O., & Eviatar, Z. (2009). Semantic asymmetries are modulated by phonological asymmetries: Evidence from the disambiguation of homophonic versus heterophonic homographs. *Brain and Cognition*, 70, 154–162.

Peleg, O., & Giora, R. (2011). Salient meanings: The whens and wheres. In I. Kecskés (Series Ed.), *Mouton Series in Pragmatics: Vol. 12. Salience and defaults in utterance processing* (pp. 35–52). Berlin, Germany/New York, NY: Mouton de Gruyter.

Peleg, O., Giora, R., & Fein, O. (2008). Resisting contextual information: You can't put a salient meaning down. *Łódź Papers in Pragmatics*, *4*(1), 13–44.

Pijnacker, J., Geurts, B., van Lambalgen, M., Buitelaar, J., & Hagoort, P. (2010). Exceptions and anomalies: An ERP study on context sensitivity in autism. *Neuropsychologia*, *48*, 2940–2951. doi:10.1016/j.neuropsychologia.2010.06.003.

Ratcliff, R., & Rouder, J. N. (1998). Modeling response times for two-choice decisions. *Psychological Science*, *9*, 347–356.

Sartory, G., Heine, A., Müller, B., & Elvermann-Hallner, A. (2002). Event- and motor-related potentials during the continuous performance task in Attention-Deficit/Hyperactivity Disorder. *Journal of Psychophysiology*, *16*, 97–106.

Schindele, R., Lüedtke, J., & Kaup, B. (2008). Comprehending negation: A study with adults diagnosed with high functioning autism or Asperger's syndrome. *Intercultural Pragmatics*, *5*, 421–444.

Tager-Flusberg, H. (1981). On the nature of linguistic functioning in early infantile autism. *Journal of Autism and Developmental Disorders*, *11*, 45–56.

Tager-Flusberg, H., & Anderson, M. (1991) The development of contingent discourse ability in autistic children. *Journal of Child Psychology and Psychiatry*, *32*, 1123–1134.

Tantam, D. (1991). Asperger syndrome in adulthood. In U. Frith (Ed.), *Autism & Asperger syndrome* (pp. 145–183). Cambridge, UK: Cambridge University Press.

Thibodeau, P., & Durgin, F. H. (2011). Metaphor aptness and conventionality: A processing fluency account. *Metaphor and Symbol*, *26*, 206–226.

Wang, A. T., Lee. S. S., Sigman, M., & Dapretto, M. (2006). Neural basis of irony comprehension in children with autism: The role of prosody and context. *Brain*, *129*, 932–943.

Wang, A. T., Lee. S. S., Sigman, M., & Dapretto, M. (2007). Reading affect in the face and voice: Neural correlates of interpreting communicative intent in children and adolescents with autism spectrum disorders. *Archives of General Psychiatry*, *64*, 698–708.

Williams, D., Botting, N., & Boucher, J. (2008). Language in autism and specific language impairment: Where are the links? *Psychological Bulletin*, *134*, 944–963.

Wyer, R. S., & Radvansky, G. A. (1999). The comprehension and validation of social information. *Psychological Review*, *106*(1), 89–118.

APPENDIX A

TABLE A1
Participants with AS (Experiments 1–2)

No.	Age	Sex	Level of Education	Other Disabilities	Medication (Trade Name)	Medication (Generic Name)
1	27	M	Full matriculation exams	NA	Risperdal	Risperdone
2	20	M	Part of matriculation exams	ADD	Recital	Citalopram
3*	25	M	Part of matriculation exams	NA	NA	NA
4	29	M		Yes	?	?
5*	25	F	Part of matriculation exams	NA	Proxil	Proglumetacin
6	26	M	12 years schooling	NA	Valporal	Valproic Acid
7*	22	F	12 years schooling	NA	NA	NA
8*	21	M	12 years schooling	NA	Flutine Prothiazine	Fluoxetine Prothiazine
9	29	M	Part of matriculation exams	NA	Perphenan Recital	Perphenazine Citalopram
10	26	M	12 years schooling	ADD	Cipralex	Escitalopram
11	34	M	12 years schooling	NA	NA	NA
12	25	M	Full matriculation exams	NA	NA	NA
13	23	M	Part of matriculation exams	ADD	Ritalin	Methylphenidate
14	20	M	12 years schooling	NA	NA	NA
15	19	M	Part of matriculation exams	Learning disability (reading comprehension)	NA	NA
16	18	M	Part of matriculation exams	Learning disability (dysgraphia)	Ritalin Risperdal	Methylphenidate Risperidone
17	20	M	Part of matriculation exams	Learning disability (reading comprehension) + ADD	Cipralex Cipramil	Escitalopram Citalopram
18	23	M	Part of matriculation exams	OCD	Tegartol Recital Maronil Valium Sorbon Zyprexa	Carbamazepine Citalopram Clomipramine Diazepam Buspirone Olanzapine

(*Continued*)

TABLE A1
(*Continued*)

No.	*Age*	*Sex*	*Level of Education*	*Other Disabilities*	*Medication (Trade Name)*	*Medication (Generic Name)*
19	21	M	Part of matriculation exams	NA	NA	NA
20	21	M	11 years schooling		Risperdal	Risperidone
21	20	M	Part of matriculation exams		Risperdal Recital	Risperidone Citalopram
22	24	M	Part of matriculation exams	NA	NA	NA
23	19	M	Full matriculation exams	NA	NA	NA
24	21	M	Full matriculation exams	Learning disability	NA	NA
25	22	M	Part of matriculation exams	Learning disability	NA	NA
26	25	M	Part of matriculation exams	NA	NA	NA
27	20	M	12 years schooling	NA	NA	NA
28	23	M	12 years schooling	NA	Sertraline	Sertraline
29*	21	M	Full matriculation exams	NA	NA	NA
30*	22	M	Full matriculation exams	NA	NA	NA
31*	24	F	Full matriculation exams	NA	NA	NA
32*	23	M	Full matriculation exams	NA	NA	NA
33*	24	M	Full matriculation exams	NA	Risperdal	Risperidone
34*	38	M	12 years schooling + courses in programming	NA	√	√
35*	30	F	Full matriculation exams + courses in the Open University	OCD	NA	NA
36*	40	M	M.A		√	√
37*	29	F	B.A	NA	NA	NA
38*	27	M	Full matriculation exams + courses in Acting	NA	NA	NA

(*Continued*)

TABLE A1
(*Continued*)

No.	*Age*	*Sex*	*Level of Education*	*Other Disabilities*	*Medication (Trade Name)*	*Medication (Generic Name)*
39*	27	F	Full matriculation exams			39
40*	26	M	Full matriculation exams	ADHD	√	40
41*	26	M	15 years NA Special education school	Motor difficulties & behavioral problems		41
42*	26	M	B.A			42
43*	54	M	B.A		√	43
44*	23	F	Part of matriculation exams	Epilepsy	√	√

Note. The first 28 participants are those of Experiments 1–2; asterisks indicate the 20 participants who participated in Experiment 3 (some of whom also participated in Experiments 1–2).

√ = medication unspecified.

? = no info about whether medication is taken.

TABLE A2
The Comparison Group (Experiments 1–2)

No.	*Age*	*Sex*	*Level of Education*	*Other Disabilities*	*Medication (Trade Name)*	*Medication (Generic Name)*
1	24	M	Full matriculation exams	NA	NA	NA
2	24	M	Full matriculation exams	NA	NA	NA
3	23	M	Full matriculation exams	NA	NA	NA
4	23	M	Full matriculation exams	NA	NA	NA
5	23	F	Full matriculation exams	NA	NA	NA
6	24	M	Full matriculation exams	NA	NA	NA
7	23	M	Full matriculation exams	NA	NA	NA
8	23	M	Full matriculation exams	NA	NA	NA
9	24	M	Full matriculation exams	NA	NA	NA
10	22	F	Full matriculation exams	NA	NA	NA
11	22	M	Full matriculation exams	NA	NA	NA
12	22	M	Full matriculation exams	NA	NA	NA
13	21	M	Full matriculation exams	NA	NA	NA
14	22	M	Full matriculation exams	NA	NA	NA
15	22	M	Full matriculation exams	NA	NA	NA
16	22	M	Full matriculation exams	NA	NA	NA
17	22	M	Full matriculation exams	NA	NA	NA
18	26	M	Full matriculation exams	NA	NA	NA
19	24	M	Full matriculation exams	NA	NA	NA
20	22	M	Full matriculation exams	NA	NA	NA
21	21	F	Full matriculation exams	NA	NA	NA

(*Continued*)

TABLE A2
(*Continued*)

No.	*Age*	*Sex*	*Level of Education*	*Other Disabilities*	*Medication (Trade Name)*	*Medication (Generic Name)*
22	23	M	Full matriculation exams	NA	NA	NA
23	22	M	Full matriculation exams	NA	NA	NA
24	23	F	Full matriculation exams	NA	NA	NA
25	22	M	Full matriculation exams	NA	NA	NA
26	23	M	Full matriculation exams	NA	NA	NA
27	22	M	Full matriculation exams	NA	NA	NA
28	28	M	Full matriculation exams	NA	NA	NA

APPENDIX B

Sample Items

Experiment 1 (Outside a Supportive Context)

1a. One can imagine *easy money*. (FM)
1b. One can imagine a *wall of shame*. (NM) [In Hebrew the collocation is "wall shame"]
1c. One can imagine an *oasis*. (FL) [In Hebrew "oasis" is a 2 word collocation]
1d. One can imagine *green skin*. (NL) [*Skin* is a Hebrew heterograph meaning also "light"; "green light" is a familiar collocation]

2a. Peter educated me on *sealed lips*. (FM) [In Hebrew the word order is "lips sealed"]
2b. Peter educated me on the *root [of] memory*. (NM) [In Hebrew the collocation is "root memory"]
2c. Peter educated me on a *water well*. (FL)
2d. Peter educated me on the *castle [of] salt*. (NL) [In Hebrew the collocation is "castle salt"; in addition, in Hebrew *salt* sounds like *king*, which makes *castle [of] salt* sound like *castle [of] king*, namely, "king's castle"]

3a. The advertisement promises *common sense*. (FM) [In Hebrew the collocation is "straight sense"]
3b. The advertisement promises *turbulent dream*. (NM)
3c. The advertisement promises a *private house*. (FL)
3d. The advertisement promises *safe lifting*. (NL) [In Hebrew *lifting* (nesi'a) is a heterograph meaning also "trip"]

Experiment 2 (Inside a Supportive Context)

1a. Rina and Zak have started a business together. They work for hours and want to succeed. Lately they have realized it's not going to be *easy money*. (FM)
1b. Shelly feels regretful about her actions. For years she has lived behind a *wall of shame*. (NM)

1c. The tourists who came to Israel are not updated on life here. Their expectation was to find here an *oasis*. (FL) [In Hebrew *oasis* is a 2 word collocation]

d. Ben works in a lab. After finishing some experiments with hazardous materials, he looked at his hand and saw *green skin*. (NL) [*Skin* is a Hebrew heterograph meaning also “light”; “green light” is a familiar collocation]

2a. I’ve just started a new interesting job. During the first staff meeting, I sat with my lips sealed. (FM)

2b. I heard a song my mother used to sing to me. The song is my *root [of] memory.* (NM)

2b The Rothschild family had an old mansion. It was very unique since in the yard there was a *water well*. (FL)

2d. A year ago we went to Peru. When we were in the desert, we built a *castle [of] salt.* (NL)

3a. In order to assemble an IKEA dresser you need the manual. You can’t do it by just using *common sense.* (FM) [In Hebrew the collocation is “straight sense”]

3b. My grandfather died last week. After the funeral we talked about the trip we took together and thought of it as a *turbulent dream.* (NM)

3c. Zack loves surfboards and jet skis. Recently he saved some money and also bought a *private house*. (FL)

3d. Jack builds his own gym room. He takes in different fitness devices and weights and he always pays attention to *safe lifting*. (NL) [In Hebrew *lifting* (nesi’a) is a heterograph meaning also “trip”]