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TOWARDS THE UNDERSTANDING OF THE NEUROGENESIS OF SOCIAL COGNITION: EVIDENCE FROM IMPAIRED POPULATIONS

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Abstract. One accepted and straightforward approach to understand the genesis of social cognition – as of any particular human neoformation – is to look for specific developmental disorders in the hope to find clear double dissociations. In this regard, contrasting subjects with autistic spectrum disorders on the one hand and subjects with Williams syndrome on the other has gained large acceptance. Subjects with autistic spectrum disorders have been interpreted as being impaired specifically in social cognition, while in WS subjects social cognition is interpreted to be spared. Detailed studies, however, indicate that the situation is by far not that simple and straightforward. The seemingly simple term "social cognition" covers several aspects from gaze contact through different facets of theory of mind ability to social inferencing in language pragmatics. In this paper a survey of the different tasks and results will be presented that all seem to challenge the simplicity of the implied "social cognition" module. Our own empirical data also indicate that (1) in individuals with autistic spectrum disorders theory of mind ability, as a central aspect of social cognition, shows a highly heterogeneous pattern, as manifested in their ability to understand written irony; and that (2) in WS subjects the unfolding of the social mind can be differentiated into more specific social skills, as manifested in various tasks related to pragmatics of word meaning acquisition.

Keywords: autism spectrum disorders, neurocognitive development, social cognition, pragmatics, Williams syndrome

TOWARDS BIOLOGICAL INTERPRETATIONS OF THE "SOCIAL MIND"

Whether it is admitted openly or just entertained implicitly, mainstream contemporary research in human psychology, including its social aspects, is done under a functionalist umbrella of meta-theoretical and methodological assumptions. This functionalism has, as it is well-known, at least three layers. First, it sets the focus of research on patterns of human behavioral functions, and the pattern of mental-cognitive functions that underlie them. Second, it takes evolutionary history of adaptation as an especially relevant context for the explanation of the specific present-day

pattern of these functions. Third, in one or another sense we are mostly functionalists regarding the mind-brain relationship, too – even if we are aware that any current version of functionalism is certainly not the final and satisfying view on this matter. The latter two aspects of functionalism directly take us to our focus in this paper: how empirical research on neurodevelopmental disorders offers an embedding of human social cognition in a broader biological context. This biological context is twofold: the history of adaptive changes which formed our social mind/brain, and its neural basis in a developmental perspective.

Beyond these general considerations, however, more specific and important convergence of various research advancements from the last few decades put more emphasis on the neurodevelopmental background of social cognition. Below we briefly point to some of such advancements.

Forget the traditional individual mind/brain approach: the intrinsically social mind. Both theoretical-conceptual considerations (such as, for example, HUMPHREY's; 1984) and empirical studies (e.g., BYRNE and WHITEN 1988; PREMACK 1988; PREMACK and WOODRUFF 1978) have suggested that the human mind is, so to say, *intrinsically* and *specifically* social. By "intrinsically" we mean that complex social cognition seems to belong to our species-specific biological constitution, determined to a considerable extent by our genetic endowment. By "specifically" we mean that complex social cognition does not seem to rely on our domain-general cognitive abilities (at least, not in its entirety), it is not just one accidental "focus" of thinking or problem-solving. Instead, as some of the evidence cited below suggest, (partly) domain-specific neurocognitive mechanisms are dedicated to many aspects of social understanding. Domain specificity is often – though, arguably, mistakenly – identified with modularity. It is worth noting here that besides the now-classical Chomskyan (e.g., 1968, 1975; see also HAUSER, CHOMSKY and FITCH 2002) and Fodorian (FODOR 1983) concepts of modularity, several other models of mental architecture and development have been elaborated and applied to social cognition, too, which involve one or other kind of domain-specific but non-modular elements (see, e.g., GOPNIK and MELTZOFF 1997; KARMILOFF-SMITH et al. 1995).

"Theory of Mind" as one of the central aspects of social cognition. The emerging view of social cognition as a specific human adaptation received much motivation and clarification from the quickly expanding research on "naive theory of mind" ("ToM" – folk psychology, mentalizing ability, common sense psychology, etc.; see CARRUTHERS and SMITH 1996). Little doubt can be raised against the idea that our ability to attribute mental states to various agents, in order to interpret, explain and predict their actions, plays a central role in complex human social life and intentional communication. However central this role is, it should be clear that "human social cognition" cannot be identified with "theory of mind ability", as we shall argue for it briefly below. Moreover, ToM research in itself rapidly lead to a more structured

conception of this ability, its development, the underlying cognitive/neural machinery and, consequentially, of social cognition. In several studies an early but gradual emergence of this ability has been revealed, involving qualitatively different states (e.g., GOPNIK and WELLMAN 1994; LESLIE 1994), as well as different and to some extent dissociable aspects/components of it in its mature functioning (e.g., BARON-COHEN 1995; TAGER-FLUSBERG and SULLIVAN 2000). In sum, a quite structured image of social cognition and ToM ability, as a part of it, is suggested by empirical findings.

Social control, attribution, and culture in evolution. Based to a large extent on such empirical findings, sometimes quite ambitious and comprehensive – though to some extent clearly tentative – reconstructions have attempted to integrate this structured view of human social cognition into a broader model of the evolutionary and individual history of acquiring culture. One of the most influential such reconstructions is that of TOMASELLO (1999), yielding a quite detailed image of how language, imitation, social teaching, various aspects of ToM functioning and other human abilities evolved and develop in a quite intricate pattern of interactions.

The social brain revealed in brain damage. After the pioneering work of DAMASIO (e.g., 1994; see also DAMASIO and MAURER 1978) on social consequences of frontal lobe injuries, studies on both impaired and non-impaired human and non-human subjects, using various methodologies (traditional neuropsychological methods, neuroimaging, etc.) have made significant steps towards identifying brain structures playing central role in various aspects of social cognition (e.g., EMERY and PERRETT 2000; FRITH and FRITH 2000; STONE 2000; for a review of pragmatic aspects, see PLÉH 2000). The most important such structures involved in ToM functioning are the medial prefrontal cortex, the temporal pole, the amygdala, and the supra-temporal sulcus, though the entire "social brain" involves other structures, and other socio-cognitive functions, too (see, e.g. BURNS, in press).

Cognitive systems underlying social understanding, and major psychiatry. Another growing field of integrative models is that of theorizing about mental disorders of social adaptation, by drawing together data from psychiatric, neurobiological, psychological, paleoanthropological and primate studies. For example, the influential "speciation" model of CROW (1995, 2002) on the evolution of the neural background of schizophrenia has important social aspects, but BURNS's (in press) alternative model, while criticizing CROW's, still regards schizophrenia as an illness of the "social brain".

THE LOGIC OF STUDYING NEURODEVELOPMENTALLY IMPAIRED POPULATIONS

Studying neurodevelopmental disorders with (at least, partially) genetic background and with specifically impaired or specifically preserved social cognition has gained specific importance in understanding the origins of human social cognition to some extent precisely because, as a field of inquiry, it lies in the overlapping area of the above-noted research directions. Due to their genetic backgrounds, they are relevant in an evolutionary context; being neurodevelopmental in their nature, they are relevant in understanding the neural basis of social cognition; showing selective impairments/preservation of various aspects of social cognition they offer insights about how these are organised and embedded within the overall architecture of the mind/brain. Moreover, they offer a window onto developmental unfolding of social cognition. This latter aspect is, at the same time, both a promising and a complicating one: it gives a new, ontogenetic dimension both to the problem and to the potential explanation, as compared to acquired cases of impairments in previously well-functioning social cognition.

Though it has been criticised repeatedly (see, e.g., SHALLICE 1988; THOMAS and KARMILOFF-SMITH 2002), the most traditional and most widely used method for decomposing mind/brain into component systems builds on cases of *double dissociation*. In the research on neurodevelopmental disorders, this methodology accompanies the more basic one, contrastive studies involving an impaired target group and at least one well-matched control-group (either with typically developing subjects, or subjects with general learning disability).

An essential part of what is believed to be known today about the developmental and neural aspects of human social cognition has come from such contrastive studies on autism, or autism spectrum disorders. From the first proposal and confirmation of a selectively impaired theory of mind functioning in this syndrome (BARON-COHEN, LESLIE and FRITH 1985), a huge bulk of studies have not only further corroborated this central claim (BARON-COHEN 2000), but also refined the data and to some depth characterized the underlying cognitive mechanisms (e.g., LESLIE 1987; LESLIE and GERMAN 1995; LESLIE and THAISS 1992) and neural mechanisms (e.g., FRITH and FRITH 2000). Another set of evidence shows that theory of mind impairment is not only present in autism/ASD, but explains many of the definitive behavioral symptoms (see HAPPÉ 1994 for a summary).

SOCIAL COGNITION AS A UNIFIED MODULE *VERSUS* DISSECTING THE "SOCIAL MIND" – CONTRASTING AUTISM AND WILLIAMS SYNDROME

Since the mid-1990's, autistic spectrum disorders (ASD) are often contrasted with Williams syndrome (WS), even to the extent of proposing an impaired social module in the former and a selectively intact one in the latter, allegedly so offering a case of double dissociation. Generally, the contrast between the two syndromes is noteworthy, as will be clearer later, and tentatively can be documented in the broader cognitive profile (e.g., poor spatial and arithmetical skills in WS, while often preserved such skills in ASD), and even on the neural level, in terms of a roughly opposite pattern of structural impairments in the cerebellum (see, e.g., KARMILOFF-SMITH et al. 1995).

The comparisons of the two neurodevelopmental disorders in the field of social behaviors emphasize that autism is characterized, among other features, by poor social skills and empathy, face recognition deficits, and impairments in prosody and pragmatics, while WS shows just the opposite pattern (e.g., BELLUGI et al. 1999; KARMILOFF-SMITH et al. 1995).

It is worth noting, at this point, however, that both existing empirical findings and clinical observations from these syndromes could have suggested – and indeed suggested (see, e.g., BARON-COHEN 1995) – a more elaborated view of both the "architecture" of social cognition and the nature of these syndromes, already in the mid-1990's. Two reasons should be mentioned here for this point. First, though the two syndromes are clearly different, their behavioral manifestations, clinically, show some overlap even in the social area. The non-distinctive approach to familiar/unfamiliar people shown by children with Williams syndrome can also be seen as a not rare symptom of autism, especially in the phenomenological sub-group called "active-odd" (see, e.g., WING 1996), and is widely interpreted as an effect of limited social insight. Second, as FRITH and HAPPÉ (1994) argued elegantly on the basis of their "fine-cut method", *not all* aspects of social behaviors are consequentially impaired in ASD, but only those which build on the grasp of others' mental states. That is, several social skills may be present in several subjects with autism, therefore the syndrome, as it appears, cannot be characterized as a *general and all-or-none* impairment in social understanding.

Consequentially, the concept of a unified social module (domain) and the alleged contrast between autism/ASD as a syndrome with a selectively impaired social module and Williams syndrome as a case of selectively preserved social module, have only a limited plausibility even before a systematic and targeted empirical testing of these ideas. More data supporting this scepticism will be cited below.

Although we are sceptical about the existence of such a sharp and perfect contrast between the two syndromes even just in terms of the patterns of socio-cognitive

skills, we hold that they offer important insights into the neural and cognitive basis of human social cognition. And, very importantly, they offer these insights in a developmental perspective, with important evolutionary implications, too – due to their (partly) genetic etiologies and their essentially developmental nature. Below we first introduce the two syndromes concisely, and then present some of our recent empirical findings on the developmental patterns of social cognition in them, as its various aspects are manifested by pragmatic abilities.

WILLIAMS SYNDROME AND AUTISM (ASD) – SOME BASIC FACTS

Williams syndrome

Williams syndrome is a rare (1 in 25 000) genetically-based condition caused by micro-deletion of genes on the long arm of chromosome 7. Physical characteristics include typical facial features, joint limitations, endocrine and cardiovascular problems (BEUREN 1972; JONES and SMITH 1975). The Williams syndrome phenotype is also characterized by a very specific pattern of behavioral and cognitive strengths and weaknesses. Individuals with WS typically live with mild to moderate mental retardation, with an average IQ of 50, they show serious deficits in spatial cognition and motor skill learning. In contrast to serious deficits in cognitive domains in general, children with this syndrome have surprisingly good language abilities, and show hypersensitivity to sounds. More importantly here, they have good social skills and face recognition abilities; they are sometimes called hyper-sociable because of their affective communicative style and their often indiscriminately positive approach to unfamiliar people.

Autism spectrum disorders (ASD)

While Williams syndrome has specific physical and physiological characteristics, autism, or, more broadly, autism spectrum disorders are defined and diagnosed on the basis of behavioral features, observable developmentally: marked and qualitative developmental impairments in (1) reciprocal social interactions and socialization, in (2) reciprocal communication (both verbal and non-verbal), and in (3) flexible organization of behavior and interests; the developmental impairment must be clearly present before the age of three (e.g., WING 1996). Nevertheless, autism is a neurodevelopmental disorder, underlain by an atypical development of the nervous system, as is shown by many direct and indirect evidence (GILLBERG and COLEMAN 2000). It

has a complex and heterogeneous aetiology, not yet known in details, but it seems certain that genetic factors play an important, in many cases exclusive role in it (with an involvement of chromosome 7, too, HILLIER et al. 2002). Although ASD tends to co-occur with mental retardation, overall cognitive abilities can be even exceptionally high in this syndrome, as it appears throughout the entire human IQ range. ASD is much less rare than Williams syndrome, the highest empirically-based estimations on its occurrence go up to 80 in 10000, that is, 0.8% (GILLBERG 2003).

VARIETIES OF DEVELOPMENTAL "THEORY OF MIND" IMPAIRMENT IN ASD

Although, as mentioned above, theory of mind (ToM) or mentalizing impairment is well documented in autism and explains many of the behavioral manifestations, key issues are still open. One of them is represented by individuals with autism who pass formal theory of mind tasks. In the literature there exist various tentative hypotheses about the cognitive processes underlying such task success: proposals range from the claim that non-ToM-based compensatory strategies substitute ToM competence in some individuals (e.g., HAPPÉ 1994), through claims that atypically functioning ToM competence may characterize these individuals (e.g., KLIN, SCHULTZ and COHEN 2000), to claims that ToM competence can be nearly normal (e.g., PENNINGTON et al. 1997). All of these proposed models have considerable conceptual and empirical plausibility. Moreover, etiological, neurobiological and behavioral heterogeneity in autism suggests that the competing models are not necessarily mutually exclusive. It can be argued that converging data of various kinds can only solve the problem (GYŐRI 2003).

Here we report preliminary findings from two studies, which were aimed at investigating whether those subjects with ASD who pass at least some standard false belief tasks, as heuristic indicators of theory of mind ability, do indeed possess a genuine capacity to understand and attribute mental states, or the task success can be attributed to non-typical cognitive functioning. We used the ability to understand ironic language-use, as a test field of understanding minds. SPERBER and WILSON (1986) argue that ironic language-use requires a second order theory of mind ability, and HAPPÉ (1993) presented important empirical evidence for this claim.

Our experimental paradigm was based on understanding written irony, as developed from GIBBS (1986), and HAPPÉ (1993). A self-paced sentence-by-sentence method was used for presenting brief stories in written form, ending with either a literally meant or an ironic utterance. The last sentence of each story was an utterance of the main character (target utterance). When the subject read it and pushed the space button, an "interpretation question" appeared and offered an interpretation of

the target utterance, either literal or non-literal, so either correct or incorrect. The subject had to indicate whether she/he thinks the offered interpretation correct or incorrect, by pushing a "yes" or "no" button. Then an "emotional state question" popped up on the screen. It was a statement about the momentary emotional state of the speaker when making the target utterance – again, either a wrong or a right statement. When the subject had made his/her yes/no decision and pressed the "yes" or the "no" button, a message occurred on the screen, offering a little rest to the subject, before beginning the next story. Subjects received no feedback on whether their response was right or wrong, and had no possibility to return to an earlier sentence of any of the stories.

Study I

In the first study with adolescents and adults with high functioning autism (N = 23; age range: 9;2–43;3 vIQ range: 63–117, with a longitudinally confirmed diagnosis), and with chronological age and verbal IQ matched controls without autism (N = 21), subjects were presented 28 target stories in two blocks. Six story variables were varied systematically – most importantly among them, the literal vs. ironic nature of the target utterance (see *Table 1* for an example story with an ironic target utterance). Also, the verbal subtests of a Wechsler intelligence test, and a second-order false belief task (BARON-COHEN 1989) was administered in all subjects. If the latter task was either failed or invalid in case of a subject, we presented two standard first-order false belief tasks, too.

Though, as expected, ASD subjects significantly under-performed controls, as the most important finding, we found an *unexpectedly high performance* in the experimental group (all but one subject performed significantly above chance – see *Figure 1* below).

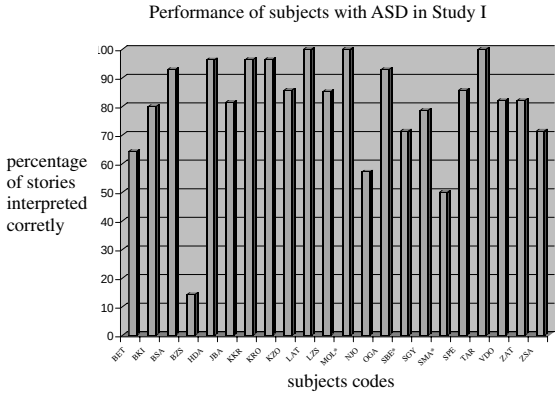

Figure 1. The performance of subjects with ASD in Study I, in terms of the percent of stories understood correctly (from a total of 28). Chance level of performance was 25%

However, some of the findings suggested that this performance was not based on the same kind of processes as in control subjects: the effects of stimulus variables on success/error rates showed different patterns in the two groups; subjects with ASD were generally much slower than controls; their reaction times showed a significantly higher variance; the task performance and false belief understanding scores showed significant positive correlation in the controls (r = 0.42), but not in the experimental group (r = 0.08). Moreover, findings showed that a part of subjects might have made use of explicitly verbalized mental state terms in the stimulus stories. A further study was designed to clarify whether the unexpectedly high performance in this task does indeed indicate a complex understanding of mental states.

Study II

A part of subjects with ASD from the previous study (N = 15) took part in Study II. Here we introduced a new story type, called "False Irony Task", ending with *an ironic utterance arising from a false belief of the speaker*, and its counterpart, the "False Literal Task" (ending with a literally meant utterance arising from a false belief – see *Tables 2* and *3* for examples). These were introduced in order to test the presence of a hypothetical non-ToM-based compensatory strategy – we named it the *"reality-based shortcut strategy"*. This, in our hypothesis, could enable a subject without ToM competence to detect and interpret ironic use of language. This algorithmic strategy was supposed to be comprised of the following steps: (1) representing the contextual reality of the story; (2) representing the literal meaning of the utterance; (3) comparing the two representations; (4) either keeping the literal meaning as the "real" meaning, if the two representations were in line, or turning the literal meaning into its opposite and taking this as the "real" meaning, if the two representations contradicted to each other; (5) attributing a context-appropriate emotional state to the speaker.

It was assumed that those subjects who had a genuine understanding of minds would not only understand simple ironic stories (as in Study I), but would pass False Irony and the False Literal Tasks, too; while those who used the "reality-based shortcut strategy" would consequentially fail in these latter – though would still understand (as had indeed passed in Study I) – simple ironic stories. Expected patterns of performance and their interpretations are shown in *Table 4* below.

Table 1. One of the ironic stories presented to the subjects in Study I and II

PRESENTED TEXT AND TEST QUESTIONS
Bill has his lunch at home every day, usually some tinned food.
Today he wanted something really delicious.
So he chose stuffed cabbage.
When he opened it, it turned out that it had spoiled and smelled really bad.
Bill said disgusted:
This is a nice lunch indeed!
DID BILL REALLY MEAN that the lunch was nice?
WHEN BILL SAID THIS, was he disappointed?

Table 2. One of the *False Irony Tasks* presented to the subjects in Study II

PRESENTED TEXT AND TEST QUESTIONS
John built a house, and he asked his brother to come over in the weekend to help him.
His brother promised him to be there Saturday morning at 8 o'clock.
John was very happy about it because he hoped they could do more together.
Saturday morning he waited till 10 o'clock, but his brother did not come.
Then he left sadly, since he had a lot of work to do, and he could not go back to the house in that weekend.
So he did not know that his brother arrived Saturday around noon, and he worked on the house all the weekend.
Monday morning, when they met, John said only this:
You have really helped me a lot!
DID JOHN REALLY MEAN that his brother did not help at all?
WHEN JOHN SAID THIS, was he grateful?

Table 3. One of the *False Literal Stories* presented to the subjects in Study II

PRESENTED TEXT AND TEST QUESTIONS
Kathy and Eve met each other in the street in an autumn afternoon.
They decided to go to a cinema, because it kept raining all the day.
They sat down in the cinema, to see an American movie.
They did not know that it stopped raining outside, and the sun began to shine.
When the movie was over, and they stood up, Eve said:
Now, it's time to go back to the rain!
DID EVE REALLY MEAN that it's time to go back to the rain?
WHEN EVE SAID THIS, was she happy about it?

Table 4. Hypothetically expexted patterns of performance and their tentative interpretations in Study II

PERFORMANCE IN			PROPOSED INTERPRETATION ON THE UNDERLYING PROCESSES
FALSE IRONY TASKS	FALSE LITERAL STORIES	SIMPLE IRONIC STORIES	
success	success	success	genuine ToM ability
failure	failure	success	reality-based shortcut strategy
failure	failure	failure	NO reality-based shortcut strategy NO genuine ToM ability (?)

The method of stimulus presentation, way of responding and data recording was the same as in Study I. Performance patterns shown by subjects in Study II (and in the two studies, together) confirmed the existence of the hypothesized sub-groups.

The most striking finding in this study is certainly that 7 of the 16 subjects passed all the False Irony Tasks and False Literal Stories. (This pattern of performance is significantly different from the pattern that could be expected from a random response strategy.) Given that understanding false ironic stories requires multiple inferences about representational mental states in a highly complex context, it is hard to doubt reasonably that these subjects *do possess an ability to reason about epistemic mental states* and connected emotional states.

Two of our subjects showed that particular pattern of performance, which we expected as a potential *evidence for the application of a "reality-based short-cut*

strategy" . These subjects failed closely consequentially in the three false ironic stories, consequentially failed in the two false literal stories, and performed highly significantly above chance in the simple ironic and literal stories.

Most importantly, these findings show that autism or ASD is quite heterogeneous in terms of theory of mind performance. While some subjects can solve quite complex problems requiring this ability (like understanding an ironic statement arising from a mistaken belief), others apply non-typical, non-theory-of-mind-based cognitive "bypasses" to solve similar problems – and, in relatively simple contexts, with considerable success (like understanding simple irony).

There is not enough room here to discuss the broader implications of these findings to the theory of mind hypothesis of autism and to understanding socio-cognitive development, so we refer the reader to our forthcoming publications on these issues.

TWO PRAGMATIC ISSUES IN WS

As it will be clear from the discussion below, the idea of an intact social module based on impressive social skills in WS (KARMILOFF-SMITH et al. 1995) is challenged by results showing that (1) development of these abilities follows an abnormal trajectory, (2) performance on tasks requiring sophisticated mentalizing is often poor and parallels autistic patterns of performance.

Pragmatic abilities in WS

As already mentioned above, essential aspects of pragmatic abilities build on cognitive, linguistic and social competence. Since pragmatic abilities have a specific pattern in Williams syndrome, WS provides us a good ground for testing questions concerning pragmatic abilities as well. Earlier studies mostly tested story-telling abilities of English (REILLY, KLIMA and BELLUGI 1990), French (BERNICOT et al. 2002) and Spanish (PIRCHIO and CASELLI 2002) subjects with WS. Conclusions agree that people with WS tell long stories, use language for social function effectively in general (although their language use is somewhat effusive) and have high scores on many structural measures of language, while story structure is often deficient. Stories often lack a plot, coherence and cohesion is violated, subjects with WS do not take context into consideration, they do not establish causal relationships. In conversation, turn-taking is often inadequate both from cognitive and linguistic aspects, in spite of the often-emphasized good social skills in WS: they are unable to cooperate with the speaker; communicative relevance and social adjustment is also missing. There is also evidence that individuals with WS do not understand jokes, double senses and metaphors (GARAYZÁBAL et al. 2002; SOTILLO, CAMPOS and GARAYZÁBAL 2002).

Mentalizing Abilities and Early Communication in WS

Results in the literature concerning mentalizing abilities in WS are controversial. People with WS are attracted to social interaction, and this tendency is already present in early childhood. JONES et al. (2000) examining components of hyper-sociability in WS often found abnormal social attention devoted to the experimenter in this group: many children with WS were so focused on the experimenter's face that it prevented them from executing the task: they were much more interested in the interaction with the experimenter than in carrying out the task.

Early communication abilities show other impairments, too. SINGER-HARRIS et al. (1997) point out that children with Williams syndrome in their first 6 years of life show the same degree of language delay as, and produce a lot less gestures than children with Down syndrome. In early language development in Williams syndrome, contrary to what is observed in typical development, naming *precedes* pointing with an average of 6 months (MERVIS and BERTRAND 1997). LAING et al. (2000) tested 17 WS infants and found that they used less pointing in general, and there was also less social referencing, but their comprehension matched that of controls.

Based on good social abilities observed in older children and adolescents, special attention devoted to people and faces, and worrying personality sympathetic to others' problems we would expect that people with Williams syndrome have good mentalizing abilities. In line with this prediction KARMILOFF-SMITH et al. (1995) emphasized that theory of mind abilities are relatively intact in WS. In their studies participants with WS had to go through standard Theory of Mind tests. Most subjects with WS passed first-order false belief tasks, and some were able to solve second-order false belief tasks as well. The age range of the WS group in this study, though, was 9 to 23 years, so even the youngest was well past the age that is the milestone of solving such tasks in typical development (the fourth year of life). Also, it is worth noting that many subjects with ASD are able to pass first-order false belief tasks, some of them even second-order false belief tasks in this age range (e.g., BARON-COHEN 1989; HAPPÉ 1993).

Studies of TAGER-FLUSBERG and SULLIVAN (2000) argue against selectively intact theory of mind abilities in WS. They decompose naive theory of mind abilities into two sub-components, and talk about a social-cognitive and a social perceptual component. The social-perceptual component is crucial in online judgment of the other's mental state, based mainly on facial expressions and gestures; this group of abilities is less tied to language and other cognitive abilities, and is in closer connection with the affective system. The social-cognitive component is what has traditionally been termed theory of mind in cognitive psychology, and is more closely related to language: this is the conception of the mind as a *representational* system, the typical test of which is the false belief task. The developmental rate of the two systems is

different: infants already show differential reactions to different facial expressions, while the mind as a representational system starts to unfold only at about 3 years of age and stabilizes approximately by 4 years. The neural structures implementing the two functions are also distinct: the prefrontal lobe serves as the basis for the cognitive component, while the main neural structure of the social-perceptual system is the amygdala.

The studies of TAGER-FLUSBERG and SULLIVAN lead to the conclusion that in Williams syndrome, the social-perceptual component is intact (as evidenced by performance on tasks of recognition of emotional expressions, and of explanations for different types of actions) while the social-cognitive component is impaired (shown by performance in standard false belief tasks). In contrast to the study of KARMILOFF-SMITH et al., TAGER-FLUSBERG and SULLIVAN used dolls instead of people to act out the story, with the aim of getting rid of the aspects of the task touching upon the social perceptual component. Based on these findings, we are not entitled to postulate selectively intact abilities in WS, relative to groups of children with mental retardation (of different etiology). The social-cognitive component thus seems impaired in WS. As an intriguing aspect of these findings, it is hard to account for worse performance in WS than in the other two groups. The authors do not dwell upon this problem. Their general conclusion is that people with Williams syndrome are well able to judge other's emotional perspective, but judging the other's cognitive perspective is often too difficult for them.

Social Determination of Word Learning

Taken these controversial findings, and also motivated to learn about possible bases for peculiarities of lexical knowledge and organization in WS (see LUKÁCS, PLÉH and RACSMÁNY 2003) we were curious what word learning situations reveal about mentalizing abilities in WS. BALDWIN and TOMASELLO (1998) emphasize that word learning is the best field of inquiry for examining early pragmatic abilities, since, in their view, the crucial (though not exclusive) capacity in solving the induction problem of word learning is a social ability of humans, which is not specific to language. During language acquisition children build on their ability to interpret other people's behavior in terms of goals and intentions. The central determinant of word learning became being able to recognize the speaker's intention. Many studies have shown that children actually actively search for similar cues in a communicative situation. BALDWIN (1991, 1993) has shown that by 18–19 months, infants are able to rely on the Speaker's Direction of Gaze (SGD), instead of the direction of their own gaze (Listener's Direction of Gaze or LDG strategy) when they had to find a referent for a new word, even when that direction does not coincide with the direction of their own

gaze (SDG strategy). TOMASELLO and his colleagues showed in numerous experiments (e.g., TOMASELLO 1995, 2001; TOMASELLO and AKHTAR 1995; TOMASELLO and BARTON 1994) that in a word-learning situation, children do not only rely on direction of gaze, body posture or other pre-wired cues: in decoding social pragmatic cues they flexibly adjust to different word-learning situations. They carried out experiments in which the only way children could figure out the proper referent of a new word was finding out the speaker's intention to find an object (in the case of new nouns) and to perform an action (in the case of new verbs). Children knew that speaker's utterances announce their intended actions, and used this knowledge to select the appropriate referent for a new word.

In two of our studies we explored whether participants with Williams syndrome are able to make use of the speaker's referential intent during word learning. Our questions were multiply motivated. First of all, in the light of the general observation that one of the main peculiarities observable in Williams syndrome – besides their remarkable linguistic abilities – is the delay or deviance in the use and understanding of word meaning and lexical representations, the explanation of deviant linguistic behavior in this domain might hide in mechanisms of acquisition of word meaning. STEVENS and KARMILOFF-SMITH (1997) have already shown that not all constraints of typical word-learning operate in WS. On the other hand, as we saw, results concerning mentalizing abilities in Williams syndrome are controversial: if inferring others' beliefs and desires is problematic in general, they cannot rely on this ability in determining word meaning. Although finding out the other's communicative intent does not necessarily imply relying on a theory of mind, in most cases it requires some kind of mentalizing or at least a precursor of it. More specifically, as joint attention is crucial in establishing joint reference in infancy, results concerning abnormal attention devoted to people and less social referencing in Williams syndrome (see JONES et al. 2000 and LAING et al. 2000 above) motivate testing the ability to rely on social-pragmatic cues in word learning. BARON-COHEN, BALDWIN and CROWSON (1997) showed that people with autism do not rely on the SDG to infer the intended referent of a novel word. Unlike people with autism, children with WS are not expected to be mislead in mapping by too much attention devoted to objects in their focus of attention, and by applying a LDG strategy, but by a possible failure to *follow* the speaker's direction of gaze after looking at her face, an inability to detach their attention from people.

Both of our studies tested 14 participants with WS (9–22 years) with a control group matched on verbal age and sex (6–9 years). In the first study, we wanted to explore whether members of the Williams syndrome group are, like their typically developing peers, able to apply the SDG strategy in determining the referent of a new word. The paradigm we applied closely followed BARON-COHEN, BALDWIN and CROWSON (1997): the child got a novel object, while the experimenter held another

novel object in his hands. In the follow-in labelling condition, the experimenter, when uttering a novel name, looked at the child's toy (i.e., the same object that the child is looking at). In the discrepant labelling condition, the experimenter uttered the novel name while looking at his/her own toy (i.e., the one that was not in the focus of the child's attention). After each condition, the child had to select from an array of 6 objects (containing the two used in the particular condition) the one that matched the novel name. The critical condition was the one involving discrepant labelling: for choosing the right object, the child had to rely on the speaker's direction of gaze instead of his own one (in the follow-in condition, the two directions were the same). Results are shown in *Table 5,* while results of the BARON-COHEN, BALDWIN and CROWSON study are given in *Table 6* for comparison.

Table 5. Proportion of subjects passing each condition in the Williams syndrome and in the verbal control group

	Follow-in labelling	Discrepant labelling
WS	11/14 (78%)	12/14 (86%)
Verbal control	12/14 (86%)	13/14 (93%)

Table 6. Proportion of subjects passing each condition in autism, mental retardation and typical development (BARON-COHEN, BALDWIN and CROWSON 1997)

	Follow-in labelling	Discrepant labelling
Autism	14/17 (82,35%)	5/17 (29,4%)
Mental retardation	15/17 (88,23%)	12/17 (70,58%)
Typically developing 2-year-olds	17/24 (74%)	19/24 (79%)

As results show, people with Williams syndrome, unlike people with autism – who performed at chance in the discrepant labelling condition in BARON-COHEN, BALDWIN and CROWSON (1997) – and just like typically developing children and people with mental retardation of other etiology, can rely on the SDG in word learning. When hearing the novel word, both participants with WS and verbal controls looked up to the speaker's face to check and follow her direction of gaze and establish intended referent of a novel label. Although participants with WS in our study did not have problems with joint attention, it is possible that the abnormal attention devoted to the other's face, mentioned earlier, prevents gaze following just like it prevents solving other motor and cognitive tasks, and the WS child at that stage of development might be incapable of switching her attention from the adult's gaze to the object.

In our second study we applied the method of TOMASELLO and BARTON's study 4 (1994; see description of the procedure therein). In the original study the aim was to

determine whether the child, in the course of word learning, utilizes the contiguity of the novel word and the object, or she is a more active participant of the learning process and determines the adult's referential intent on the basis of more complex social-pragmatic cues. In both conditions of the study, the child is watching the experimenter facing a row of five buckets, each containing a novel object. At the beginning of the session, the experimenter expresses his/her intention to find an object with a novel name (e.g., *Let's find the toma!*). In the "without search" condition, s/he expresses delight at retrieving the object from the first bucket, then retrieves the other four, again expressing delight. In the "with search" condition, s/he retrieves two objects frowning and discontented, then expresses delight at the third object, and then retrieves the other two. At the end of both conditions, the child has to select the one that matches the novel name from among the five objects.

Table 7. The ratio of participants selecting the target object in the two conditions, in the Williams syndrome and in the verbal control group. The last shows results of TOMASELLO and BARTON's results for comparison (TOMASELLO and BARTON 1994)

	With search		Without search	
	Production	Comprehension	Production	Comprehension
WS	13/14 (93%)	13/14 (93%)	8/14 (57%)	8/14 (57%)
Control	13/14 (93%)	14/14 (100%)	7/14 (50%)	8/14 (57%)
2-year-olds (TOMASELLO and BARTON 1994)	6/15 (40%)	6/15 (40%)	4/15 (26%)	10/15 (66%)

Although our results differed from TOMASELLO and BARTON's in several respects (see *Table 7*), from the point of view of our questions, the important result is that the performance of the WS group and the verbal control group did not differ in either the *with search* or in the *without search* condition. In spite of significant differences between the two conditions, participants with Williams syndrome, like verbal controls, were able to rely on more complex social-pragmatic factors in choosing the referent for a novel word, and their performance decayed in a similar way, when these cues were not straightforward enough. In a non-ostensive context, where neither contiguity nor lexical principles assisted mapping the intended referent to a new word, individuals with WS just like controls recognized the speaker's intention to perform an action involving the referent of a new word, and skipped over intervening objects until the speaker fulfilled her intention.

These results show that people with Williams syndrome, like their typically developing peers, rely on social-pragmatic cues in word learning. We found evidence that the social-psychological intention-attributing mechanism considered so

important by TOMASELLO (1999) for the entire language system, is available in Williams syndrome as a pragmatic starting point, and can be used to crack the code of language. At the same time, we consider the question, whether following these cues presents a difficulty at earlier ages in this neurodevelopmental disorder, to be a subject of further study. Another important issue to pursue is whether this mentalizing ability interpreting communicative intent on the basis of social-pragmatic cues is operating in a general fashion or there is some limit, perhaps drawn by knowledge effects regarding the complexity of the cues processible in Williams syndrome.

Motivations for our research concerning pragmatic cues in word learning were twofold. First, as results in the literature concerning theory of mind abilities in WS were mixed, we wanted to test them in word learning situations that crucially depend on inferring the speaker's communicative intent. Although performance of individuals with WS matched those of control children in both situations, we would not take our results to argue for selectively intact theory of mind abilities. The pragmatic cues to word meaning were very simple in both conditions. The cue was the SDG in the first study, and although cues are not so easily identifiable in the second study, they were certainly based on facial expressions of emotions: sadness was cued by frowning and happiness was cued by wide eyes and a joyful gasp. These are well within the realm of the social-perceptual component of TAGER-FLUSBERG and SULLIVAN's model. Again, we emphasize that further research on word learning is needed to plot the limits of mind-reading in Williams syndrome.

GENERAL CONCLUSIONS

We wish to emphasize three general conclusions of our studies, beyond the more specific ones put explicitly earlier.

First, the valid results presented above demonstrate that studying linguistic pragmatics is a fruitful research strategy not only for itself, but also to study the functioning and development of the social mind/brain in developmentally impaired populations.

Second, developmental pathways to, and neurocognitive mechanisms underlying various complex social behaviors show sometimes surprising variability. As we have seen in the case of subjects with ASD, success in relatively simple socio-cognitive tasks, normally based on theory of mind functioning, can be due to cognitive mechanisms which are radically different from each other in their nature. Short-cut strategies seem to serve for substituting the impaired theory of mind mechanism, relying on language and domain-general cognitive mechanisms. As we have seen in WS subjects as well, seemingly intact aspects of social cognition appear in the context of a markedly atypical developmental pattern and a markedly atypical broader pattern

of social behaviors. Most broadly, social cognition appears many-faceted both in its functioning and in its development.

Third, as it follows from the above points, by no means it seems to be appropriate to hypothesize about a single unitary social module or domain and its unitary developmental course.

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