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Development and Decay of Extra-Linguistic Communication

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Cognitive Pragmatics theory is concerned with analyzing the cognitive processes underlying communication. In previous works we have explained the emergence

of communication in context, as revealed by very young children, and the communicative deficits shown by closed head injury patients. The aim of the present work is an extension of Cognitive Pragmatics to the emergence and the decay of extra-linguistic communication. In particular, we investigate the performance of 2- to 7-year-old children and that of Alzheimer's patients in standard and nonstandard (irony and deceit) pragmatic tasks. The predictions derived by Cognitive Pragmatics are confirmed. Comprehension of pragmatic phenomena which are more complex according to the theory emerges later in the development (Experiment 1), and their decay is most severe in Alzheimer's patients (Experiment 2). We conclude that the framework provided by Cognitive Pragmatics can accommodate both the development and the decay of extra-linguistic communication.

Introduction

Pragmatic competence is the ability to communicate in context. Within the framework provided by Speech Act theory, Airenti, Bara, and Colombetti (1993a) propose Cognitive Pragmatics theory, which is concerned with the cognitive processes underlying human communication. The theory can explain differences in difficulty among different communicative acts in terms of the complexity of the mental representations and the chain of inferences involved.

In this paper we are concerned with both standard and nonstandard communication, in particular, with irony and deceit (Airenti, Bara, & Colombetti, 1993b).

Cognitive Pragmatics

A major assumption of Cognitive Pragmatics theory is that a cognitive analysis of dialogue should distinguish between its *conversational* and *behavioral* aspects. When one communicates, her aim is to achieve a certain effect on a partner, namely, to change the partner's mental states and possibly to induce him to perform some action. The choice of a communicative way to attain this goal provides her with the subsidiary goal to follow the rules of conversation. Behavioral and conversational goals have completely independent origins; thus, an agent's behavior may be noncooperative, in spite of his conversational cooperation:

Ann: Would you please type this letter for me?
Bernard: Sorry, but the director authorized me to go out now. (1)

Behavioral cooperation requires that the agents act on the basis of a plan that is at least partially shared; we call this plan the *behavior game* of *x* and *y* (Airenti, Bara, & Colombetti, 1984). The behavior game in (1) is:

[MAKE-A-FAVOR]
x asks *y* a favor
y makes *x* the favor (2)

The actual actions performed by the agents realize the moves of the behavior game they are playing. The meaning of a communicative action (either linguistic or extra-linguistic, or usually a mix of the two) is fully understood only when it is clear which move of the behavior game it realizes. Thus, we will consider speech acts as moves of behavior games; conversely, each move of a behavior game has a communicative value, and can therefore be considered as a communicative act.

Bara and Bucciarelli (1998) carried out a study on the acquisition of pragmatic competence by 2- to 7-year-old children. They confirm the predictions of Cognitive Pragmatics: (i) standard communication is easier than nonstandard communication, (ii) there exists a trend of difficulty where, from the easiest to the most difficult, the comprehension tasks have the following order: simple speech acts, complex speech acts, ironies, deceits.

Bara, Tirassa, and Zettin (1997) have also used a similar linguistic protocol to test the predictions derived by the theory on closed head injuries patients. The same trend of difficulty has been observed.

In order to extend our knowledge to nonverbal aspects of communication, we devised an extra-linguistic protocol to test the theory both on young children and on Alzheimer's patients. A main consequence is that the predicted trend of difficulty posits irony at a higher level of difficulty with respect to deceit. In fact, ironies are based essentially on the linguistic code, and they are heavily penalized by the absence of language. Along with the new trend of difficulty, our aim was to confirm two further predictions: that the comprehension of more complex phenomena according to Cognitive Pragmatics should emerge later in the development, and that such comprehension should be the first one to decrease in case of decay of pragmatic performance.

The pragmatic protocol involves the comprehension of three simple speech acts presented *in the wild.* While the participants were introduced into the experimental setting, the experimenter realized simple communicative acts through gestures like handing a glass of water (offering water) or a box of candies (offering candies). Then, the comprehension of a series of communicative acts was tested with short video-typed fictions, three in each of the following categories: simple acts, complex acts, deceits, and ironies. Participants had to comprehend the communicative intention of an actor in a fiction. An example of deceit is: two kids, A and B, are playing: A breaks a vase on the table. A woman enters the room looking at the disaster, and A points to B. An example of irony is: two girls, A and B, are sitting at a table. B takes two chocolates from a box, and eats one of them. A touches her shoulder, opening her hand in a gesture of request. But, B eats also the second chocolate. A, with a smile, caresses B. The answers consisted in choosing the correct representation of A's intention among four possible drawings.

TABLE 1
Percentages of Correct Responses by Children in the Four Age Groups in the Pragmatic Tasks

	Pragmatic tasks					
	Simple in the wild	Simple	Complex	Deceits	Ironies	Overall
2;6–3	78	38	52	43	33	49
3;6–4	68	47	68	45	25	51
4;6–5;6	72	73	70	48	27	61
6–7	82	82	73	58	55	70
Overall	75	60	66	48	35	58

Experiment 1: Emergence of Extra-Linguistic Communication

Methods. Eighty children belonging to the following age groups participated in the experiment: 2;6–3, 3;6–4, 4;6–5;6, and 6–7 years. There were 20 subjects in each group with an equal number of boys and girls. The experiment was conducted in a single session and lasted about 30 min. The order of presentation of the pragmatic tasks was balanced according to age group and gender of the subjects.

Results. Table 1 shows the percentages of correct responses by children in the four age groups in the pragmatic tasks. Simple acts presented in the wild are the easiest tasks to deal with, even easier than simple acts in fictions (Wilcoxon test: $z = -3112, p < .002$). As regards the pragmatic phenomena investigated through fictions, standard communication is easier than nonstandard communication (Wilcoxon test: $z = -5.29$, $p < .0001$), and the predicted trend of difficulty among pragmatic tasks is confirmed (Page's L test: $L = 3895.5$, $p < .01$).

Experiment 2: Decay of Extra-Linguistic Communication

Methods. Fourteen Alzheimer's patients (according to NINCDS/ADRDA criteria) and thirteen controls comparable for age and education took part in the experiment. The age of the participants ranged from 60 to 80 years. They were selected according to the severity of dementia assessed by the Global Deterioration Scale (Reisberg et al. 1988): patients above the fourth level of the scale were discarded as they were potentially unable to understand the tasks.

The experiment was conducted in two sessions: one for the neuropsychological battery, and one for the pragmatic tasks. The neuropsychological battery included the global assessment of dementia (MODA: Brazzelli et al. 1994), the Block Design and Picture Arrangement subtests of the WAIS, and an assessment of the frontal lobe functions (Phonemic Fluency and Elithorn Labyrinths).

TABLE 2
Percentages of Correct Responses by Patients and Controls in the Pragmatic Tasks

	Pragmatic tasks					
	Simple in the wild	Simple	Complex	Deceits	Ironies	Overall
Patients	79	79	64	52	19	59
Controls	95	95	95	77	59	84

Results. Table 2 shows the percentages of correct responses by Alzheimer's patients and controls in the pragmatic tasks. For patients, simple acts in the wild were equivalent to simple acts in fictions. Further, as regards the pragmatic phenomena investigated through fictions, standard communication was easier than nonstandard communication (Wilcoxon test: $z = -2.94$, $p = .003$), and the predicted trend of difficulty among pragmatic tasks was confirmed (Page's L test: $L = 392.5$, $p \ll .00005$).

The same pattern of results holds for the control group: simple acts in the wild are as easy as simple acts in fictions, and standard communication is easier than nonstandard communication (Wilcoxon test: $z = -2.83$, $p < .005$). Although not significant, the trend of difficulty among pragmatic tasks is in the predicted direction.

Overall, the global performance of Alzheimer's patients was poorer than the performance of the controls (Mann-Whitney: $z = -3.81$, $p = .0001$). Also, patients performed worse than controls both in standard communication (Mann-Whitney test: $z = -3.27$, $p < .001$), and in nonstandard communication (Mann-Whitney: $z = -3.3$, $p = .001$).

The analytical results show that difference in performance between the two groups is due to difference in performance in the most complex tasks. In fact, patients did not differ from controls neither for simple acts in action (Mann-Whitney: $z = -1.62$, $p = .10$), nor for simple acts in fictions (Mann-Whitney: $z = 1.04$, $p = .29$). The two groups differ according to complex acts, deceits and ironies (Mann-Whitney test: z value ranging from -2.43 to -2.93, p value ranging from .015 to.001). The results concerning the neuropsychological test are in Table 3.

TABLE 3
Mean Scores by Patients and Controls in the Neuropsychological Tests

	Neuropsychological tests				
	MODA	WAIS Block design	WAIS Picture arrangement	Phonemic Fluency	Elithorn Labyrinths
Patients	74.92	12.86	10	20.36	5.58
Controls	92.60	27.15	21.53	29.23	11.36

Patients performed worse than controls in all the neuropsychological tests (Mann-Whitney test: z ranging from -2.5 to -4.44, p value ranging from .012 to $< .0001$). Only a few significant correlations were found between performance in the neuropsychological tests and the pragmatic tasks. In the patients' group, Block design and simple acts (Fisher's $r = .729$, $p = .0034$), and Picture arrangement and deceits (Fisher's $r = .662$, $p = .0117$); in the control group, complex acts and Phonemic Fluency (Fisher's $r = .554$, $p = .048$), and ironies and Phonemic Fluency (Fisher's $r = .705$, $p = .0056$).

Conclusion

The present work was based on an original extra-linguistic protocol that we constructed in order to extend Cognitive Pragmatics' predictions to extra-linguistic communication. Experiment 1 represented the first systematic investigation in the emergence of extra-linguistic communication. Children basically follow the same path of the emergence of linguistic competence, with the predicted inversion between irony and deceit. Regarding the decay context, the inverse trend was found in Experiment 2. We outline that in Alzheimer's patients the decay in pragmatic tasks is not simply related to frontal functions (planning and problem solving). The hypothesis is that pragmatic competence is an autonomous domain of investigation in degenerative dementia. Cognitive Pragmatics attempts to explain in terms of mental representations and inferences the respective difficulty of different kinds of communicative acts. In a diachronic perspective, we have investigated the relations between complexity of pragmatic phenomena and their appearance, development, and decay.

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Spatial Learning on the Morris Water Maze Test after a Short-Term Paradoxical Sleep Deprivation in the Rat

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Twelve rats were deprived of paradoxical sleep (PS) for eight hours using the small platform method. PS-deprived and control rats then learned either the standard allocentric version (using external cues) of the Morris Water Maze (MWM) or a delayed alternation version (changing the platform location between trials: MWM_{DA}). Overall, rats learning the MWM_{DA} made more quadrant entries than rats learning the allocentric version. Compared to other rats, PS-deprived rats crossed more quadrants only in the MWM_{DA}. These results show that MWM_{DA} is a more complex task to learn and is more vulnerable to PS deprivation than allocentric spatial orientation. Since delayed alternation is dependent upon frontal structures, we propose that tasks involving the frontal cortex are more sensitive to short-term PS deprivation than tasks related to hippocampal structures.

Introduction

Several studies have shown in humans and animals the existence of a relationship between paradoxical sleep (PS) and cognition, particularly concerning memory (Smith, 1985; 1995). While most of these studies demonstrate the detrimental effect of PS deprivation on memory consolidation, much fewer studies have analysed the effects of PS deprivation *preceding* the acquisition of a new task in order to evaluate the preparatory nature of PS on learning itself. The literature suggests that complex tasks are more vulnerable to PS deprivation than simple tasks where the animal does not have to manifest an important behavioral adaptation (Smith, 1985). In the present study, we measured the effects of short-term PS deprivation on learning a simple and a complex version of the Morris Water Maze Test (MWM).

Methods

Thirty-six young male Sprague–Dawley rats (300–350 g) were divided into three equal groups and submitted to one of three sleeping conditions for eight hours, starting at the onset of the light period: 12 rats were PS