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Abstract

We analyzed the role played by Theory of Mind in children's ability to recognize and repair different kinds of communicative failures. In particular we analyzed three different kinds of communicative failures: failure of the expression act, communicative meaning and communicative effect. We administered videotaped stories where people act out a communicative failure and ToM tasks, to 120 children ranging in age from 3;6 to 8;6 years. The children showed a trend of increasing difficulty in managing the communicative failures investigated. Moreover, children's ToM ability is partially correlated with recognition and repair of a communicative task, however it is not able to explain the trend of difficulty we detected. We suggest that the factor better explaining such trend is the increasing complexity of the mental representations underlying the three different kinds of failures.

Keywords: communicative failures, recognition, repair, theory of mind, development cognitive pragmatics

Introduction

The purpose of this research was to investigate the role of Theory of Mind (ToM) in recognizing and repairing a communicative failure, an important phenomenon in the pragmatic domain albeit somewhat ignored by the recent literature.

Pragmatics refers to the use of language to perform social functions, i.e. to communicate with other people (see for example Habermas, 2000). A communicative failure occurs when a person does not succeed in modifying another person's mental state in the desired way. Recognition of a communicative failure occurs when a speaker realizes such a failure has occurred and the repair of a communicative failure is another attempt by the speaker (following the failed attempt) to convince the partner to adhere to his communicative purpose. The recognition and the recovery of communicative failures require pragmatic communicative competence since they imply the use of language for social purposes.

ToM is the ability to attribute mental states to other people and to oneself, and to use such knowledge to interpret and predict other people's and one's own behavior (Premack & Woodruff, 1978).

In order to test ToM ability we used first-order (Baron-Cohen, Leslie & Frith, 1985; Perner, Leekam & Wimmer, 1987) and second-order classical false belief tasks (Sullivan et al. 1995), in addition to the Picture Sequencing task (Langdon & Coltheart, 1999), a non-verbal test investigating the comprehension of false belief and social interaction. False belief tasks is a specific case of use of ToM and consists in the ability to attribute mental states to other people and to use such knowledge to interpret and predict other people's behavior, when one's own knowledge of the world differs from another person's one. False belief paradigm has been classically used to investigate ToM in the developmental domain (Perner & Wimmer, 1983; Wimmer & Perner, 1985; Sullivan et al. 1995; see Wellman & Liu. 2002). Some authors highlighted the role of communicative failure, as the case of misunderstanding, during a communicative interaction, considering it not so much a breakdown but an integral part of the comprehension process (see Dascal,1985; Blum-Kulka and Weizman, 1988; Weigand 1999; Bazzanella & Damiano 1999; Bosco et al. 2015).

Weigand (1999) for example contends that in instances of non-understanding during a communicative interaction, the hearer signals the problem and starts the clarification process, whereas in cases of misunderstanding the process of clarification is usually initiated by the speaker. Bazzanella and Damiano (1999) proposed five levels at which misunderstanding can arise in everyday conversation: phonetic, syntactic, lexical, semantic, and pragmatic, all of which involve a discrepancy between the speaker's intent and the hearer's interpretation. The level of discrepancy may vary, depending on the extent to which the hearer accepts or refuses the speaker's meaning, and it is this that determines the degree to which an utterance is understood.

In the developmental domain the main empirical studies concerned with children's ability to manage communicative failures were conducted in the 1970s (Robinson & Robinson, 1977; Perterson et al. 1972), 1980s (Beal, 1982) and 1990s (Marcos, 1991; Marcos & Kornhaber-le Chanu, 1992). An analysis of some of these studies revealed that children are able to adopt different kinds of repair strategies depending on what kind of failure occurs, and that as they grow up, they use different forms of repair. For example, one of the first repair strategies used by toddlers in case of communicative failure is repetition (Golinkoff, 1986) a strategy that children tend to use less as they grow up (Garvey, 1984). Furthermore, Anselmi et al. (1986) pointed out that when a communicative failure occurs during an interaction, children aged between 1;8 and 3;8 years tend to repeat the whole sentence when their mother responds with a neutral query ('What?'), whereas when their mother asks a specific question ('Where's the dog?'), they accordingly provide a more specific answer. Along the same lines, Wilcox & Webster (1980) pointed out that between one-and-half and two years of age, children are able to use two different repair strategies: repetition and modification. In particular, they are able to modify their requests simply by repeating the same question, when the adult answers with a neutral query ('What?'), whereas they reformulate their request when the adult answers with a simple declarative comment ('Yes, I see it'). Marcos (1991) too showed that children of this age are able to reformulate a request, as a function of their mothers' response. Moreover, by the time they are 18 months old, children seem to adopt the correct repair strategy according to the kind of failure that occurred: when the mother misunderstands, instead of refusing to accomplish the request, they use increased vocalization in order to clarify their request rather than simply insisting by repeating it, an ability that is not present in

children aged 14 months (Marcos & Kornhaber-le Chanu, 1992). More recently, on the basis of an original study by Shwe & Markman (1997), Grosse, Behne, Carpenter & Tomasello (2010) showed that starting from the age of one-and- a-half children repair their request differently according to the failure that has occurred, for example misunderstanding the referent vs. the communicative intention.

In order to allow for the existence of different kinds of communicative failures, Bosco, Bucciarelli & Bara (2006) proposed and empirically investigated an original taxonomy of different kinds of failures which may occur in a communicative interaction, in children ranging in age from 3 to 8 years. In particular the authors reported a trend of increasing difficulty in children's ability to recognize and repair: i) failure of the expression act[1], that is failure of the literal meaning, such as for example to understand 'sheep' instead of 'ship', ii) failure of the speaker's meaning[2], that is failure of the speakers' intended meaning, such as for example, Polyphemus crying out: 'Nobody is trying to kill me' referring to Ulysses who was trying to kill him saying his name was "Nobody", and iii) failure of the communicative effect, that is the unsuccessful attempt to convince someone to do something. The authors explained their results in light of the Cognitive Pragmatics theory (Airenti, Bara & Colombetti, 1993a, 1993b; see Bara, 2010; 2011 for the most recent developments), a theory on human communication (see next section).

Several authors have highlighted the role of ToM in human pragmatic communication: a capacity to attribute mental states and to behave accordingly needs to have been developed in order to comprehend a partner's communicative intention (Bosco, Colle & Tirassa, 2009; Happé & Loth, 2002; Sperber & Wilson, 2002; Tirassa et al., 2006a, 2006b; Tirassa & Bosco, 2008;). The first authors to point to a link between Theory of Mind (ToM) and the ability to repair communicative failure were, to the best of our knowledge, Feldman and Kalmar (1996). They reported that a person in a conversation tends to repair a communication breakdown by adjusting his or her strategy to take the partner's mental states into account

[1] For theoretical reasons Bosco, Bucciarelli & Bara (2006) used the term "expression act" instead of "literal meaning". For the sake of consistency we have used the same label "expression act" instead of "literal meaning" throughout the paper.

[2] In line with the Cognitive Pragmatics Theory (Bara, 2010), we have used the term 'partner' instead of the more conventional 'listener'. By contrast, in the present investigation, for the sake of clarity, we have used the conventional term 'speaker' instead of 'Actor', which is the term used in the Cognitive Pragmatics theory.

and trying to figure out why the communicative intention was not recognized, or a request was not accepted.

In keeping with this assumption, in the field of clinical pragmatics (Cummings, 2009; 2014), it has been observed that communicative failures (see Keen, 2003) and communicative errors (Loukusa et al., 2007) occur more frequently in children with autism, Asperger syndrome or high-functioning autism, all of which have been found to be associated with a deficit in ToM (Baron-Cohen, et al., 1985), than among their typically developing peers. Volden (2004) observed that children with autism spectrum disorder (ASD) were similar to control group children in their ability to use increasingly flexible and complex repair strategies in response to neutral requests, requests for clarification, or semi-structured prompts ('Tell me another way'). However, the author also reported that children with ASD were more likely to give an inappropriate response than those in the control group. Taken as a whole, these findings suggest that a deficit in ToM affects children's ability to repair communicative failures.

We proposed that ToM plays a role in children's ability both to repair and recognize communicative failures. In recognizing a failure a person must realize that he or she has failed to modify the partner's mental state, in terms of knowledge, desire, belief and so on, in the desired way. In repairing a communicative failure a person makes another attempt to change the partner's mental state in the desired way, bearing in mind the strategy that failed. We thus predicted that:

Hypothesis 1. Children's performance on ToM tasks is correlated with their accuracy in both recognizing and repairing a communicative failure.

Moreover, in line with the relevant literature (Wellman & Liu 2002; Bosco et al. 2006) we expected that:

Hypothesis 2. Children's ability to solve ToM tasks and recognize and repair communicative failures will increase with the age.

Furthermore, in the present paper we wish to replicate the finding that children exhibit a trend of

increasing difficulty in recognizing and repairing a communicative failure reported by Bosco et al. (2006). In particular we investigated whether the trend of increasing difficulty in recognizing and repairing different kinds of communicative failures, i.e. failure of expressive act, failure of communicative meaning, failure of communicative effect, could be explained by children's performance on ToM tasks, in addition to their age.

Finally, for exploratory purposes, we also examined the role of the family's socio-economic status (SES) on children's pragmatic development, in order to verify whether this variable could affect the ability to recognize and repair communicative failures.

The Cognitive Pragmatics Theory

The Cognitive Pragmatics Theory (Airenti et al., 1993a; 1993b) explains the cognitive processes underlying human communication; it has been found to be effective for explaining the increasing accuracy with which children and young adults comprehend and produce several pragmatic phenomena such as direct and indirect communication acts, irony and deceit (Angeleri et al. 2012; Bosco & Bucciarelli, 2008; Bosco et al., 2013) and figurative language (Bosco et al., 2012). We will now summarize the main theoretical assumptions of the theory (for a more detailed description please see Bara, 2010; 2011).

Grice (1975) identified cooperation as the fundamental element of communicative interaction. According to the Pragmatics theory, for cooperation to be concrete both of the interlocutors must be familiar with the plan of action they are carrying out. Airenti, Bara and Colombetti (1993a) called the scheme of an action plan known to both A and B a *behavioral game*. A behavioral game is a shared conventional pattern of interaction in which participants in a dialogue interpret the interlocutor's communication. The speaker's communicative intention is understood on the basis of the beliefs that people share in a communicative exchange, that is on the basis of the shared behavioral game. The notion of behavioral game is useful to understand how it is possible to attribute different communicative meanings to the same communicative act (verbal or non-verbal).

Let us consider the following example taken from Bara (2010): imagine a situation in which two people are engaged in a conversation and then one of them looks at his watch. If the person who looks at his watch is of superior status, the other person will interpret the gesture as meaning it is time the conversation ended. If, on the other hand, the person of lower status looks at his watch, the other person will interpret the gesture as a request for permission to leave. If the speakers are unable to identify a shared behavioral game in which they consider the communication act as a move, they will not be able to understand it. Now consider another example, again taken from Bara (2010): a clerk is working in his office when a complete stranger comes in and says:

[1] It's snowing outside.

Although the clerk would have no difficulty in understanding the literal meaning of the utterance, he would be very puzzled. He would only be able to make the necessary inferences and thus give an appropriate answer if he were to interpret [1] as an invitation to stay indoors, a request to close the window, a reminder to take his umbrella, etc. The pure and simple literal aspect of the utterance, without a game to refer it to, has no communicative significance. Although the literal meaning is an important starting point, this on its own is not enough to enable us to answer the questions we ask ourselves when another person is speaking to us: "Why is she saying that to me? What does she want me to do?"

Consider the following communicative exchange:

[2] Anita: Oh, I'm really late!

Ben: Ok I'll drive you to the office.

Here, the speaker's communicative intention must be understood in order to recognize the behavioral game she is proposing. In [2] Anita and Ben must share the knowledge of the behavioral game [GIVE-LIFT] in order to understand the communicative meaning of the utterance proffered.

- A asks B to give her a lift;

- B may accept, refuse, propose an alternative solution, etc.

According to the Cognitive Pragmatics theory (see Bara, 2010; 2011), the actions actually performed by a person determine the moves of the behavioral game being played. The meaning of a communicative act (which may be linguistic – i.e. a speech act - or non-verbal – i.e. a communicative gesture - or, more often, a combination of the two) is only fully understood when the move of the relative behavioral game is clear. A speaker may use various moves to propose a behavioral game to the partner. Consider the [GIVE-LIFT] game once again.

Ann might ask her brother Brian to lend her his car by saying (possible moves):

[3] Please give me a lift.

[4] Would you give me a lift?

[5] My car is at the body shop; I can't go to work tomorrow.

[6] I'm sad because I haven't got a car for Saturday...

In line with the theory, the same move could have several literal formulations. Consider the formulation below [4]:

[4a] Would you mind giving me a lift?

[4b] Please give me a lift.

[4c] Would you very kindly give me a lift?

The same move might even be part of more than one behavioral game at the same time. For instance, [6] fits both the [LEND-CAR] game and the [GIVE A LIFT] game.

Behavioral games are structures that coordinate interpersonal actions, and are used during communication to choose the actual meaning of an utterance from the various possibilities that are available. Behavioral games exhibit different degrees of applicability: some are universal, others are specific

to certain cultures or social groups, and some are only known by two people.

The Cognitive Pragmatics theory also describes a sequence of processes that are necessary in order to understand and produce a (standard)[3] communication act:

Expression act: the partner recognizes the literal meaning of the speaker's utterance.

Speaker's meaning: the partner understands and reconstructs the meaning intended by the speaker.

Communicative effect: the partner acquires or modifies his/her mental states in line with, and as a consequence of the communicative intentions expressed by the speaker.

Reaction and Response: the partner produces a response.

Recognition of failure of a communication act: A taxonomy

Bosco et al. (2006) proposed, and empirically investigated, a taxonomy of the different sorts of failures that may occur during the comprehension/generation processes described above. The taxonomy takes into account the speaker's perspective and the complexity of the mental representations involved in their recognition. The label "complexity of mental representations" refers to the presence of discrepancies and inconsistencies between the expression act, the speaker's meaning and the communicative effect (see Table 1). In line with Bazzanella & Damiano (1999) we hypotesize that such discrepancy can varies in degree considering the different kind of failure analyzed and in line with Bosco et al. (2006), we assumed that children would experience more difficulties in managing failures involving mental representations of increasing complexity.

In order to recognize that a failure has occurred, and try to repair it, the person must recognize that there is a discrepancy between what the speaker wanted to obtain in proffering the communicative act (for example to induce the partner to do to something, to believe something or simply to share something) and

[3] According to the Cognitive Pragmatics theory standard communication acts are direct and indirect speech acts whereas irony and deceit are examples of non-standard communication acts.

the effect he or she actually obtained. By contrast, in successful communication the partner recognizes the speaker's goal and there is no discrepancy. In our experimental protocol successful communication represented the control condition. We thus predicted that:

Hypothesis 3: recognizing a communicative failure is more difficult than recognizing a successful (standard) communication act.

In addition, a communicative failure may also involve the presence of inconsistencies. According to Bucciarelli et al. (2003), the presence of inconsistencies between the speaker's and the partner's mental representations of the move/game played during the communicative interaction is one specific factor that may hamper the comprehension of a communication act.

Failure of the expression act occurs in the first phase of the comprehension process, when the speaker realizes that the partner has failed to understand the expressive value of the utterance. There is an inconsistency between the move proposed by the speaker and the move attributed to her or him. A breakdown at this stage brings the comprehension process to a halt, since the expression act is the first step that allows the partner to understand the speaker's communicative intention.

Failure of the speaker's meaning occurs in the second phase of the comprehension process, when the speaker realizes that the partner has failed to understand the behavioral game at play. The partner understands the expression act through which the communication act is performed, but fails to associate the move with the behavior game bid by the speaker. To fully understand a communication act, the partner must recognize the game of which it constitutes a move. The same utterance can give rise to different communicative intentions and the partner can only understand the speaker's communicative intention if he or she also recognizes the behavioral game bid by the speaker. This type of failure is caused by an inconsistency between the game to which the partner's move refers and the game suggested by the speaker's move. Unlike with failure of the expression act, this difference has more to do with the game implied by the move than with the direct move made by the speaker. To recognize failure of the speaker's meaning, the partner must detect this inconsistency in the representations of the game being played.

Failure of the speaker's meaning is therefore more difficult to detect than failure of the expression act.

Failure of the communicative effect occurs in the last stage of the comprehension process and does not involve the detection of an inconsistency. The partner comprehends the expression act and the speaker's meaning, but does not adhere to the speaker's goal. This constitutes an explicit and overt refusal by the partner to join in the game proposed by the speaker. Failure of the communicative effect is therefore the simplest type of failure to be detected. In the pragmatic domain, communicative ability is defined as an agent's intentional act proffered with the aim to modify (a part of) the partner's knowledge (Grice, 1957). In particular, successful communication is referred to as the partner's recognition of a speaker's specific intention, which includes the achievement of a specific (communicative) effect on the partner (Grice, 1989). Recognizing that the speaker has not achieved this is thus part of an individual's pragmatic ability.

Hypothesis 4. In recognizing a communicative failure, children will exhibit the following trend of difficulty, from the simplest to the most complex: failure of the communicative effect, failure of the expression act and failure of the speaker's meaning.

- Table 1 about here -

Repairing a communicative failure

When the speaker repairs a communicative failure, he or she makes another attempt to convince the partner to adhere to his communicative purpose (which previously failed, Bosco et al., 2006). The speaker may choose from a variety of repair strategies: the repair strategy adopted by the speaker depends on the kind of failure that has occurred, and thus takes into account the inconsistency and the kind of discrepancy that characterized the failure. Simply adopting a strategy is obviously not enough to guarantee success: it is up to the partner to accept or reject the speaker's proposal. According to Bosco et al. (2006), there is a trend of difficulty in repairing different communicative failures.

Repairing failure of the expression act: the *simplest repair strategy consists of repeating the failed move in exactly the same way*. Consider the following example:

[7] *Billy is sitting on the beach reading the newspaper. His girlfriend Amy arrives and says:*

Amy*:* 'How about going for a walk along the promenade*?'*

A motorboat passes close to the shore, making a lot of noise.

Billy: 'What did you say?'

In this case, Amy may repeat her request, '*How about going for a walk along the promenade?'*. This would involve repeating the same move and proposing the same behavioral game. This is the simplest repair strategy, in which nothing has to be changed with respect to the failed communication act. For this strategy to be effective, the problem (in this case the noise) must be eliminated. For example, in [7] Amy will either have to wait for the noise to stop or, if it continues, speak louder.

Repairing the failure of the speaker's meaning: the simplest strategy consists of reformulating the failed move using a different utterance. As already mentioned, different linguistic formulations may be used to express the same move. Consider the following example, in which the speaker's meaning is misunderstood:

[8] *Billy meets his sister Ann in the street; she wants to ask him to invite her for dinner.*

Ann: 'Billy, I'm really hungry'.

Billy: 'You can go to a very nice bistro nearby'.

In this case, the simplest way of repairing the failure is to rephrase the utterance in order to make the communicative intention clearer. This is a more complex case of repair with respect to the previous one since it involves at least changing the formulation of the move in order to make it effective. For example, Ann could say: 'Come on, Billy, invite me to dinner'.

Repairing the failure of communicative effect: the simplest strategy consists of choosing an

alternative, more appropriate move. This could be done by opting for a more acceptable or attractive move for instance, or even proposing an alternative game. This case of repair is more complex than the previous one because simply reformulating the move is not sufficient in order to repair the previous failure and it involves at least changing the move proposed. In our example Ann could suggest some sort of a deal with Billy, for instance:

[9] Ann: 'If you invite me to dinner I'll make your breakfast tomorrow morning!'

To summarize: the expression act is the simplest case since it can be repaired by repeating the move, without reformulating the utterance; failure of the speaker's meaning is more complex since it can be repaired by using an alternative communication act to perform the move; failure of the communicative effect is more complex to repair, as the speaker must take into account the partner's private motivations. In this case, although the partner has understood the move bid by the speaker, he or she refuses to play the game. In line with Bosco et al. (2006) we predicted that:

Hypothesis 5. Children will exhibit a trend of increasing difficulty in repairing a communicative failure, from the simplest to the most complex: expression act, speaker's meaning and communicative effect.

Hypothesis 6. Finally we wished to explore whether ToM offers an alternative explanation (with respect the one provided above) for the trend of increasing difficulty experienced by children in recognizing and repairing a communicative failure.

Socio-Economic Status and Pragmatic Development

Family socio-economic status (SES) is a predictor of many aspects of child development, particularly language development (e.g., Hoff-Ginsberg, 1998; Row, 2008). SES differences seem to be associated with differences within the normal range of performance across a number of cognitive abilities, and to be related to children's language and executive control abilities. For this reason, SES should be taken into account when investigating the development of such cognitive abilities (Noble, Norman & Farah, 2005). In a

recent study Bosco and coll. (2013) showed that SES has a moderate overall effect on children's pragmatic performance during the schooling period.

For explorative purposes, we thus examined the relationship between SES and children's ability to recognize and repair a communicative failure in order to identify some possible influences.

Hypothesis 7. We explored the influence of SES on children's performance on recognition and repair of communicative failure tasks.

Method

Participants

The sample consisted of 120 children. Since we wished to replicate evidence related to the increasing trend of difficulty in recognizing and repairing different kinds of communicative failures as previously shown by Bosco et al. (2006), we studied the performance of children within the same age groups: 3;6 to 4 years (mean age: 3;9); 5 to 5;6 years (mean age: 5;3); 6;6 to 7 years (mean age: 6;8); and 8 to 8;6 years (mean age: 8;3). The children were randomly recruited from among pupils at four different pre-schools and schools in [removed for review]. The 30 participants in each age group were balanced for gender. No bilingual participants were included in the study.

The children's socio-economic status (SES) was measured using a questionnaire filled out by their parents with information about family composition, parental educational level and occupation. We derived the SES index from the Two-Factor Index of Social Status (Hollingshead, 1975). Starting from the Hollingshead procedure and according to the current Italian social context, we updated the employment categories. We calculated the SES scores of the children's families by multiplying the scale values of both parents for occupation (ranging from 1 to 7) and for education (ranging from 1 to 7) by factor weights of 7 and 4, respectively. We then obtained the sum of these two products. If both parents were employed, we

calculated the mean of their indexes; if just one of them was employed, we used that parent's index. Possible scores on this index ranged from 77 (lowest SES) to 11 (highest SES). The majority of the children were from upper-middle class (28.3%) and middle class (24.2%) families; but some were also distributed across the other social classes (upper: 14.2%; lower-middle: 14.2%; and lower: 5%). Table 3 integrates the information on SES with age and offers more details on family composition and socio-economic factors. The parents gave their informed consent for their children to participate in our study.

- Table 2 about here -

Material and Procedure

We used the same experimental protocol concerning communicative failures administered in Bosco et al. (2006; 2012) on a new experimental group of children. In addition (with respect to Bosco et al, 2006), in the present study we also administered a set of theory of mind tasks. The protocol on communicative failure was composed of videotaped stories showing a communicative interaction; each video (in Italian) lasted approximately 10–15 s (See Appendix A for a full translation in English). 12 stories involved a failure (4 involved failure of the speaker's meaning, 4 involved failure of the expression act, 4 involved failure of the communicative effect) and 4 stories involved successful communication (the control tasks).

The experimenter visited the schools before the study commenced, in order to familiarize with the children, and subsequently administered the experimental protocols to the children individually in a single session. Each session lasted about 40 minutes and was audio-recorded. The tasks concerning communicative failures were presented in two different random orders, A and B; each protocol contained identical items but these were administered in a different sequence in each of the two forms (A and B) of the protocol, in order to rule out the possibility of the order of presentation affecting the children's performance. The participants in each group were balanced for age and gender and were assigned to order

A or B of the protocol in a balanced way.

The experimenter showed each child the video-taped stories, one at a time, using a portable computer; at the end of each story, he asked the child the specific questions concerning the communicative interaction he had just observed. Details about the questions in the recognition and repair tasks are provided in Appendix A.

For each recognition and repair task the children obtained a score of "0" when the answer was considered incorrect and "1" when the answer was considered correct (see Appendix B for examples of correct and incorrect answers). The inter-rater agreement between judges was evaluated on 30 randomly selected participants (20% of the total sample). Inter-rater agreement was very high (Cohen's $K = .88$; $p < .001$).

In addition, the following ToM tests were administered to the children. These tests were also balanced: they were presented to half of the participants before the presentation of the communicative failure protocol and to half of the participants after the presentation of the communicative failure tasks. Moreover, within this balanced administration of the items, the ToM tasks were presented in two different orders, i.e. first-order ToM tasks followed by second-order ToM tasks in half of the cases and vice versa in the second half of the sample.

We included both first and second-order false belief tasks in our experimental material because in the literature these are usually considered as classical tests for evaluating ToM ability (see Wellman & Liu, 2002). First and second-order tasks are characterized by different levels of complexity and require different abilities, that follow children's cognitive development with age (see Perner, Leekam & Wimmer, 1987; Perner & Winner, 1985). Considering the age of our sample, we considered these tasks to be appropriate for investigating the development of ToM ability in the aforesaid age ranges.

A detailed description of the structure of each task is provided in Table 3.

- Table 3 about here –

Sally and Ann task (Baron-Cohen, Leslie & Frith, 1985); the children were asked to watch a scene acted with puppets and then answer a test question (*Where does Sally think the ball is?*) and a justification question (*Why does Sally think the ball is there?).* A score of 1 was obtained when both the test and the justification were correct.

Modified Smarties task. This is a modified version of the original Smarties task (Perner, Leekam & Wimmer, 1987). We had to change the object of the task because we realized that many children do not know what Smarties are any more. In this version of the task, the experimenter shows the packet of a famous brand of potato chips.

John and Mary and Maxi Stories (Sullivan, Winner & Hopfield, 1995). These stories are a modified version of those used in Perner & Wimmer (1985) and Wimmer & Perner (1983), respectively. They have an identical structure. Scenarios of the two stories are provided in Table 3. The test questions used were the "second-order ignorance question" (e.g. *Does Bobby know that Maxi knows where the chocolate is*?) and the "second-order belief question" (e.g. *Where does Bobby go to look for Maxi*?). According to Sullivan's procedure, during the administration of the two stories, the children were also asked "fact questions" (e.g. *What did the ice-cream man tell Mary?*) and "first-order questions" (e.g. *Does Mary know where the ice-cream truck is now?*). These questions, together with the use of a background and stand-up cardboard character props, were useful to help the children to follow the story and to reduce the memory load needed. However, these questions were not taken into consideration in the scoring procedure. The children's answers could be scored 1 (correct) or 0 (incorrect) for both second-order ignorance and belief questions. The average value of the scores obtained on those questions, for each story, was then taken into account.

Picture Sequencing Task (Langdon & Coltheart, 1999). We administered part of the original task

consisting of 6 stories, including 2 social script and 4 false-belief sequences. The stories were depicted in sequences of four black-and-white cartoon picture cards. The sequences were presented after two practice runs, that were not considered in the scoring procedure, but were useful for the child to familiarize with the procedure. The children were asked to arrange the cards in the correct order and tell the story. According to Langdon's instructions, the score range was 0-6: a sequence scored 2 points if the first card was in the correct position, 2 points if the last card was in the correct position, 1 point each for the second and third cards being in the correct position. Failure to produce a sequence scored 0 (see Table 3).

In order to run the analyses and evaluate the children's performance on the different ToM tasks, we considered first-order and second-order ToM separately. In detail, the first-order ToM value was obtained by calculating the mean of the scores on the Sally&Ann, Smarties and Picture Sequencing task. Likewise, the second-order ToM value was obtained by considering the mean of the scores obtained on the Maxi and John & Mary tasks.

Results

The scores obtained by each age group on the communicative failure recognition and repair tasks are summarized in Table 4 and those obtained on Theory of Mind tasks in Table 5.

- Table 4 about here -

- Table 5 about here -

The distributions of the scores in the age groups were not normal according to the Kolmogorov-

Smirnov (Recognition overall: .001 < p < .023; Repair overall: p < .001) and Shapiro-Wilk tests (Recognition overall: .001 < p < .004; Repair overall: p < .001). We thus conducted an arcsine transformation on the children's answers to each ToM task and each failure recognition/repair task (i.e. failure of expression act, failure of the speaker's meaning, and failure of the communicative effect). We were thus able to perform parametric analyses while satisfying the required assumptions.

In order to investigate the existence of a correlation between performance on ToM tasks and failure recognition and repair tasks, we calculated partial correlation in the overall sample, controlling for age and SES index, between the ability to recognize and repair different kinds of communicative failures and ToM abilities, using Pearson's r correlation coefficient (See Table 6).

- Table 6 about here –

Moreover, we calculated the correlation between failure and ToM tasks for each age group (see Table 7).

- Table 7 about here -

Figure 1 shows the scores obtained by each age group on the recognition tasks. To investigate the children's performance in understanding successful communication acts and recognizing communicative failures, we conducted an ANOVA with one between-subject factor (type of age group, with four levels: group A (3;6-4 years), group B (5-5;6 years), group C (6;6-7 years), group D (8-8;6 years)) and one within-subject factor (type of communication task, with four levels: comprehension of successful acts, failure of communicative effect, failure of expression act and failure of the speaker 's meaning). In particular we investigated whether recognizing a successful communication act is simpler than recognizing any kind of

failure and whether children's ability to recognize communication acts increases with age. This analysis revealed an effect of the type of communication task ($F_{(3,348)} = 38.52$; $p < .001$; $\eta^2 = .25$). In addition, the analysis revealed an effect of the age group ($F_{(1,116)} = 29.59$; $p < .001$; $\eta^2 = .43$). We introduced a simple contrast, to compare the scores obtained on each type of communication act, revealing that successful communication acts are simpler than failure of communicative effect ($F = 5.65$; $p = .019$), as well as failure of expression act ($F = 33.85$; $p < .001$) and of failure of the speaker's meaning ($F = 64.46$; $p < .001$). A *post hoc* pair-wise comparison revealed a significant difference in performance by the different age groups ($.001 < p < .04$) with the exception of groups C (6;6-7 years) vs. D (8-8;6 years) which achieved similar levels of performance (Bonferroni: $p = 1$). We found an interaction between age and type of task ($F_{(3,348)} = 3.75$: $p < .001$; $\eta^2 = .088$).

More in detail, we performed separate ANOVA analyses to investigate the effect of the recognition of communicative failure task within each age group (type of recognition task, with three levels: failure of communicative effect, failure of expression act and failure of the speaker 's meaning). In all the age groups, an effect of the type of communicative failure was detected: Group A ($F_{(3,87)} = 9.84$; $p < .001$; $\eta^2 = .25$), Group B ($F_{(3,87)} = 9.33$; $p = .001$; $\eta^2 = .24$), Group C ($F_{(3,87)} = 11.105$; $p < .001$; $\eta^2 = .28$), Group D ($F_{(3,87)} = 13.91$; $p < .001$; $\eta^2 = .32$). We introduced linear contrasts for each analysis, which detected a linear trend in scores depending on the type of communicative failure in each age group: Group A ($F = 14.81$; $p = .001$; $\eta^2 = .34$), Group B ($F = 16.21$; $p < .001$; $\eta^2 = .36$), Group C ($F = 27.59$; $p < .001$; $\eta^2 = .49$), Group D ($F = 21.08$; $p < .001$; $\eta^2 = .42$). According to our hypothesis, our data revealed the following trend, from the simplest to the most complex: recognition of failure of communicative effect, expression act and speaker's meaning.

- Figure 1 about here -

Figure 2 shows the scores obtained by the children in each age group on repair of communicative failure tasks.

To investigate the increasing trend of difficulty exhibited by children in repairing failures of expression act, speaker's meaning and communicative effect, and whether their ability to repair a communicative failure increases with age, we conducted an ANOVA with one between-subject factor (type of age group, with four levels: Group A (3;6-4 years), Group B (5-5;6 years), Group C (6;6-7 years), Group D (8-8;6 years) and one within-subject factor (type of repair of failure, with three levels: repair of the expression act, repair of the speaker's meaning, repair of the communicative effect). This analysis revealed a main effect of the type of repair of failure ($F_{(2,232)} = 20.24$; $p < .001$; $\eta^2 = .15$). In addition, the analysis revealed an effect of the age group ($F_{(1,116)} = 30.9$; $p < .001$; $\eta^2 = .44$). We introduced a linear contrast, which revealed a linear trend in scores depending on the type of repair task ($F_{(1,116)} = 29.16$; $p < .001$; $\eta^2 = .20$). In line with our hypothesis, there was an increasing trend of difficulty in repairing failures of expression act, which was the simplest, failure of speaker's meaning and failure of communicative effect, which was the most complex. A *post hoc* pair-wise comparison revealed that the groups performed significantly differently ($.001 < p < .037$) with the exception of groups C vs. D which only approached significance ($p = .06$). We found no interaction between the two variables (age group and type of task) ($F_{(2,232)} = 1.98$; $p = .07$; $\eta^2 = .05$).

Also in this case, we performed separate ANOVA analyses to investigate the effect of the communicative failure task within each age group (type of repair task, with three levels: failure of expression act, failure of the speaker 's meaning, failure of the communicative effect). In all the age groups, an effect of the type of communicative failure was detected: Group A ($F_{(2,58)} = 4.67$; $p = .013$; $\eta^2 = .14$), Group B ($F_{(2,58)} = 7.13$; $p = .002$; $\eta^2 = .20$), Group C ($F_{(2,58)} = 11.12$; $p < .001$; $\eta^2 = .28$), Group D ($F_{(2,58)} = 2.99$; $p = .05$; $\eta^2 = .09$). We introduced linear contrasts for each analysis, revealing a linear trend in scores depending on the type of communicative failure in the age groups: Group B ($F = 6.62$; $p = .01$; $\eta^2 = .19$),

Group C (F = 19.65; p < .001; η^2 = .40), Group D (F = 7.96; p < .009; η^2 = .21); the only exception is represented by group A (3;6-4 years) (F = 2.87; p = .10; η^2 = .09).

- Figure 2 about here -

We also explored the influence of Socio Economic Status (SES) on all the abilities investigated, expecting it to have a moderate overall effect on children's performance. We used the Index of Social Position (ISP) as the indicator of the children's family SES (see Table 8).

Our results showed that SES was only partially related to the ability to recognize and repair communicative failures. In particular, SES correlated only with the ability to recognize a failure of the communicative effect in group A (3;6-4) and B (5-5;6) and with the ability to recognize a failure of the expression act in group B (5-5;6) and C (6;6-7). As regards the ability to repair communicative failures, SES only significantly correlated with the ability to repair a failure of the expression act in group B (5-5;6) and with the ability to repair a failure of the speaker's meaning in group D (8-8;6).

- Table 8 about here -

Finally, in order to investigate whether age, SES or ToM were factors that might be able to explain the increasing trend of difficulty shown by children in recognizing and repairing a communicative failure, we conducted a series of regression analysis, using as dependent variable the children's performance on each type of failure tasks and using as predictors the age, the SES and ToM performance (see Table 9). In particular, we created a hierarchical model of multiple regression analysis, including as predictor variables age – Step 1 – SES – Step 2 – I order ToM ability - Step 3 – and II order ToM ability – Step 4. Table 9 displays

the adjusted regression coefficients (R^2_{Adj}) for each predictor variable, the change in R^2 after the addition of SES and first and second order ToM (R^2_{Change}), the change in F (F_{Change}) and its significance value (Sig F $_{Change}$).

The regression analysis revealed that age (Step 1) was able to explain the results obtained by the children on the failure tasks, both for recognition and repair. We then, introduced Step 2 with another predictor, i.e. SES index. The analysis showed that, in the majority of cases, with the exception of the most difficult tasks, i.e. recognition of speaker's meaning and repair of communicative effect, SES significantly improved the prediction.

Similarly, the third Step we tested (adding children's performance on first-order ToM tasks as a regressor) was able to significantly improve the prediction for recognition of the communicative effect and recognition of the expressive act, but not for the most difficult task to solve, i.e. recognition of the speaker's meaning; as for repair, Step 3 was able to improve the prediction for the Repair of the expressive act and repair of the communicative effect, but not for the repair of the speaker's meaning. Finally, we introduced Step 4 (second-order ToM tasks), which was not able to improve the prediction for any of the failure tasks, considering both recognition and repair tasks.

In particular, the analysis revealed that within both the model comprehending first-order ToM (Step 3) and the model comprehending second-order ToM (Step 4), the R^2 did not increase in line with the trend of increasing difficulty exhibited by children in solving the tasks, both in recognizing and in repairing a communicative failure. The R^2 value indicates how much variance is explained by a certain variable. If ToM (both first and second-order) were the factor that best explained the difference in difficulty between the tasks, then we would expect the R^2 value to follow the trend of difficulty in the recognition and repair of communicative failures whereas, by contrast, the increase in the R^2 value did not follow the expected trend. A similar explanation also holds for age (Step 1) and SES (Step 2): the R^2 did not increase in line with the trend of increasing difficulty exhibited by children in solving the tasks, both in recognizing and in repairing a communicative failure.

- Table 9 about here -

Conclusions

This study empirically investigated the role that ToM, age and SES play in the ability to recognize and repair a communicative failure. We predicted that ToM would be correlated with children's ability to recognize and repair communicative failures. We also proposed that the increasing complexity of the mental representations, i.e. the existence and the number of discrepancies and inconsistencies involved in a communicative failure, explains the increasing difficulty that children had in recognizing and repairing the different sorts of communicative failures we investigated, i.e., failure of the expression act, failure of the speaker's meaning and failure of the communicative effect. Finally we investigated whether ToM, age or SES were alternative factors, with respect to the complexity of the mental representations involved, able to explain the increasing trend of difficulty we detected.

First of all, we replicated the overall results of Bosco and colleagues (2006), confirming that a successful act, involving neither discrepancies nor inconsistencies, is always easier to understand than each kind of failure recognition task. Focusing on the ability to both recognize and repair communicative failures, we found that, in line with our expectations, there was an effect of age on the children's performance and that their scores improved with age. However, we only detected an improvement in performance on all tasks up to 6;6 years of age. For what concerns the recognition of failure of communicative effect, the easiest recognition task to solve, we detect a "ceiling effect" in the older group of 8-years-old. For what concerns the others tasks a possible explanation for such lack of improvement is that during this developmental period the gap between the two age groups is too small and it is possible that testing older children, for example aged 9-10 years, could reveal an improvement in performance.

Focusing on each age group, separate analyses confirmed our prediction concerning the existence

of an increasing trend of difficulty in the recognition of a communicative failure; children in all the age groups found it easier to recognize: failure of communicative effect, followed by failure of expression act and then failure of speaker's meaning.

Similarly, focusing separately on the performance of the different age groups in terms of their ability to repair the failure of a communication act, we observed, in line with our prediction, that children found it easier to repair the failure of the expression act than the failure of the speaker's meaning, followed by the repair of the communicative effect. This applied for all the age groups, with the only exception of the youngest group of children aged 3;6-4 years. In this case their performance approached a “floor effect”. One possible explanation is that repairing a communicative failure is too difficult for children aged 3;6-4 years.

Focusing on the relation between ToM and the ability to recognize and repair each kind of failure and in order to have a “pure” measure, we conducted a correlation analysis controlling for the role of age and SES index. This showed that, considered overall, ToM tasks correlated with recognition of communicative effect and expression act, but not with the recognition of the speaker’s meaning, the most difficult task for children to recognize. Similarly regarding repair abilities, ToM performance correlated with the repair of expression act and of the speaker’s meaning but not with the repair of the communicative effect, again the most difficult task for children to solve. These data suggest that ToM could have only a partial role in explaining the increasing trend of difficulty we detected in recognizing and repairing a communicative failure, since it does not correlate with the tasks that the children found most difficult to recognize and repair. We have also performed, considering the overall sample, a correlation analysis considering the role of first and second-order ToM separately, and found first-order ToM to correlate with a larger number of communicative failure tasks., i.e. with recognition of failure of communicative effect, failure of expression act, repair of failure of expression act and repair of failure of communicative effect, than second-order ToM, which only correlates with the recognition of failure of the communicative effect and failure of the expression act.

In order to study the issue in more depth, we also investigated the correlation between these variables i.e. I and II order ToM and the ability to recognize and repair each kind of failure, in each age group. Our data revealed that the correlations were only statistically significant in some cases. In particular we found that I order ToM correlated with the performance of the youngest group of children (3-year-olds) on all the recognition and repair tasks, with the only exception of the recognition of failure of the speaker's meaning. By contrast, in the other age groups the only significant results concerned the correlation between I order ToM tasks and repair of failure of the expression act in the groups of 5- and 6-years-olds children. For what concenrs II order ToM tasks ore results reveal a significant correlation with recognition of communicative effects and recognition of expression act in the youngest 3-years.odls children. For what concenr the other age groups significant correlation were only revealed between II order ToM and repair of the communicative effct in the group of years-old children and with the repair of the speaker's meanning in 8-years-olds children. Taken as a whole, these data suggest that I order ToM plays a role in explaining the development of children's ability to recognize and repair a communicative failure mainly in the 3;6-4 years age group, that is the developmental period in which children usually start to pass the false belief task, which constituted our principal task for measuring I order ToM ability. Furthermore, no part of such pattern of correlations is in line with the predicted trend of difficulty we detected. For example, first-order ToM does not systematically correlate with the easiest task to solve and second-order ToM does not systematically correlate with more difficult ones.

For explorative purposes, we also investigated the possible relationship between children's ability to recognize and repair communicative failures and their socio-economic background (SES index) for each age group. The analysis revealed no significant correlation with the exception of a few cases testifying that recognition and repair of a communicative failure are only partially affected by the SES indicator.

Finally, we performed a regression analysis in order to acquire a deeper understanding of whether the trends of difficulty in recognizing and repairing the different kinds of communicative failures we detected, could better be attributed to the children's ToM abilities, age or SES rather than - as we proposed

- to the complexity of the mental representations involved. In particular, we created a hierarchical model of multiple regression analysis, including as predictor variables age – Step 1 – SES – Step 2, I order theory of mind abilities - Step 3- and II order ToM abilities - Step 4. The results revealed that age explains the trend of the results and SES also seems to be able to imply a significant increase in the variance of performance on simple tasks, regarding both recognition and repair abilities; indeed, no significant changes connected to the SES emerged in recognition of the speaker's meaning and in the repair of the communicative effect.

Moreover, the insertion of Step 3, including first-order ToM, determined a significant increase in the variance of performance on failure tasks, though not in all cases. In particular, considering ability on recognition tasks, first-order ToM was found to have a role in explaining the variance in children's performance on recognition of the communicative effect and recognition of the expressive act, but not for the most difficult task to solve, i.e. recognition of the speaker's meaning; as for Repair, Step 3 including first-order ToM as a regressor, determined a significant increase in the variance of performance in repairing the expressive act and the communicative effect but not in repairing the speaker's meaning.

Finally, the introduction of Step 4 (including second-order ToM performance as a regressor), did not determine any increase in the variance of performance on failure tasks, considering both recognition and repair.

More in detail, we analyzed the trend of R^2 referring to each particular failure task. If ToM were the principal factor in explaining the children's increasing difficulty in recognizing the different tasks we analyzed, when introducing Step 3 and 4 (I and II order ToM), we would expect to see an increase in the R^2 value indicating how much variance is explained by a certain variable, in line with the observed trend. By contrast, we observed that when introducing Step 3 and Step 4 (I and II order ToM, respectively) the R^2 value did not increase in line with the trend of increasing difficulty experienced by the children in recognizing communicative failures. In detail, both in Step 3 and Step 4, the higher R^2 value corresponds to the relationship between ToM and recognition of the failure of the communicative effect, which is the simplest kind of task to solve, whereas the lower R^2 value corresponds to the relationship between ToM

and recognition of the failure of the expression act, which is not the most difficult type of failure to recognize. A similar explanation also holds for age (Step 1) and SES (Step 2): the R^2 did not increase in line with the trend of increasing difficulty exhibited by children in recognizing a communicative failure.

We found a similar pattern of results for the repair of a communicative failure. If ToM were the main factor in explaining the children's increasing difficulty in repairing the different tasks we analyzed, when introducing Step 3 and Step 4 (I and II order ToM, respectively), we would expect to see an increase in the R^2 value, in line with the observed trend. By contrast, the higher R^2 value corresponds to the relationship between both I and II order ToM and the repair of the failure of the speaker's meaning, which is not the most difficult kind of repair task whereas the lower R^2 value corresponds to the relation between both I and II order ToM and the repair of the failure of the communicative effect, which is the most difficult repair task. Again, a similar explanation also holds for age (Step 1) and SES (Step 2): the R^2 did not increase in line with the trend of increasing difficulty exhibited by children in repairing a communicative failure. Considered as a whole, these results suggest that age, ToM (I and II order) and SES seem not to be the best predictors of the trend of difficulty in recognizing and repairing a communicative failure that we observed.

The results of the present study are in line with those reported previously in the literature showing that children's ability to manage communicative failures increases with age (e.g. Garvey, 1984; Marcos, 1991). The results of the present study are also partially in line with previous research (Bosco et al., 2012) using the same experimental protocol concerning communicative failures that we administered in this study, which showed that in patients with schizophrenia there is a correlation between (a deficit in) ToM, i.e. False Belief (Baron-Cohen, Leslie & Frith, 1985) and Strange Stories tasks (Happè, Brownell, & Winner, 1999), and the (difficulty in) recognition and repair of a communicative failure. However, in the aforesaid study by Bosco et al. (2012), ToM was not able to explain the increasing trend of difficulty in recognizing and repairing a communicative failure experienced by the patients. The convergence of the results of these two studies supports the validity of our theoretical model, both for the development and for the impairment of the ability to handle a communicative failure. A possible suspect is that our results contrast

with the study of Bernard & Deleau (2007) showing that in children of 3 and 4 years of age conversational perspective taking ability predices the performance to false belief attribution tasks. However the main difference between our research and the mentioned one consists in the object of the study and, as a consequence, in the different experimental material used to empirically investigate it. The experimental task used by Bernard and Deleau requires the child to understand who, among several possible speakers in a picture story, is proffering a specific utterance. By contrast, our experimental tasks require the child to understand (or produce) the (pragmatic) communicative meaning of a communicative act (for example the child sees a person spoiling something and another person commenting "Well done", and has to understand that the communicative intent of the utterance is to be ironic/to see something funny). The experiment of Bernard and Deleau investigates something different, i.e. (conversational) perspective taking with respect to our study, i.e. communicative pragmatic ability, and thus the results of the two studies are not directly comparable. Furthermore Bernard & Deleau (2007) concluded their study (page 456) as follows:"*Considering perspective-taking at the intra-individual level opens the question of the underlying process(es) and its (their) ecological validity. Although the construction of the tasks as well as the data analyses were conducted under an assumption of unicity (i.e. conversational perspective-taking as a unique construct), this assumption has to be discussed in future both in theoretical terms (does conversational perspective-taking refer to one major ability or are there different groups of pragmatic or discursive abilities contributing to conversational perspective-taking?) and through empirical work using more refined models to analyze data collected from a diversity of judgment tasks in larger groups of participants*."

As a final point, again in their conclusion, Bernard and Deleau (2007) state (page 455) that "*in accordance with our hypothesis conversational perspective taking scores at a given age contribute independently to the variability of false belief attribution scores at later age*" (page 455).

We do not think this conclusion is in contrast with our results. Moreover, several theoretical (Tirassa, Bosco & Colle, 2006a; 2006b) and empirical (Wellman and Liu, 2002) studies in the literature are in line with Bernard and Deleau (2007) showing that in a developmental domain, perspective taking ability

precedes the ability to solve false belief tasks.

The limit of the present investigation is that it focuses too much on a specific measure of ToM, i.e. the False Belief task. Future research could consider other aspects of ToM, such as for example comprehension of intention, and also investigate younger children in order to examine the simplest ToM components, such as perspective taking. Moreover, in further studies it might be interesting to include measures of language ability in children, in order to control for this factor as well.

To summarize, notwithstanding its limitations, the novelty of the present study lies in the fact that it empirically investigates the role of ToM in children's ability to recognize and repair a communicative failure, showing that children's ToM plays a partial role in such ability. In particular, considering the overall sample of children, when controlling for age and SES, ToM correlated with the ability to recognize the failure of communicative effect and expression act, but not with the ability to recognize the speaker's meaning, the most difficult task for children. Similarly, ToM correlated with the ability to repair failures of the expression act and failures of the speaker's meaning but not with the ability to repair failures of the communicative effect, again the most difficult task for children. In addition, analyses performed on each age group separately showed that ToM only has a significant role in explaining the ability to recognize and repair different kinds of communicative failures in the youngest group of children, aged 3;6-4 years. Furthermore, we found no empirical evidence to suggest that ToM, SES or age are the factors that best explain the trend of increasing difficulty shown by children in recognizing and repairing the different communicative failures investigated. By contrast, the increasing complexity of the mental representations involved provides a more convincing theoretical explanation for their different performance on the various failure tasks investigated (see also Bosco et al. 2006). This explanation is in line with previous studies investigating pragmatic ability in children (Bara & Bucciarelli, 1999; Bosco, Bucciarelli & Bara 2004; Bosco & Bucciarelli, 2008; Bosco, Vallana & Bucciarelli, 2012; Bosco et al., 2013) showing that the complexity of the mental representations necessary to solve a communicative pragmatic task is an important cognitive factor in accounting for children's communicative performance.

Appendix A

Experimental protocol

Here we provide an example of each kind of failure investigated, an example of a control task and the questions that the experimenter posed to the subjects.

Communicative failures

FAILURE OF THE EXPRESSION ACT:

(1) Anna is close to Barbara and says:

Anna: 'I'm so hungry. . .'

Anna turns round and washes her hands. While Anna is washing her hands, Barbara opens a cupboard, takes out a sandwich, and offers it to her friend, saying

Barbara: 'Anna, do you want a sandwich?'

Anna has her back turned to Barbara, the water is making a lot of noise, and Anna has not heard what Barbara said. Anna finishes washing her hands and as she turns off the faucet, she says:

Anna: 'Did you say something?'

FAILURE OF THE SPEAKER'S MEANING:

(2) There are a lot of books on the floor along with an empty bookcase. Luciano is putting the books in the

bookcase and says:

Luciano: 'Mario is coming, I'll ask him to help me put the books in the bookcase'.

Mario comes in.

Luciano: 'Hi Mario, are you busy at the moment?'

Mario: 'No, I'm free, we could go have an ice-cream!'

FAILURE OF THE COMMUNICATIVE EFFECT:

(3) Mother and daughter.

Daughter: 'Mum, please, will you buy me a doll'

Mother: 'No, you have lots of dolls'

Daughter: 'Mum I promise this will be the last time I ask you for one'.

Mother: 'I said no, there's no point in asking me again!'.

QUESTIONS

At the end of each video-taped interaction the experimenter asks the child:

C1: In your opinion, has [name of partner] understood/done[4] what [name of speaker] asked (for/to do) or not?

.....

[4] In Failure of the expressive act and Failure of the speaker's meaning, the children were asked if the partner has understood what the speaker said. In Failure of the communicative effect, such a question is inappropriate because the crucial point is not the partner's denial, and not his understanding of the speaker's question. Therefore, the children were asked if the partner has done what the speaker wanted.

If the child recognizes the failure, the experimenter asks:

RI: 'What might [name of speaker] say or do now to obtain what she/he wants?'

.....

If the subject DOES NOT RECOGNIZE the communicative failure the experimenter asks:

R2: 'What might [name of speaker] say or do now?'

.....

Successful communication

CONTROL TASKS

(4) Elisa and Giovanni are in a room and the window is open:

Elisa: 'It's very cold in here, please do something about it!'

Giovanni: 'Yes Elisa, I'll close the window'

Giovanni closes the window.

CONTROL QUESTIONS:

C1: In your opinion, has [name of partner] understood what [name of speaker] asked (for) or not?

.....

If the subject answers yes, the experimenter asks

RI: 'What might [name of speaker] say or do now?'

.....

If the subject answers no, the experimenter asks:

R2: 'Why didn‘t [name of partner] understand what [name of speaker] asked (for)?

Appendix B

Examples of correct and incorrect answers

Recognition

Answer to question C1 for all failure tasks:

Correct answer: No

Incorrect answer: Yes

Repair

Answer to question R1 and R2.

FAILURE OF THE EXPRESSION ACT (1):

Examples of correct answers: "She can say it again", "She could repeat it louder"

Examples of incorrect answers: "She can offer something else, maybe a glass of water", "I don't know", "Say please".

FAILURE OF THE SPEAKER'S MEANING (2):

Examples of correct answers:" He should say he needs help", "He can say 'Maybe later but now, please, help me'".

Examples of incorrect answers: "He should go closer", "I don't know"

FAILURE OF THE COMMUNICATIVE EFFECT (3):

Examples of correct answers: "She can promise her mum that she will help her with some chores in return",

Examples of incorrect answers: "She can repeat what she said", "She can say please", "I don't know".

CONTROL TASKS

Examples of correct answers: "Yes, He was kind and he closed the window".

Examples of incorrect answers: "No, he didn't understand"

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Tables and Figures

Table 1

Recognition	Discrepancy	Inconsistencies	Representational complexity
Successful communicative act	No	No	-
Failure of Communicative Effect	Yes	No	+
Failure of Expression Act	Yes	Yes (move)	++
Failure of Speaker's Meaning	Yes	Yes (game)	+++