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Presupposition and Implicature comprehension in ASD

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Abstract

The paper deals with implicature processing in autism spectrum disorder (ASD). It is widely recognized that this clinical population is characterized by an impaired pragmatic functioning, but the reason for this and its possible cognitive substrate are still a very much debated issue. Moreover, pragmatic competence is a very elaborate domain of investigation and, sometimes, research on the topic seems to be over simplistic in its approach to the testing of these skills. The research presented here aims at verifying the presence of a very specific ability, namely that of implicature comprehension, in this clinical population. Twenty-nine ASD people, and an equal number of typically developing individuals, were tested for such an aim. The test was devised for this research carefully taking into consideration the fundamental role context plays in pragmatic interpretation. Videos of brief communicative interactions were used so as to provide participants with the appropriate amount of contextual clues necessary for the drawing of the implicature. Results go against previous findings, in that ASD people show a considerable degree of implicature processing and understanding.

Keywords: Autism spectrum disorders, presuppositions, implicatures.

1. Introduction

Notwithstanding the amount of research conducted on the topic of pragmatic impairment in ASD (see section 2 for a review), agreement on the causes and on the degree of this impairment is lacking. There are mainly two reasons for this. One is that researchers investigating on this topic lack a solid basis of theoretical pragmatics and oversimplify concepts belonging to this domain. The second is that they try to demonstrate that the cognitive-psychological theory they adopt is *the* key theory that will explain the cognitive and functional deficits characterizing this clinical population, something that often results in a biased interpretation of the data collected.

This paper adopts a rigorous linguistic perspective on both the devising of the testing materials and the interpretation of data. Taking into

consideration the interdisciplinary nature of the topic under discussion, two theoretical backgrounds will be presented. First, autistic spectrum disorders will be dealt with from both a medical and a cognitive perspective. Then, I will present a general overview of the pragmatic skills under analysis here, namely presuppositions and implicatures. Section 2 is devoted to an overview of previous research on pragmatic and, more specifically, implicit meaning comprehension deficits in ASD. Section 3 illustrates the research conducted, presents and discusses the results; section 4 concludes.

1.1 Theoretical background: Autism Spectrum Disorders

Bleuler coined the term *autistic* in 1911 to describe a subgroup of schizophrenic patients characterized by a tendency to isolate and withdraw into themselves. In 1943, after having observed 11 patients, Kanner hypothesized that autism was a disorder of its own, not related to schizophrenia, and he was the first to describe the clinical picture characterizing these patients. Even if not all of the symptoms that he described are systematically associated with ASD today, he was able to identify the main areas of impairment present in this clinical population. This condition affects social interaction, communication, and patients show restricted interests, stereotyped, and repetitive behaviors. Another key contribution in the description of this condition was given by Asperger (1944), who identified a syndrome similar to autism that today bears his name. His work, though, only became known thanks to Wing, who coined the term ‘Asperger’s Syndrome’ to refer to patients with autistic features but no mental retardation or language delay. Wing is also responsible for the creation of the term ‘autism spectrum disorders’ (ASD), which she put forward to underline quantitative, and not qualitative, differences among autistic patients. The term ‘spectrum’ is used to underline the continuum along which autistic-like conditions situate. At one end, we find severe classical autism and, at the other, high functioning autism (HFA) and Asperger syndrome (AS). Today, ASD is described as a pervasive developmental disorder, a description that specifies that it affects several areas of functioning (pervasive) and it has its onset during childhood (developmental). In the absence of biological markers for autism, the diagnosis of ASD is made according to behavioral criteria which are described by two manuals: the Diagnostic and Statistical Manual of Mental Disorders (published by the American Psychiatric Association and currently at its fifth edition), and the International Statistic

Classification of Diseases and Related Health Problems (published by the World Health organization)¹. Two other tools used for diagnostic purposes are The Autism Diagnostic Interview-Revised (ADI-R), a structured interview for parents of children suspected with ASD, and the Autism Diagnostic Observation Schedule (ADOS), consisting in a series of activities during which the child is observed by the clinician.

As already stated, there are three main areas of dysfunction in this population. One is that of social interaction. ASD people find it extremely difficult to establish social relationships, not simply for a disinterest in other people, but because they find social interaction puzzling, and tasks such as the interpretation of facial expressions and non-verbal behaviors extremely difficult. They fail to make eye contact, make scarce use of body language, do not feel the need of sharing their emotions, and appear not to understand others' emotions². Second, this clinical population is characterized by communication deficits. Language emergence is delayed in these subjects (not in the case of Asperger syndrome), and some of them remain completely, or selectively, mute being yet able to physically articulate language. In some cases, they only communicate basic needs not recognizing the socio-affective component of communicative exchanges. People with ASD that do speak are the ones at the highest levels of functioning and their language is often characterized by extreme verbosity and erudition, delayed echolalia, pronoun reversal, use of non words, atypical prosody, difficulties in initiating and sustaining a conversation, difficulties in turn-taking, and impairment of pragmatic skills. The third area of impairment is the one that concerns interests and activities. People with ASD are reported to have extremely restricted interests, mostly about unusual topics, and may become obsessive about adhering to their routines. The area of interests is also characterized by surprising *islands of ability*³. These people are sometimes able to make extremely difficult calculations in very little time, they have an excellent memory, which they apply to whatever their interest is, and they are able to notice very little details that neurotypical individuals usually ignore.

¹ American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders DSM-V*. Arlington, VA: American Psychiatric Publishing.

World Health Organization (2010). *The ICD-10 Classification of Mental and Behavioural Disorders: Clinical Descriptions and Diagnostic Guidelines*. Geneva: World Health Organization.

² See Baron-Cohen (2003, 2008), Baron-Cohen *et al.* (1997), and Rutherford *et al.* (2002) for a discussion of empathy and emotion understanding in ASD.

³ Not to be confused with expertise areas of people affected by Savant Syndrome. In the majority of cases, these people have serious mental retardation, while in autism this is not always the case.

The causes of autism are still unknown, but as Frith *et al.* point out, “it is now generally accepted that there must be a biological origin to autism” (1991:433). This emerges considering also the amount of research that report data on the structural and functional differences between the autistic and the typically developed brain (Nelson & Nelson 1987, Bauman & Kemper 1987, Baron-Cohen *et al.* 1996, Williams *et al.* 2001, Amaral *et al.* 2003, Müller *et al.* 2003, Oberman *et al.* 2005, Dapretto *et al.* 2006, Just *et al.* 2007, Bookheimer *et al.* 2008, Kana *et al.* 2009, Kleinhans *et al.* 2009, Mosconi *et al.* 2009, Lombardo *et al.* 2011, among others). Neurotransmitters as well have been found to work differently in the autistic brain (Hussman 2001, Langford 2006, Pardo & Eberhart 2007). There is also evidence for genetic and hormonal factors in autism (Folstein & Rutter 1977, Bailey *et al.* 1995, Rutter 2000, Muhle *et al.* 2004, Ronald *et al.* 2006, Millis *et al.* 2007, Sarachana *et al.* 2011).

ASD etiology is also accounted for by cognitive theories. There are three main cognitive theories that have dealt with this condition, and they are the Theory of Mind (ToM), Weak Central Coherence (WCC), and Executive Functions (EEF)^{4,5}. Theory of Mind accounts for the ability that people have to entertain beliefs and attribute mental states to oneself and to others. Research about ToM dysfunction –also called *mindblindness* in autism⁶– (Perner *et al.* 1989; Frith *et al.* 1991; Leslie 1991; Charman & Baron-Cohen 1992; Tager-Flusberg 1992; Happé 1994a,b; Baron-Cohen *et al.* 1997; Tager-Flusberg 1999; Peterson & Siegal 2000; Rutherford *et al.* 2002; Kana *et al.* 2009; Senju *et al.* 2009; Lombardo *et al.* 2011) agree that people with ASD are delayed in the development of this crucial skill: this results in the cognitive deficits characterizing them. This theory accounts for the linguistic impairment of ASD people putting forward the idea that, being unable to attribute an intention to their interlocutor, autistic people are also unable to attribute a *communicative* intention to him/her and, hence, show difficulty in several linguistic skills among which are the comprehension of irony, sarcasm, figurative language, and implicit meanings.

Weak Central Coherence is how Frith (1989) described the cognitive style of autistic people. Their way of processing information is opposite to

⁴ For a thorough account of these theories and an assessment of their pragmatic adequacy see Cummings (2009).

⁵ An alternative account is provided by the ‘Mirror Neuron’ Theory of autism. For space restrictions, this theory will not be presented here; the interested reader is referred to Williams *et al.* 2001, Oberman *et al.* 2005, Dapretto *et al.* 2006, Ramachandran & Oberman 2006.

⁶ See Baron-Cohen (2003, 2008) for the ‘Empathizing-Systemizing’ theory of autism, a superset theory of ToM.

that of typically developing individuals in that they tend to focus on parts of objects rather than wholes, present an extreme sensitivity to small changes in the environment, are superior at recalling and processing information, and do not rely on contextual clues for ambiguous sentence interpretation (Jolliffe & Baron-Cohen 1999 a, b, among others)⁷.

Executive Functions, on the other hand, are a set cognitive functions including planning, problem solving, concept formation, working memory, multi-tasking, attention shifting, abstract and inferential reasoning, impulse control, inhibition, and mental flexibility. ASD people have been found to perform poorly on tasks of EEF, and several researchers have proposed an executive dysfunction as the explanation for autism (see Pennington *et al.* 1997, Ozonoff *et al.* 2004, Joseph *et al.* 2005, Lopez *et al.* 2005, among others).

As pointed out in Cummings (2009), the existence of three –four if one is to consider the ‘Mirror Neuron’ theory of autism– different cognitive theories of autism, all supported by extensive experimental findings, posits a primacy issue as to which of the three, if any, has identified the core deficit, and which is just describing impairments that are a consequence of this condition and, crucially, not the cause. That is why no position will be taken here as to which of the three better accounts for the purported pragmatic impairment of ASD people.

1.2 Theoretical background: Presuppositions and Implicatures

The Pragmatics Encyclopedia (2009:349) defines presuppositions as “propositions whose truth is taken for granted in an utterance and without which the utterance cannot be assigned a truth value”. Consider the example in (1)⁸:

(1) John’s wife is pretty.

For (1) to be true (or false), it has to be presupposed that John actually has a wife. Elements that elicit this kind of inference are called presupposition triggers and are: definite descriptions, factive verbs, change of state verbs, iteratives, implicative verbs, possessive constructions, temporal clauses, cleft sentences, comparatives, counterfactual conditionals.

⁷ See Martin and McDonald (2003) for a critical evaluation of this theory.

⁸ All the examples in this section, apart where otherwise specified, are taken from Formisano (in press)b.

Presuppositions started to receive linguistic interest in the 1970s. As inferences strictly depending upon the linguistic structure of an utterance, they were thought to belong to the domain of semantics. Nonetheless, it was soon noticed that they are sensitive to some extra linguistic factors and, as such, should belong to pragmatics. Indeed, presuppositions are cancelled when they are inconsistent with background knowledge, and when what is uttered is inconsistent with what is presupposed, respectively (2)' and (3)':

(2) She cried before writing her testament.

>> She wrote her testament

(2)' She died before writing her testament.

~>> She wrote her testament

(3) You finally managed to open that door.

>> You tried to open that door

(3)' In a context in which a child has been playing with a ball inside the house, and his mother has been insisting for him to stop because he could have broken a window, if the mother utters:

You finally managed to break that window!

~>> You tried to break that window⁹

Being sensitive to context and to background knowledge, presuppositions belong to the domain of pragmatics. Moreover, as Stalnaker (1973:387) highlighted, "to presuppose a proposition in the pragmatic sense is to take its truth for granted, and to presume that others involved in the context do the same". In other words, presuppositions can be defined as propositions whose truth a speaker takes for granted and, crucially, assumes that his/her listeners do the same. Consider:

(4) A: John's wife is pretty.

>> John has a wife

B: Well, he is a handsome guy.

C: What?! I didn't even know John got married!

In (4), A uses a definite description taking for granted that both B and C share a knowledge with him/her, namely the presupposition 'John has a wife'. Of course, sometimes speakers' assumptions about the shared knowledge can be incorrect, as in the case of C who did not know John had a wife. What is fundamental to point out, though, is the wording of the utterance in (4) that reflects the speaker's assumptions of his/her hearers' background knowledge. If A had known that C did not know that John had a wife, he/she would have uttered something like:

⁹ Example from Bertuccelli Papi (1993:229).

(5) A: You know, John got married. I met him yesterday, his wife is pretty.

The utterance in (5) explicates the presupposition that John has a wife because the speaker knows that his/her hearer does not have that notion in his/her knowledge, and thus provides him/her with that information.

Implicatures, on the other hand, are a part of what is communicated without being part of what is ‘said’ by the speaker. They are pragmatic inferences derived via the tacit assumption, shared by the speaker and his/her audience, that what is communicated has to be true, informative, relevant, and clear. These features reflect what Grice (1957, 1975, 1989) described through the Cooperative Principle and the Maxims of conversation^{10,11,12}. Grice divided implicatures into conventional and conversational. The first ones are non-truth conditional inferences that do not derive from superordinate pragmatic principles, but are conventionally attached to certain lexical items and thus do not change according to the communicative context (see examples 6 through 9).

(6) She studied very hard for her exam, therefore, I think she’ll pass it.
[*therefore* engenders the implicature that studying is linked to passing an exam]

(7) The wolf is a slim animal but it is very strong.
[*but* is used to implicate that what follows it contrasts with what precedes it]

(8) Even John knew that they broke up.
[*even* engenders the implicature of ‘contrary to what might be believed’]

(9) Susan is a successful businesswoman, moreover she is a very good mother.
[*moreover* indicates that the second proposition is something ‘in addition to’ the first one]

¹⁰ See Cosenza (2002) for a thorough analysis of Grice’s framework.

¹¹ Though I recognize that Relevance Theory (Sperber & Wilson 1986, 1995, 2002, 2004, and Wilson & Sperber 1991) is undoubtedly one of the most prominent theories in pragmatics, following Sbisà (2007), in the present work the Gricean framework will be maintained. I agree with Sbisà that the Principle of Relevance is an overly bare substitute of the Cooperative Principle and its Maxims, which “(...) appiattisce tutte le caratteristiche della conversazione cooperativa ideale sulla sola pertinenza e impoverisce la gamma delle strategie argomentative a supporto degli impliciti” (2007:113) (“reduces all the properties of ideal cooperative conversation to relevance alone, and impoverishes the range of argumentative strategies supporting implicit meanings” my translation). Furthermore, the Gricean framework allows us to account for implicit meaning comprehension in ASD people in a more detailed and articulated fashion compared to the one offered by Relevance Theory.

¹² See Levinson (1983, 2000), Bertuccelli Papi (1993), Horn (2004) for a discussion of critiques to the Gricean framework.

Conversational implicatures on the other hand, have to be inferred according to the communicative context, and, depending on their context-dependence, are divided into generalized (henceforth GCIs) and particularized (henceforth PCIs). GCIs are derived assuming that the context of the utterance is an ordinary conversation. On the contrary, PCIs are highly context dependent, and can be interpreted only in reference to a ‘particular’ context. Scalar implicatures are an instance of generalized conversational implicatures. They are generated by quantifiers and any kind of ordered scale. For example uttering ‘they have two children’ +> ‘they have exactly two children’ referring to the scale of numbers or, also, ‘the coffee is warm’ +> ‘the coffee is not hot’ following the scale of ‘warmth’. Under the Maxim of Quantity, these sentences are interpreted as being as informative as required and, hence, the use of a weak term on a scale (two *vs.* three, warm *vs.* hot) is taken to implicate that the stronger term of that scale is ruled out. In order to draw PCIs instead, hearers are required to take into account the particular context of the conversational exchange (see example (10))

(10) Context: A is reading, B turns on the radio

A: I’m studying.

+> could you turn off the radio?

The utterance ‘I’m studying’ only in this particular context means ‘could you turn off the radio?’.

Implicatures and presuppositions have received substantial experimental attention both in neurotypical individuals (see Wetzel & Molfese 1992, Noveck 2001, Noveck & Cheveaux 2001, Noveck & Posada 2003, Bezuidenhout & Morris 2004, Chierchia *et al.* 2004, Feeney *et al.* 2004, Sanford & Moxey 2004, among others) and in clinical populations (see Eisele *et al.* 1998, Happé *et al.* 1999, Kasher *et al.* 1999, Zaidel *et al.* 2000, Tompkins *et al.* 2004, among others). Agreement is still lacking, though, as to the neuro-cognitive correlates of this kind of implicit meanings. For the scope of the present study, an overview of specific research on ASD impairment in implicit meaning processing will be presented in the next section.

2. Discussion of previous research

Since Rapin & Allen coined the term *semantic-pragmatic syndrome* in 1983, and then Aarons & Gittens (1993) noted that this diagnostic label actually described the linguistic features of ASD people, a considerable amount of research has been conducted about the language impairments characteristic of this clinical population. Presenting and discussing the entire range of impaired linguistic skills in ASD goes beyond the scope of this paper, which solely concentrates on presupposition and implicature understanding and, hence, only reviews specific studies on these skills¹³. Suffice here to say that ASD people have been found to be impaired in several pragmatic skills, among which are: verbal and non-verbal communication (Stone & Caro-Martinez 1990), responses to social scripts (Loveland & Tunali 1991), humor comprehension, inferential abilities and understanding of indirect requests (Ozonoff & Miller 1996), humor comprehension (Emerich *et al.* 2003), integration of contextual information (Lokusa *et al.* 2007).

More specific research on implicit meanings in ASD has been conducted, and a representative sample will be discussed here. Eales (1993) analyzed conversation samples of adults who in their childhood had received a diagnosis of either autism or receptive language disorder; the participants with a diagnosis of autism showed poorer pragmatic skills compared to the ones of the other group. Analyzing the data, the author makes a distinction between execution and communicative intention and, following this, he proposes that ASD only present impairment in the second competence, which results in sentences that violate the Maxims of Quantity, Quality and Relevance (not the Maxim of Manner, which is the only maxim linked to the linguistic form of the utterance).

Conversational Maxims and their violations were also analyzed by Surian *et al.* (1996). The authors presented ASD children (m.a. 12;11) with tape-recorded conversational exchanges in which the violation of a Maxim was present; they were then asked to indicate which character said something “funny or silly” (1996:62). ASD group’s results were compared to a control group of SLI and typically developing children matched for verbal age. The authors conclude “most children with autism are ‘deaf’ to violations of Gricean Maxims. Such a deficit is itself likely to be the result of an impairment in mindreading” (1996:67). This study, though, does not seem to give context the due importance in a task such as the one required to participants in this study. The sentences used to test the recognition of Maxim violation, to a more meticulous analysis, appear to be perfectly acceptable if one imagines the right context for them. For example, answering ‘in a cup’ to the question ‘how would you like your tea?’ would

¹³ The interested reader is referred to Cummings (2009) and Formisano (in press)b.

be acceptable if the person answering it likes to change his/her drinking habits, let's say choosing among glasses, mugs, and cups, and the person asking is looking into the cupboard where there are glasses, mugs, and cups. Of course, there are also some non ambiguous examples in the study, nonetheless the ambiguity highlighted above, and present in the majority of the testing items, makes a point for reflection about conducting research in pragmatics. When considering what is not adequate, it is important to keep in mind that providing decontextualized examples renders the interpretation and judging tasks more difficult, because of the lack of environmental clues to rely on.

Dennis *et al.* (2001) analyzed the comprehension of different implicit meanings in 8 HFA children (m.a. 9;9): presuppositions, script inferencing, metaphor, and speech acts. The authors conclude that, contrary to previous findings, HFA children appear to be able to make some inferences, namely the processing of presuppositions deriving from mental states verbs, suggesting that they can connect a text to fixed knowledge. Nonetheless, this is not the case with implications, suggesting an inability to connect the text to the local sentence context and, also, with metaphor comprehension, interpreted as a failure to attribute a communicative intention to the speaker. The authors conclude "(HFA children) often fail to make inferences that are the basis of successful social communication; for example, those that elaborate meaning for the listener or signal awareness of intentions. They seem unable to make contextual inferences about thoughts" (2001:53).

These examples, and other studies examined, reveal the emergence of some controversies in the studies investigating pragmatic competence in general, and implicit meaning understanding in particular. In some studies, participants were extremely young (e.g., Stone & Caro-Martinez 1990 tested children of 4 to 13 years of age; Dennis *et al.* 2001's participants' mean age was 9; Lokusa *et al.* 2007 younger group's age was comprised between 7 and 9), hence the purported pragmatic impairment might actually derive from developmental factors. Some other studies concentrated only on the production (e.g. Stone & Caro-Martinez 1990), inferring from the absence of a feature in the linguistic production of people with ASD the impairment of the related skill. Other studies (e.g. Surian *et al.* 1996) show a misinterpretation of the nature of pragmatics by neglecting the fundamental role of context in the disambiguation of utterances, distorting the notion of context (Jolliffe & Baron-Cohen 1999a) or including non-verbal behaviors in pragmatic competence (e.g. Chandler *et al.* 2002, Caro-Martinez 1990).

3. The present study

This section presents the research I conducted¹⁴. As discussed in the previous section, ASD people have been found to be impaired in several pragmatic skills, among which the ability to comprehend implicit meanings. Nevertheless, an analysis of the existing literature on the topic revealed several inconsistencies between pragmatic notions and the way they have been tested in the experimental practice. Therefore, the rationale behind conducting a research of this kind is the need of investigating a pragmatic phenomenon from a strictly pragmatic perspective. The research involved the devising of a test with the aim of analyzing the understanding of implicit meanings (IMs) in ASD people and, also, verifying whether comprehension of IMs is connected to their degree of context dependence. In other words, whether a higher context dependence corresponds to higher difficulty in the processing of the implicit meaning on the part of this clinical population. Were this to be the case, presuppositions should result easier than conventional implicatures, and conventional implicatures easier than conversational implicatures. Examining such specific skills could help the creation of *ad hoc* treatments for ASD people, considering that all too often speech therapists lack a solid theoretical linguistic background.

Having established the kind of IMs to be tested, a test was created keeping in mind the fundamental role context plays in sentence interpretation and IMs processing. To include as many contextual clues as necessary in everyday communication, videos of brief communicative exchanges were used as testing items for conversational implicatures. Three experts¹⁵ attested the pragmatic and neuro-psychological adequacy of the test.

There are 45 questions in the test, of which 23 ascertain general comprehension and function as control items, and 22 are questions on IMs comprehension. Table 1 illustrates the details.

¹⁴ The complete research is thoroughly presented in Formisano (in press)b.

¹⁵ For the assessment of its pragmatic adequacy, I am thankful to Carla Vergaro (University of Perugia) and Marina Sbisà (University of Trieste); for the assessment of its neuro-psychological adequacy, my thankfulness goes to Dr. Maddalena Petrillo (ASL 8 – Arezzo).

Table 1. Question quantity and typology

23 general comprehension	22 Implicit Meanings				
	14 Implicatures			7 presuppositions	1 logical implication
	4 conventional	10 conversational			
		5 relation	3 quantity	2 scalar	

The category of implicatures is more articulated than that of presuppositions, therefore, to allow for testing of different implicatures, a higher number of these was included. Seven items test presupposition comprehension, and 14 test implicatures. Four items include a conventional implicature, and 10 a conversational implicature; these are thus divided: 5 test conversational implicatures derived from the Maxim of Relation, 3 derived from the Maxim of Quantity, 2 from Scalar items¹⁶.

3.1 Participants

Twenty-nine people participated in the study (8 females and 21 males). They all had a diagnosis of ASD – either high functioning autism (9) or Asperger syndrome (14) –, were native speakers of Italian, and had an IQ higher than 70 (meaning no mental retardation was present). Six participants have a diagnosis of PDD-NOS but were included in the study all the same because of their very high levels of cognitive and linguistic functioning, attested by the results of either ADI or ADOS, and confirmed by their neuropsychiatrists and speech therapists. It should be highlighted that the boundaries between these three conditions (HFA, AS, PDD-NOS), especially at high levels of functioning, are sometimes blurred. Indeed, the PDD-NOS group results do not differ significantly from those of the HFA, or the AS group. The participants' age ranged from 11 to 39 (m.a. 18;3 SD of 5.8). The first cut off point for age had been established to 13 in order to avoid any developmental bias¹⁷, but considering that the performance of

¹⁶ Implicatures deriving from the Maxims of Quality and Manner, present in the test draft, were eliminated because the neurotypical individuals who participated in the pilot test performed poorly on them.

¹⁷ Analyzing pragmatic competence in young children could lead to a misinterpretation of their errors, which may actually derive from developmental factors rather than their clinical conditions.

the subjects under 13 did not diverge in any significant way from the older ones, it was decided to include them in the study.

The control group consisted of an equal number of neurotypical individuals, native speakers of Italian, matched for age and sex. I.Q. matching was not deemed necessary, given the fact that participants in the ASD group do not have mental retardation and are all at very high levels of cognitive functioning.

3.2 Test Administration and Scoring

The test was administered to one participants—at the time, in a quiet room at the autism centers or hospitals through which the subjects had been recruited. Participants were told that the test required them to answer T/F/don't know questions on the basis of the information provided and, then, to motivate their answers. They answered orally, and their answers were noted down on an answer sheet.

In the scoring phase, both the answer and the explanation provided to support it were analyzed. This was deemed necessary so as to have a more complete picture of the IM processing. Consider the following example:

(11) Video:

A living room. A woman trimming the ends of green beans. A girl with a school bag enters the scene.

W: So, how did your math test go?

G: Hum ... What are we having for lunch today?

Answering 'true' to the question 'The girl wants to change topic of conversation' does not guarantee that the participant has correctly processed the implicit meaning deriving from the violation of the Maxim of Relevance. Indeed, one participant said it was true that she wanted to change topic but, when asked to motivate his answer, he said that it was because she was hungry and not, as expected, because she does not want to talk about her math test. Thus, in this case the answer was considered as non-target.

For both the ASD group and the control group, the mean and the standard deviation (SD) of total and IMs target answers were calculated. The means were then compared and the *Mann-Whitney Test* was applied to check the statistical significance of the difference between them.

As concerns the questions on IMs, the results were sorted by kind of implicit meaning, and the percentages were weighed according to the occurrence of every kind of IM¹⁸.

3.3 Results

Twelve participants in the control group scored 100% target answers. Twelve only gave one non-target answer, and the remaining 5 vary between 2 and 3 non-target answers. This corresponds to a mean of total target answers of 98% (SD 0.9), and a mean of target answers on implicit meaning of 97% (SD 0.7).

Seventeen participants provided a non-target answer on the item testing the conventional implicature engendered by 'in spite of'. The testing item is reported in (12):

(12)

The grey wolf is a strong animal in spite of its slim build. It lives in Europe, Asia, and North America.

The question aimed at verifying the comprehension of the conventional implicature 'usually animals with a slim build are not strong' engendered by 'but'. As already said, 17 participants in the control group did not process this implicature and answered 'false', providing examples of slim and strong animals, such as cheetahs, in support of their answer. A developmental pattern for the non-processing of this conventional implicature does not emerge as not only the young participants failed to process it. A possible reason for this result could be that these people were not able to suspend their background knowledge about slim animals being strong, even if they had been told to answer only on the basis of the information provided in the sentence. Taking in consideration that more than half of the participants in the control group found the processing of this implicature problematic, I decided to eliminate this specific testing item from the results of both the control and the ASD group.

After calculating the percentages excluding this testing item, it resulted that 24 out of 29 participants scored 100% of total target answers, and 25

¹⁸ Weighing the percentages was necessary considering that there is a different number per kind of IM. Of the 22 IMs, 7 are presuppositions, 5 are conversational implicature related to the Maxim of Relation, 4 are conventional implicatures, 3 are conversational implicature related to the Maxim of Quantity, 2 are conversational implicature related to scalar items, 1 is a logical implication. Therefore, in calculating the percentages of target answers for every IM, these occurrences were considered.

out of 29 scored 100% of target answers on implicit meanings. Hence, the percentages change to:

- mean of total target answers: **99%** (SD 0,5)
- mean of target answers on implicit meaning: **99%** (SD 0,3).

These percentages are a better term of comparison. Being closer to 100%, it means that the testing items are clear for typically developing individuals and can thus be used to test if and how the results of the clinical population examined differ from the norm.

In sum, 83% of the participants in the control group correctly answered 44 out of 44 questions. 10% correctly answered 43 out of 44 questions, and 7% 42 out of 44. As for IMs comprehension, 86% of the participants provided target answers for 21 out of 21 IMs, and the remaining 14% (4 participants) produced one non-target answer to questions on IMs. For these people a developmental factor could be hypothesized, given that their mean age is 13;10. However, before putting forward a developmental explanation, it should be considered that they did not produce any other non-target answer on IMs, and three out of four also produced a non-target answer on a control item. Thus, a developmental explanation could be possible, but should not be proposed as a straightforward conclusion.

The results of the ASD group show a good processing ability not only for general understanding but, also, for IMs comprehension. They are as follows:

- mean of total target answers: **91%** (SD 4,3)
- mean of target answers on implicit meaning: **88%** (SD 2,5).

Participants of the ASD group produced 88% of target answers on IMs. Consequentially, their percentage of non-target answers on IMs is 12%, that is 76 out of 609, with a mean of 2,6 (SD 2,5). As standard deviation values indicate, this group performed in much more heterogeneous fashion compared to the control group. Figure 1 illustrates the percentage of people relating to their performance on total target answers.

Figure 1. Percentages of people in the ASD group according to their total target answers

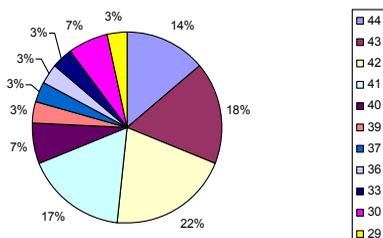
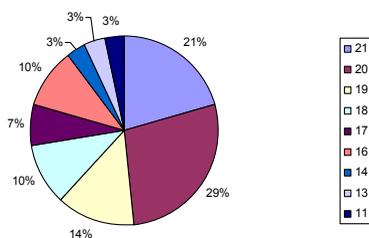


Figure 1 shows that almost three quarters of the participants (71%) produced ≥ 41 out of 44 target answers on total comprehension. Four participants out of 29 (14%) performed at 100%. The mean of total non-target answers is 4, of which 2,6 is on IMs, and 1,4 on control items.

Figure 2 illustrates participants' percentages relating to their production of target answers on IMs.

Figure 2. Percentages of people in the ASD group according to their IMs target answers



For IMs understanding as well, almost three quarters of the participants (74%) produced 3 or less non-target answers, and 6 out 29 (21%) performed at 100% on IMs understanding. The highest percentage (29%) is that of participants that produced only one non-target answer.

Previous research suggests that the difficulty of IMs interpretation is connected to their context dependence. Thus, the percentages of non-target answers should increase from presuppositions to conventional implicatures to conversational implicatures. Results of this study seem to agree with this prediction. Figure 3 breaks down the 12% of non-target answers on IMs according to the kind of IM, the results are of course weighed on the basis of the occurrences of the different testing items.

Fig.3. Percentages of non-target answers divided by kind of IM

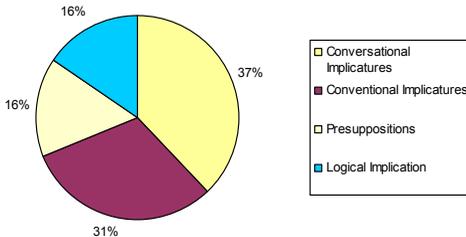


Figure 3 illustrates the correlation between context dependence and difficulty of processing. The category of IM that proved to be the most difficult, in percentage, was the one of conversational implicatures, followed by conventional implicatures, and by presuppositions and the logical implication with the same percentage of non-target answers. Table 2 provides the number and percentage of non-target occurrences for every kind of IM.

Table 2. Details on IMs occurrences and non-target answers

	Total Occurrences	Non-Target Answers #	Non-Target Answers %
Logical Implication	29 (1:29)	2 out of 29	7%
Presuppositions	203 (7:29)	14 out of 203	7%
Conventional Implicatures	87 (3:29)	12 out of 87	14%
Conversational Implicatures	290 (10:29)	48 out of 290	17%

In Table 2, the first column lists the kind of IMs; the second the total occurrences, which was obtained multiplying the quantity of every IM present in the test by the number of participants; the third column explicates the calculation to arrive at the percentages in column four. Only the 7% of occurrences of both logical implication and presuppositions were non-target. For conventional implicatures this percentage was 14%, and for conversational implicatures it was 17%. Thus, the least context dependent IMs were actually the least problematic. As context dependence increases, the non-target answers on IMs increase as well. These results would seem to confirm the hypothesis of a correlation between context dependence and difficulty of interpretation. However, this is not true at a more specific level of analysis.

Dividing conversational implicatures into generalized (therefore less context dependent) and particularized (highly context dependent), the correlation between difficulty of interpretation and context dependence does not emerge. Table 3 presents a detailed analysis on conversational implicatures.

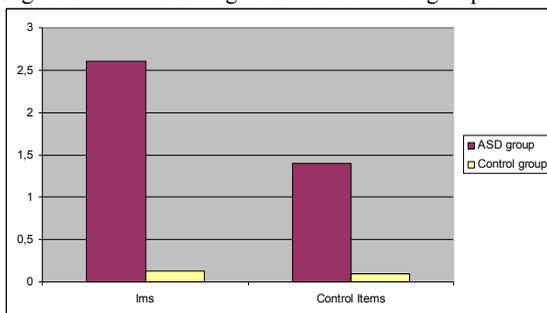
Table 3. Generalized and Particularized Conversational Implicatures

	Total Occurrences	Non-Target Answers #	Non-Target Answers %
Generalized (Scalar)	58 (2:29)	13 out of 58	22%
Particularized	232 (8:29)	35 out of 232	15%

What emerges from Table 3 is an unexpected result. Scalar items should be easier to interpret compared to particularized conversational implicatures, considering that they are less context dependent than PCIs, but this is not what the results show. The percentages of non-target answers are in fact higher for scalar items (22%) than for PCIs (15%). The non-processing of the scalar implicatures never depended on a logical meaning attribution to the scalar items¹⁹, but rather on the fact that, as the analysis of the motivations provided revealed, they were ignored. It would be interesting in future research to focus on this particular implicit meaning, and verify whether this clinical population is characterized by a specific difficulty in their processing.

A comparison of the performance of the ASD and the control group are summarized in Figures 4 through 6.

Fig. 4. Mean of non-target answers for both groups



¹⁹ This has also been shown to be true for typically developing adults tested in their L1 and L2. See Formisano (in press)a.

The results of the ASD group seem to confirm the hypothesis, based on previous research findings, of a difficulty on the part of individuals in this clinical population to interpret implicit meanings deriving from implicatures and presuppositions. Nonetheless, as Figure 4 shows, the mean of non-target answers is quite low, both for general understanding and for IMs comprehension. The mean of total non-target answers was 4, corresponding to 9%. For the control group this mean was 0.2 (0.5%), ($p < .00001$).

Figure 5 shows the distribution of non-target answers among the different kind of IMs.

Fig. 5. Mean of non-target answers for both groups divided by kind of IM

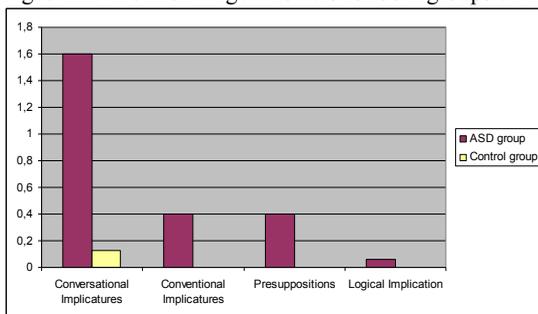


Figure 5 illustrates that there seems to emerge a context-dependence pattern. The more the kind of IM relies on context for interpretation, the more it proves to be difficult to interpret by both ASD and, also, control people. The percentages are visibly different, and statistically significant as revealed by the Mann-Whitney Test ($p < .00001$). Nonetheless, the highest mean on non-target answers on IMs, namely that on conversational implicature, is 1.6, a number that does not reveal a deep impairment in the IMs interpretation skill(s). As previously stated, the context dependence pattern does not emerge when the results of conversational implicatures are divided into generalized and particularized. Participants from both groups produced more non-target answers on questions testing scalar implicatures (GCIs) compared to those testing PCIs, hence a more specific problem with this kind of IM could be hypothesized to account for this result.

Summing up, it was shown that all the results of the ASD group mirror, with different percentages, those of the control group. Both groups produced more non-target answers on:

- IMS vs. Control Items
- Conversational Implicatures vs. Conventional Implicatures, Presuppositions, and Logical Implication
- GCIs vs. PCIs
- Maxim of Relation vs. Maxim of Quantity.

Figure 6 presents a comparison between the non-target answers produced by the two groups and the age of the participants.

Fig. 6 Non-target answers related to age for both groups

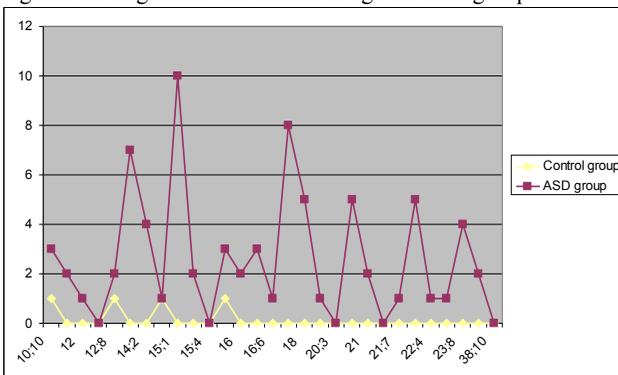


Figure 6 illustrates that a developmental pattern emerges more clearly for the participants of the control group. After the age of 16, no non-target answer was provided. On the other hand, for participants of the ASD group the number of non-target answers was very heterogeneous, and did not decrease with the increase of age. Hence, a developmental factor influencing IMs interpretation seems to be excludable for the tested clinical population.

Considering that the people in the ASD group had different diagnosis (14 AS, 9 HFA, 6 PDD-NOS) results will also be presented sorted by diagnostic group. Again, it has to be highlighted that the boundaries between these three conditions are not always clear-cut. Figure 7 presents the mean of non-target answers for each group.

Fig. 7. Mean of non-target answers sorted by diagnosis

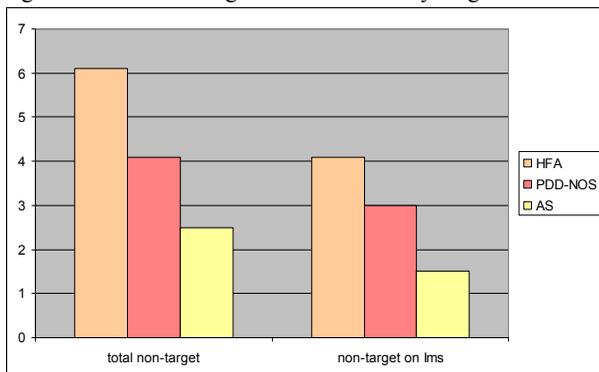


Figure 7 shows that participants with a diagnosis of HFA produced the highest mean of non-target answers, followed by the PDD-NOS ones and, lastly, by the AS ones. Considering these results, a difference in pragmatic proficiency among these three groups does seem to emerge. Nevertheless, before such a difference can be considered as a means of any diagnostic significance, further research on this issue is needed.

3.3.1 IMs understanding

Considering the overall good performance of the ASD group in IMs understanding, it is interesting to report some examples showing the correct processing of the different kinds of implicit meanings. (13) provides some examples of correct processing of presuppositions (total target answers on this IM was 93%).

(13)

i. [...] before a bolt of lightning strikes us

Testing item: Josef and his friends have been struck by a bolt of lightning

-F, because he says before so that means that they haven't been struck yet

- F, because Josef says before a bolt of lightning strikes us

ii. W: How did your math test go?

G: Hum ... what are we having for lunch today?

Testing item: The girl had a test at school

- T, Oh yes she had! And, also, she didn't do it well!

- T, she had the test because her mother asks her about it

- T, she had it but it mustn't have gone very well

iii. [...] Her horse passed through an opening in a wall

Testing item: There was an opening in the wall

- T, the horse went through it so there had to be one
- T, it says an opening so there was an opening

The correct productions on conventional implicatures were 86%. In (14) some examples of correct answers are provided.

(14)

i. She thought about her brothers, her sisters and some of her nephews, and so she calmed down.

Testing item: Oriana calmed down looking at the landscape out of the window

- F, she calmed down looking at the pictures
- F, she was thinking about her family
- F, thinking about her brothers, sisters, and nephews

ii. [...] it walked leaning the front part of the paws on the ground. It was thus a plantigrade, like bears

Testing item: Bears are plantigrade animals

- T, it says like bears
- T, there it is written plantigrade like bears so it means that bears are plantigrade animals

iii. The coyote has a robust body, like the wolf, but it has shorter legs

Testing item: The coyote is exactly like the wolf

- F, it has shorter legs
- F, only for the body
- F, it has shorter legs, and for the muzzle and the ears it is more similar to the fox

Examples of correct processing of conversational implicatures (total target 83%) are reported in (15).

(15)

i. W: Would you like some coffee?

M: I wouldn't sleep all night

Testing item: The man accepts the coffee

- Drinking the coffee he would not sleep and he does not want it
- The coffee has the effect of keeping him awake, he does not want it
- He refuses the coffee, that's why he says that he wouldn't sleep
- Because he has to drink the coffee and, drinking it, he wouldn't sleep²⁰
- F, he wouldn't sleep

²⁰ Interesting to point out that with this answer the participant also explicates another IM present in the interaction, namely 'Would you like some coffee'+> to drink.

- F, he wouldn't have slept

ii. W: Will you show me this ball?

M (gives her the ball): yes, it's crystal

Testing item: The woman has to be careful with the ball

- T, because it's made of crystal

- T, that's why the man said that the ball is made of crystal

- T, the man told her that the ball was made of crystal because she did not know and could have broken it

- Because it is precious, she does not have to show it around²¹

iii. G1: I am studying

G2 turns off the radio

Testing item: One of the two girls turns off the radio because she was tired of listening to it

- F, because the other said that she was studying

- F, it was bothering her friend

- F, because she had to allow the other girl to study

- F, Because she understood what the other was saying

- F, Because the other girl reproached her

- F, The other girl said that she was studying she meant²² that she couldn't study

- F, She had been asked to do so

These are just a few examples that show how people with ASD are actually able to process highly context dependent implicit meanings when provided with the appropriate context.

4. Conclusion

The research reported in this paper aimed at investigating the extent to which people on the autistic spectrum (ASD) understand implicit meanings. This clinical population has been shown to present an impairment in several pragmatic skills, among which is the inferential ability to process implicit meanings (IMs).

However, what has also emerged from previous research is an underestimation of contextual clues in elaborating tests to analyze pragmatic competence and, also, a disregard of developmental factors that might have biased the results.

Therefore, the necessity of examining inferential skills in these people using a more pragmatically adequate testing methodology emerged. For this purpose, a test was devised including videos of communicative

²¹ This was counted as a target because the participant recognized the adherence to the Maxim, he just provided a different interpretation.

²² This participant has the difference between 'what is said' and 'what is meant' by the speaker very clear.

exchanges with the aim of providing participants with the contextual clues necessary to utterance interpretation. The IMs tested were: a logical implication, presuppositions, conventional implicatures, and conversational implicatures.

Twenty-nine ASD people, and an equal number of typically developing individuals, participated in the study. Results of the clinical population confirmed the hypothesis of a correlation between context dependence and processing difficulty. Interestingly enough, results of the control group showed the same pattern as well, albeit with different percentages. However, this context dependence pattern does not hold when comparing GCIs and PCIs but, as discussed, this could depend on a specific difficulty with the GCI tested, namely scalar implicatures. Future research would need to focalize on scalar implicatures, to further test them in both clinical and typically developing individuals²³.

Results of this study correspond to previous research findings qualitatively, in the sense of a correlation between context dependence and processing difficulty. Difference emerges, however, when looking at the results from a quantitative point of view. In **88%** of the cases (compared to 99% of people in the control group), ASD people were able to adequately interpret implicit meanings. It appears thus that autistic people's impairment on implicit meaning understanding is neither severe, as the high percentage on target answers demonstrates, nor generalized, as shown by the standard deviation value (2,5).

This quantitative difference could be explainable in terms of testing methodology. Including videos for items testing particularized conversational implicatures seems to have fostered implicit meaning understanding. This kind of IM is highly context dependent, thus providing the context for the conversational exchanges through videos was deemed fundamental for it to be tested. In addition, including verbal reports on the tested items revealed to be of fundamental importance in the interpretation of some results that, otherwise, would have been analyzed in the opposite way, hence not corresponding to participants' intended responses.

Future research is needed to test ASD people's pragmatic skills with more pragmatically adequate testing methodologies. As for IMs comprehension, results on scalar implicatures encourage further investigation, which should also be carried out on the two conversational

23 For the influence of testing methodology in research on scalar implicatures in L1 see Guasti *et al.* (2005), Chierchia *et al.* (2004), and Feeney *et al.* (2004). For L2 see Formisano (in press)a.

maxims which, for methodological reasons, were not included in this study, namely, the Maxim of Quality and the Maxim of Manner.

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