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Paolo LEGRENZI, Maria SONINO LEGRENZI

REASONING AND SOCIAL PSYCHOLOGY: FROM MENTAL LOGIC TO A PERSPECTIVE APPROACH

I. Mental logic and natural deduction

1. Introduction

A year ago, in a school in Milton Keynes (Great Britain), the capacity of 11-year-old children to make inferences starting from promises and permissions was studied (Light, Girotto, Legrenzi, 1990). They were presented with the following story:

Imagine that we are in a school like yours, in which the children are divided into groups. Each group has a head. The teacher makes the following promise:

"If you get a score of at least 10, you can have a sweet".

The teacher leaves the sweets on the table and goes away, trusting the children. Later she returns and checks that no-one has cheated. Imagine you are the teacher. On the table in front of you are four cards referring to four children. One side of these cards states whether that child took or did not take the sweet; the other side states her score: 10 or 4. Faced with these four cards:

1) card with sweet

2) card without sweet

3) card with a score of 10

4) card with a score of 4

which card would you turn over to check if someone had cheated?

Cards 1 and 2 indicate two children whose scores are unknown. But the sweet is there on the first card, so it would be a good idea to turn it over to see if the child has got a score of 10. Cards 3 and 4 indicate one child with a score of 10 and one who only got a score of 4. The latter card is the one which should be turned over to check whether she took the sweet she was not entitled to. That is, cards 1 and 4 should be turned over, because they could reveal cheating. Turning over cards 2 and 3 serves no useful purpose, because there is no point in knowing the score of a child who has not taken the sweet or in knowing what the child who got 10 did, because in any case she deserved the sweet.

The same story was presented in the "permission" version. In this case, the promise was replaced with the corresponding permission:

"If you want a sweet, you must get a score of at least 10"

Again, cards 1 and 4 were the ones to be turned over, because there were two possible kinds of cheating:

- by the child who took the sweet, because she had the right to take it only if she got a score of 10 (card 1 to be turned over);
- by the child who only got a score of 4, and therefore did not deserve the sweet (card 4 to be turned over).

We can complicate the story further and introduce a "promise agent". In this case, the sweets are not taken directly by the children themselves, but are given out by the heads of each group, who thus become the agents of the teacher's promise and who can hand out sweets only to those who deserve them. But a group head can cheat too. If the group head is presented as a selfish person who tries to keep the sweets for herself, faced with the above four situations: (1) card with sweet; (2) card without sweet;

(3) card with a score of 10; (4) card with a score of 4, cards 2 and 3 are to be turned over. It is a good idea to check that someone deserving a sweet has not been refused it. But there is no point in checking cards 1 and 4, because the child who got the sweet (card 1) definitely deserved it, seeing that the selfish group-head will certainly not waste prizes. And the child who did not get a score of at least 10 (card 4) need not be checked, again because an egoist would certainly not give sweets to those who did not deserve them. The situation changes if the group head is presented as a nepotist, because in this case he will tend to favour his friends: all four cards must be turned over to check for possible cheating. If cheating was partial, he may have given sweets to his friends who did not deserve them: cards 1 and 4 are to be turned over. And he may have refused to give sweets to deserving enemies in order to give them to his friends, so cards 2 and 3 must also be turned over.

If readers are experimental psychologists, they will perhaps expect results other than those described above for the various cases. To us, adult readers, all four versions described above seem obvious and quite easy tasks to solve, and we may thus presume that there was some point in presenting such a task to 11-year-olds, according to the hypothesis that they would not be able to solve it as adults would. Instead, we found that, in every situation, even 11-year-old children almost always choose the cards which reasoning would indicate should be checked: 1 and 4 in the case of promise and permission, 2 and 3 in the case of the selfish agent, and all four in the case of the nepotist agent. Why does *Cognitive Development* publish experimental work revealing such apparently obvious results? Simply to demonstrate that, by the age of 11, we are already able to carry out hypothetical and deductive reasoning aiming at identifying potential cases of falsification? Or perhaps because, in making these inferences, we are capable of bearing in mind the viewpoint (perspective, aims, motivations, etc.) of the person (agent) who carried out the teacher's promise?

Thirty years ago, this work would probably never have been accepted for publication by a scientific journal. This means that these results have taken on theoretical significance in the eyes of psychologists, if not the man in the street who, although he might be pleased to know that children can reason like adults, would not be greatly surprised about it. After all, these inferences start from permissions and promises which are typical of a school situation and inserted in very simple, easy-to-understand stories.

2. Psycho-logic

Let us imagine a world with only two states in it: **P** and **Q**. **P** corresponds to "child with a sweet" and **Q** to "child with a score of 10". The negation of **P**, i.e., **not-P**, stands for "a child without a sweet" and the negation of **Q**, i.e., **not-Q**, for "a child without a score of 10". There are four worlds which may be constructed with these two states, **P** and **Q**, and their negations **not-P** and **not-Q**, as shown in the first two columns of *Figure 1*.

			P and Q	**If P, then Q**
1)	**P**	**Q**	**T**	**T**
2)	**P**	**not-Q**	**F**	**F**
3)	**not-P**	**Q**	**F**	**T**
4)	**not-P**	**not-Q**	**F**	**T**

Figure 1 - Columns 1-2: the four worlds which can be constructed combining two states **P** and **Q** and the negation. Column 3: truth values of **P and Q**. Column 4: truth values of implication "**If P, then Q**".

Let us now establish a relation between **P** and **Q**: **PrQ**. The simplest logical relation is that of the conjunction **P** and **Q** which corresponds to the

everyday case: "One child with a sweet and one child with a score of 10". This relation is true only in the first of the four possible worlds shown above. In the other three, the relation is false: in 2, **Q** is missing; in 3, **P** is missing; in 4 both are missing. A more complex logical relation is that of implication, which may be expressed in everyday language by: if **P**, then **Q**. This relation is always true except in the second of the four possible worlds of Fig. 1: the world in which **P** exists but **Q** does not. Let us imagine a permission such as:

"If you want a sweet, you must have a score of at least 10".

Only in the second of the four possible worlds is this permission not respected. That is, we have **P**, i.e., a child with a sweet, but we do not have **Q**, i.e., a score of 10. In a world in which **P** accompanies **not-Q**, this permission is violated because the child has taken the sweet without deserving it. There is thus a parallel between the violation of a permission and the falsification of a logical implication.

We can thus interpret in formal terms, or rather in the terms of the so-called calculus of propositions (Fitch, 1952) the structure of the problem given to the Milton Keynes children in the "permission" version. We have the usual four cards:

1) card with sweet: **P**
2) card without sweet: **not-Q**
3) card with score of 10: **Q**
4) card with score of 4: **not-Q**

and must decide which to turn over to check if the permission has been respected or violated. As we have already seen, the two useful cards — which are the ones to be turned over — correspond to **P** and **not-Q**, since they are the only ones which reveal the combination **P and not-Q**. This combination corresponds to the only case in which a child can have violated that permission, since he took the sweet although he only had a score of 4. But it is also the combination of two truth values of **P** (True) and **Q** (False) which falsify the relation of implication.

3. Psychology of reasoning

Confronted with a problem like that given to the Milton Keynes children, the task of the psychology of reasoning is to explain: (a) how children transform the problem, externally presented by means of words and drawings, into internal (i.e., mental) representations; (b) how they integrate these representations with already available information (e.g., how they know what *promisor, promisee, promises* and *permissions* are, and in what conditions they are maintained); (c) how, once they have integrated these representations, they use them to resolve the task (and later, to generate new beliefs: in many contexts these new beliefs can in turn reorganize knowledge and thus produce new actions).

It is better to avoid explaining performance on a given task by means of an *ad hoc* model. When faced with a problem consisting of choosing cards which, once turned over, can reveal violations of permissions and promises, the least "specific" approach may seem to consist of explaining performance in terms of competence about logical transformations. The task is therefore "deprived" of its specific aspects, to be interpreted in terms of calculus of propositions. We mentioned an example of this "translation" in the previous section, showing how a relation of implication may be reached through a rule of permission. This approach is mostly defined as "syntactic", since the structure of reasoning is deprived of its semantic components (i.e., we pass from "contents" to letters such as **P** and **Q**). If the psychology of reasoning accepts this perspective, it is presumed that, in order to solve the task, the following operations must be carried out:

1) Identify the formal structure underlying the task. The problem is interpreted in general terms. The single cards correspond to the four possible worlds of Figure 1.

2) Master the operations of the calculus of propositions. In our example, this mastery consists of identifying the combination **P and not-Q** as the only possible world in which the relation of implication becomes false.

3) Identify the cards showing **P** and **not-Q**. There are only two cards which, once turned over, can generate the possible world of **P and not-Q**: there may be **not-Q** on the other side of **P**, and **P** on the other side of **not-Q**. We know from the truth tables of implication that the world in which **P and not-Q** is possible is the only one which falsifies the implication **if P then Q**.

4) Return from the calculus of propositions to the specific domain of permission. In this case, the operation under point 1) must be reversed. Logical values must be reinterpreted, with the consequence that the two cards **P** and **not-Q** are the only ones which have to be checked.

If phases 2 and 3 corresponded to real mental operations, we would have a description of reasoning competence, and solving this specific task would be an index of more general competence, i.e., the capacity to find the conditions in which a relation of implication could be falsified. In other words, the formal description of the reasoning capacity of the Milton Keynes children becomes a general explanation. We would therefore arrive at an application of that theory of deductive reasoning which is often called "mental logic". Its supporters claim that mental operations may be sufficiently described by means of the logical operations of predicate calculus. So we could say that that specific task is solved because the children are generally capable of making correct inferences starting from an implication like that of Fig. 1. What still requires an explanation is our capacity to pass from one domain with specific content, e.g., permissions, to the underlying logical structure (phase1), together with the capacity to reinterpret the result of the logical inferences required by the task (phase 4) in terms of permissions. From this perspective, possible reasoning errors are the consequence of insufficient

understanding of the structure of the task. This lack of understanding may be due to various factors, e.g., insufficient linguistic formulation, or misunderstanding of task instructions. One explanation of errors in terms of unsuccessful communication (see Henle, 1962) has often been accompanied by strictly logicist views of our mental capacities (see Johnson-Laird, 1983, for a critical review of approaches such as Piaget's which depend on "mental logic").

4. Natural deduction

A different assumption regarding our capacity for abstract thinking is that of the supporters of "natural deduction" (see Rips, 1983, 1989, 1990). "Natural deduction" is a logical technique invented by Gentzen (1935, 1969) and Jaskowski (1934), in which conclusions are reached thanks to the application of a limited set of elementary rules of inference. These simple rules are, for example, the elimination of the conjunction (**P** may be deduced from **P and Q**) and the *modus ponens* (**Q** may be deduced from **if P then Q** and **P**). This approach is simple and intuitive, and for this very reason was used in the past in introductory logic tests as a method of natural deduction (see Fitch, 1952). It is therefore not surprising if psychologists resorted to "natural deduction" to predict performance on reasoning tasks (Osherson, 1974, 1976; Rips, 1983; Braine, Reiser & Rumain, 1984). In our specific case, the natural deduction approach also predicts correct performance, it being sufficient to identify the logical structure of the task, having interpreted it in formal terms (i.e., deprived it of its contents). The task does require the application of very simple inference rules. According to the theory of natural deduction only a subclass of inferences, called "natural", are taken as fundamentals. All the other valid inferences have to be derived formally in such a logic, and it is implausible that people would possess such a complex system in a mental logic. It would be more plausible to place restrictions on a mental logic as in Sperber and Wilson (1986), who postulate a system which works only

with the so-called elimination rules. Even in such a restricted system, there will still be the problem of translating natural language into it and translating back to natural language after any inference is performed.

Approaches such as mental logic and the natural deduction theory using logical calculation as an inferential mechanism are doubtless very elegant, if only because they exploit much of the work done by logicians. However, the elegance of the intermediate processing phase has its price in terms of the complexity of the first and last phases (coding phases 1 and 4 described above). But these phases are in any case indispensable for the "double journey" from the domain of specific knowledge to the underlying logical structure. The coding phases may seem simple when it is easy to translate everyday language into logical language. The example of permissions and promises is very clear here, in view of the obvious formal structure of the problem. Let us pose, superficially, the usual permission: **"If you want a sweet, you must have a score of at least 10".**

The passage from this superficial permission structure to the logical relation of implication is immediate: the sweet becomes **P**, the score of 10 **Q**, and permission the relation **if P then Q**. Let us imagine we have the same scenario, story and task. Only the rule to be checked changes. This consists of a promise equivalent to the preceding permission: **"If you have a score of at least 10, you can take a sweet".**

In the case of this promise, as seen above, the cards to be checked are the same as before: sweet and undeserving child. That is, the same cards (i.e., those which should be chosen both with permission and with promise, corresponding to sweet and undeserving child) take on the logical values of **not-P** and **Q**. In the case of permissions, a parallel exists between superficial structure and formal interpretation. In the case of the promise, we have the converse of the corresponding permission: the antecedent of the conditional becomes a consequent and vice versa.

The elegance of logicist approaches on the formal plane thus complicates the problem of intelligent decoding of the single domains. The above example shows that, in order to interpret a conditional statement, it is not enough simply to replace **P** with the antecedent and **Q** with the consequent. If we consider cases in which the promise is materially fulfilled, not by the promisor but by an agent, interpretation becomes even more complex, since the agent's aims before proceeding to logical interpretation must also be calculated. Let us consider the case of the nepotist agent: all four cards must be turned over. For this result to arise from logical interpretation, we must decode the promise as a relation of equivalence: **if P then Q, and if not-P then not-Q.** This relation is defined by the following truth values:

If P then Q, and if not-P then not-Q

1)	**P**	**Q**	**T**
2)	**P**	**not-Q**	**F**
3)	**not-P**	**Q**	**F**
4)	**not-P**	**not-Q**	**T**

Figure 2 - The four worlds which may be constructed by combining two states **P** and **Q** and their negations. Truth values of the logical relation of material equivalence: **if P then Q, and if not-P then not-Q**.

If the logical interpretation of the conditional is that shown in *Figure 2*, each of the four cards, once turned over, may falsify the logical relation.

In conclusion, approaches which adopt any formal system as an inferential mechanism shift complexity to the level of the first and last coding operations. Analogously, we can find this methodological problem

in the debate on the relations between logic and artificial intelligence (see Thagard, 1988, p, 3 et seq.).

II. Reasoning theories based on content

1. Form and content

Very few psychologists today accept a formalist approach like that described above as a reasoning theory. That is, they do not accept that mental operations must be described using a language recalling the inferences of logical calculus. The "golden age" of mental logic inside a Piagetian framework (see Carey, 1990) is over, while the logicistic approach resists, now called the theory of natural deduction.

One of the greatest difficulties that such an approach must face is that of the influence of content on reasoning processes. We have just seen how, for example, various contents and scenarios of a conditional statement complicate interpretation. Even promises and permissions must be interpreted by means of different formal structures. We have also discovered, and known for a long time now, that — underlying structure being equal — some versions of the same problem are much more difficult than others. For example, the problem given to the Milton Keynes children may be transformed into a completely abstract version, and in fact the original version of the task invented by Wason (1966) used a content completely lacking in references to everyday life.

In the classic "selection task" (so called because the right cards must be "selected"), experimental subjects are given the rule: **If one card has the letter A on one side, then it has the number 2 on the other**, and are shown four cards lying on a table, marked respectively A, B, 2 and 5. The task consists of indicating which cards are to be turned over to decide whether the rule is true or false. It is easy to see that the structure of the problem is identical to that of the Milton Keynes test, in spite of the fact that it has a different content: letters and numbers in place of children and sweets. In both cases,

the rule is falsified by the state of the world in which **P and not-Q** occur, corresponding to A and 5 in the abstract version. However, when the classic version of the selection task is given to adult subjects, only 10% choose the card showing 5, i.e. **not-Q**. Why is the **not-Q** case not chosen? That is, how can we explain that, when we are dealing with permissions granting sweets to deserving children, the card corresponding to **not-Q** is easily seen as a potentially falsifying case, while this does not happen when we are dealing with abstract rules linking numbers and letters? From the viewpoint of mental logic, the "abstract" version of the selection task should be easier, not more difficult. According to this approach, it is presumed that the problem is "deprived" of its specific content. Inferences are then made on the underlying logical structure. Hence, we should expect the abstract task to be easier to understand and to solve than the Milton Keynes task, especially in the version concerning the promise, because in this case, logical interpretation must take the agent's interests into account. The more "abstract" the version of the problem, the shorter should be the mental path needed to pass from the specific domain of the problem to the logical code used for operations (and vice versa). Instead, the opposite occurs.

During the 1970s — when the formalist approach was stronger — attempts were made to explain how adults systematically failed on one task: the search for potentially falsifying cases, which for Piaget was a mainstay in the stage of formal thinking (see Legrenzi,1975). Some scholars such as Griggs & Cox (1982) and Manktelow & Evans (1979), suggested an equally radical alternative solution. They stated that, when faced with tasks like the selection task, subjects — not only children but also adults — do not in fact reason at all, but simply try to search their memory for available counter-examples to the rule to be checked. If these examples are not available, as in the case of the abstract rule, then they simply choose the cards mentioned in the rule. This "blind" strategy would explain the choice of **P** and **Q** and the non-choice of **not-Q** when dealing

with letters and numbers. This profoundly empirical perspective — in the sense that it did not involve the slightest inferential capacity — was later abandoned, since it was noticed that even tasks dealing with rules which were certainly unknown to subjects were correctly solved.

Cheng and her coworkers were the first to put forward a theoretical proposal, "intermediate" between the formalism of mental logic and the radical empiricism of the supporters of the role of memorization of counter-examples in past experience (Cheng & Holyoak,1985; for a complete review, see Holland, Holyoak, Nisbett & Thagard, 1986, p. 268 et seq.).

2. Pragmatic schemas of reasoning

Cheng's theoretical proposal assumes that, when faced with tasks like the Milton Keynes one, subjects use pragmatic schemas of reasoning. This is the name given to knowledge structures activated at an intermediate level of abstraction. The word "schema" indicates the fact that the mind does not contain either an abstract structure, like the truth table of implication, or separate coding of single permissions. We have a set of rules which are pragmatically appropriate for all permissions. The term "pragmatic" indicates that this is not a formal abstract schema, but a special one for a specific category of social situations, like permissions. In this perspective, correct solutions and errors depend on the ease with which a definite task can be interpreted in terms of a pragmatic schema of reasoning (i.e., the ease with which we understand that a certain situation corresponds to that "form"). Why an intermediate level of abstraction? Precisely because the schema does not correspond either to the truth table of implication or to a specific permission: it may be said to operate on an intermediate level of generality. It is more general than a single permission, because it applies to all pragmatically similar situations. For example, the permission granted to deserving children recalls a schema of permission consisting of a set of rules which does not necessarily refer to

sweets and scores. These rules deal with conditions which must be satisfied (in that specific case, a score of at least 10) in order for something to be permitted (take the sweet).

Cheng & Holyoak (1985) used experimental data to demonstrate that a suitable theory of reasoning capacity must move to an intermediate level, from a completely syntactic-formal approach to one based on the exclusive action of memory. For this, they went back to a previous version of the selection task (Johnson-Laird, Legrenzi & Legrenzi, 1972). That experiment used a postal regulation which stated that sealed letters were to be sent with stamps worth more than those stuck on unsealed letters. The permission to be checked was: "If a letter is sealed, then it needs a 40-lire stamp". During the early 1970s, the rule that unsealed letters cost less than sealed ones was in force in Italy and Great Britain. This form of the selection task turned out to be easy to solve by both Italian and British subjects. Its results were later explained on the basis of subjects' specific knowledge (Griggs & Cox, 1982; Reich & Ruth, 1982). It could be presumed that the memory of British and Italian subjects at that time contained counter-examples of that regulation: sealed envelopes with insufficient stamps on them. The solution thus simply required the recall of counter-examples from memory. Cheng & Holyoak (1985) succeeded in demonstrating that this hypothesis was groundless (in fact also in one version of the original postal experiment British subjects were given the task with Italian units of currency. Surely they had not all remembered posting letters in Italy, see Manktelow and Over, 1990a, p. 111). It was true that the later data of Griggs and others from subjects unaware of the postal regulation were much less satisfactory than those obtained in the early 1970s. But the low proportion of correct solutions was due to the fact that the regulation was not understood as a permission. In order to demonstrate this, Cheng and Holyoak repeated the task with: 1) subjects living in Hong Kong, where the regulation was in force; 2) subjects living

in Michigan, where it was unknown; 3) subjects living in Michigan, to whom the hitherto unknown regulation was explained.

The task consisted in indicating which envelopes should be turned over in order to check the regulation about stamps. There were four envelopes: one sealed (**P**), one unsealed (**not-P**), one with a high-denomination stamp (**Q**) and one with a low-denomination stamp (**not-Q**). Group 1 subjects solved the task correctly, like the British and Italian subjects of Johnson-Laird et al. (1972). The Michigan subjects, who did not know the regulation, did not solve the task, thus confirming the results of Griggs and Cox (1982). But the same Michigan subjects, who did not know the regulation, correctly solved the task when it was explained to them: sending a sealed envelope was a benefit which, however, involved paying more for stamps. This explanation was sufficient to interpret the regulation as a permission and thus to trigger the corresponding pragmatic schema of reasoning.

It should also be remembered how, in the experiment of Johnson-Laird et al. (1972), the abstract and realistic versions of the selection task were given to the same subjects. Although the subjects carried out one sort of trial directly after the other and there was every opportunity for transfer from realistic to abstract materials, none occurred significantly. This result is a difficulty for a formal theory of analogy. It cannot explain the failure of the realistic postal regulation to act as a helpful analog and to enable subjects to make a correct selection with the arbitrary rule. The two tasks have exactly the same formal structure of objects and relations, the trials occurred alternately, and the subjects certainly appreciated that they were similar — some even thought that they had made the same selections in both. Yet the analogy failed. Where the tasks differ, however, is in their meaning and one is bound to conclude that this difference inhibited the setting up of appropriate mappings and the transfer of relevant knowledge (Johnson-Laird, 1988, p. 316; see also Singley & Anderson, 1989, pp. 234-238).

The approach founded on pragmatic schemas was corroborated by extension to a series of researches on children by Girotto et al. (1988, 1989a, 1989b), using an experimental model consisting in simplification of the selection task. Girotto first stressed and discussed the relation between this approach and the research tradition developed at Geneva by Doise, starting from the classic Piagetian tasks (see Girotto's work in this issue). The theoretical and empirical work of Doise and his school and the theoretical proposal of Cheng & Holyoak both move in the same direction, revealing how the role of variables traditionally faced by social psychology is important. The psychology of reasoning thus seems at last to have freed itself from the tutelage of syntactic approaches. Their fascination may be explained by the influence which formal logic had for centuries, both on the prescriptive plane (rules for reasoning properly) and on the descriptive one (description of natural thinking).

III. Reasoning and social psychology

The influence of content (see Legrenzi & Mazzocco, 1974) — and in particular, of contents linked to social stereotypes — has been obvious ever since the first experiments on the inferential capacities of adult subjects more than fifty years ago. Consider, for example, the task in which different groups of subjects have to classify the conclusions of syllogisms as logically valid or invalid. From a logical viewpoint, this evaluation should depend exclusively on the form of the syllogism itself, independently of its contents. However, when a conclusion is believed to be true by subjects, it is more often judged as logically valid. For example, subjects with prejudices against people from the south of Italy believe more often that a conclusion such as "everyone from the south of Italy is lazy" is valid than a conclusion such as "everyone from the south of Italy is hardworking". The model of these experiments consisted of analysing the influence of social stereotypes, where logical structure was the same.

However, this model assumes a formalist approach because it considers deviations from logical canons as "errors". The theory of Cheng & Holyoak is innovative with respect to the traditional approach to the study of the influence of social factors, since a pragmatic schema, like that of permission, is "marked" on the social plane right from the beginning. Permission is by definition a social mechanism, in which at least two persons participate: one granting permission and one receiving it (see Sperber and Wilson, 1986, p. 245, n. 28). So the "social" contents of an inferential problem do not have, as it were, the function of "diverting" reasoning from a correct logical schema (see Girotto, in this issue). The application of these mechanisms may lead to choices which coincide fortuitously with those predicted by a formalist interpretation (e.g., the violation of a permission and the falsification of an implication). However, the application of pragmatic schemas may lead to different but not for this reason erroneous results (see the promisor/promisee situations in the experiment of Light et al., 1990).

One pragmatic schema like that of permission (or promise, obligation, etc.) could not arise in a world with a single person in it (unless we imagine someone who splits into two and invents permissions and then grants them to her/himself). In other words, the structure of the schema is socially based. Consequently, we can hypothesize that it is mastered from a child's very first "interactions" (see Astington, 1988). As pragmatic schemas function at an intermediate level (neither "particular", since they are linked to specific contents, nor "general" like logical frames), we can also hypothesize that other schemas exist, as well as those analysed by Cheng & Holyoak. For example, we can imagine using social stereotypes as activating different control strategies according to: a) the fact that a person belongs or does not belong to the group to which that stereotype refers; b) the fact that that person shares or does not share the content of the stereotype; c) the fact that the rule to be checked is composed of a positive or negative stereotype of the subject's ingroup; d) the

identification or non-identification with the source from which the stereotype comes.

Study on this hypothesis has been started in a series of pilot tasks carried out in Geneva by W. Doise, B. Cadalbert, V. Girotto and P. Legrenzi.

1. Social stereotypes and selection task

These pilot tasks were carried out in Geneva schools on 6/7-year-old children. As an experimental paradigm we used the selection task, since it is the most popular in the literature and comparative analysis of results is easy. In this experimental context, the task was to check the truth or non-truth of a stereotype composed of statements of the type: **"If a child is a little girl, she is always afraid".**

To check this, the children had to say which cards were to be turned over, as in the classic selection task. But in this case there were no cards, but four school carnets. The covers showed names, indicating whether the child was a boy or a girl, and inside were details of her/his behavior ("is always afraid" or "is never afraid"). Two of the registers were presented closed, with only the cover visible, and two were open, with only the remark about behavior visible. The first register had the name of a girl (Elsa=**P**), the second a boy (Mark=**not-P**), the third the negative characteristic (is always afraid=**Q**) and the fourth the negation of the negative characteristic (is never afraid=**not-Q**). The experimental design was complex (eight conditions) since these four rules were used with both boys and girls:

If a child is a girl, she is always obedient

If a child is a girl, she's always afraid

If a child is a boy, he is always looking for troubles

If a child is a boy, he is always brave

There were thus positive and negative stereotypes regarding typical behaviors of the two sexes, applying to both boys and girls. The scenario used to introduce the task was always the same:

"Imagine that you have changed schools and that you are now in a class like your other one. One boy (girl) who always says bad things about girls (boys) tells you about your new class: "....". Check whether what he (she) says is true or false by opening or turning these four carnets (all children in the Geneva schools had carnets like the ones we used)".

Without going into details of the results obtained, we will only note here a very interesting effect due precisely to a social factor which we could define as: "identification with ingroup and rejection by extension of the negative stereotype". The action of this factor in adopting checking strategy emerges, for example, when we have to check a negative stereotype of our ingroup, attributed to us by a member of the outgroup. This stereotype may be partially shared, in the sense that it is accepted but not as an exclusively negative characteristic of our own group. If the stereotype "If he is a boy, he is always looking for trouble" is presented as coming from a little girl (opposite source), it is sensible to adopt the following strategy:

1) Partial acceptance of negative stereotype of own group: the boy does not deny that his friends tend to "look for trouble", but denies that this negative behavior is exclusive to boys. He then proceeds to:

2) Check the applicability of the negative stereotype to the outgroup: that is, he checks whether it cannot be said that there are also girls who cause confusion.

Adoption of this strategy by a boy means the choice of **not-P** as the card to be checked to see if the statement: "If he is a little boy, then he is always looking for trouble" is true or false. The choice of **not-P**, which in these

conditions prevails over the usual choice of **P**, is not random — to the extent that in the latter assessment task 16 out of 17 subjects believe that in this context the presence of the case **not-P and Q** falsifies the negative stereotype of their ingroup (the statement that "If he is a boy, then he is always looking for trouble" is false, when the behavior also involves a girl who is always looking for trouble).

It is important to note that the conditionals in this section are not permissions or obligations, and this is the first time that effects of perspective changes have been found in non-deontic cases.

2. Analysis of perspectives

The adoption of the strategy by the Geneva children may be discussed in the light of the observations of Klayman & Ha (1987, 1988) and Gigerenzer & Hug (1990).

Klayman and Ha were the first to observe that the operations of negative "test" and "falsification" must be distinguished. When potentially falsifying cases are to be chosen, a conditional hypothesis does not necessarily have to be checked by choosing **P** cases in the expectation of finding them associated with **not-Q** cases, and vice versa. For example, let us suppose that I disagree with this hypothesis advanced by my questioner: **If one brand of shampoo has a 3% share or more of the market, it has a budget for publicity.**

If I interpret this statement as a conditional whose deep structure is **if P then Q**, I must check whether it is true or false by ascertaining whether by chance there are companies with 3% shares or greater (**P**) which do not have budgets for publicity (**not-Q**). However, things are not necessarily so in everyday life: I might be an expert in the sector, in which case I take it for granted that, at those levels, publicity must be paid for. But I want to show my questioner the general character of his statement. In my opinion: **If a brand of shampoo has a 3% share or more in the market, then it has a budget for** *television* **publicity**. In this case, I will try to find cases which falsify the

general hypothesis in favour of my more specific hypothesis. Some of the original **Q**s, for example, those corresponding to radio publicity, now become **not-Q**s. I search precisely for those specific **Q**s which show that it is impossible to find them associated with **P**s. In the contrary case I, the presumed expert, will be wrong and my questioner — who made a general statement — will be right. What does this example show? It tells us how a certain strategy must be analysed not only on the basis of the cases chosen to check it. It must also be considered in the light of what we could call the controller's "perspective", that is, the viewpoint of the person who wants to ascertain the truth or falsehood of the statement (the two goals are different, although from the logical viewpoint a true hypothesis is not false, and vice versa). That is, we cannot understand the sense of the choice of specific checking cases if we do not know the controller's perspective.

The question of controller's perspective becomes even more crucial if, as Gigerenzer & Hug (1990) have recently done, we verify how this factor may act in permission situations. The authors re-analysed the experimental scenario of the envelopes. As already mentioned, Johnson-Laird et al. (1972) used a postal regulation in force at that time which stated that sealed letters had to have more stamps on them than unsealed ones. The supporters of pragmatic reasoning schemas explained the high percentage of correct solutions in terms of correspondence between the violation of a permission schema and the falsification of an implication. We will see how Gigerenzer & Hug (1990, pp. 32-48) demonstrated that this correspondence is established only in some specific contexts, according to controller's perspective. They were able to re-use the original experimental schema, since the following postal regulation is currently in force in Germany: "If an envelope is sealed, then it must carry a 1-DM stamp on it". This regulation concerned two actors: the letter-sender and the post office. The former may try to cheat by putting a 60-pfennig stamp (for unsealed letters) on a sealed letter (**P and not-Q**). According to this

regulation, the post office cannot create plausible cases of cheating: it can only be cheated, being an authority above the parties, like the teacher in the case of the promises and permissions used with the Milton Keynes children. For this reason we avoided the obstacle by introducing the head of the group, who became the "agent" of the teacher's promise or permission. We thus avoided alluding to an implausible assumption: a teacher who does not keep her/his word. Now, say Gigerenzer & Hug (p. 40), in these two cases (and in other similar ones already studied in the literature), we have a "unilateral cheating option". And indeed, both in the school scenario with the single "teacher and pupil" pair and in the post office scenario, both actions indicated by **P** and **Q** have to be executed by the same agent. However, let us transform the scenario so as to make a "bilateral cheating option" possible. In what Gigerenzer & Hug (p. 41) call the "original perspective", subjects had to imagine they were postmen and check that the post office was not being cheated by **P and not-Q** combinations. In the "bilateral" version, we have someone working for a large company who is responsible for checking outgoing mail, stamped in various offices by other workers who are often absent-minded and inclined to make mistakes. Now the combination **P and not-Q** stands for the usual sealed envelope without a 1-DM stamp on it, perhaps simply by mistake. The combination **not-P and Q** may also be the result of mistakes made by inattentive and absent-minded clerks. Demotivated workers have no personal interest in cheating the post office by sending sealed envelopes with 60-pfennig stamps on them. In the same way, they may occasionally not notice that an envelope is unsealed and stick a 1-DM stamp on it.

In this new context created by Gigerenzer & Hug, Cosmides' theory of social contracts (see Girotto, in this issue) predicts a low percentage of choice for both combinations. Neither the "controller" worker nor the absent-minded workers gain anything from the possible discovery of either type of error. Seeing that this is a permission, the theory of pragmatic schemas predicts that **P** and **not-Q** will mainly be chosen. Yet in the

controller's perspective **not-P** and **Q** also become relevant because these are precisely the ones in which, by mistake, 60-pfennig stamps are not stuck on unsealed envelopes. And we do find 30% of responses of this type, which cannot be explained according either to Cosmides' theory or to the simple pragmatic schema of permission. The latter theory should by integrated or, better, incorporated, into what Gigerenzer & Hug call "analysis of perspectives", i.e., the viewpoints of all the actors in question.

IV. Conclusions

Politzer and Nguyen-Xuan (in press) have demonstrated the importance of perspective in experimental contexts in which various types of controller intervene on the same conditional promises. As in the case of the postal permission of Gigerenzer & Hug, *ceteris paribus* the choices of selected cards change according to the role of the controller (seller vs. person responsible for consumer protection; see Girotto in this issue). These experimental results, like those of Light et al. (1990), show the failure of the preceding theories, apart from the special cases for which they were introduced. Both in Cosmides' (1989) social contract approach and in that of pragmatic schemas, we have the explanation of special cases thanks to theoretical constructs anchored to social contents. In the case of Cosmides, these are represented by exchanges based on the cost-benefit structure ("I pay a cost to have a benefit", which leads to a *look for cheaters procedure*). In the case of Cheng & Holyoak, these are social constructs based on the condition-action structure (permission = If one wants to do action A, then one must satisfy precondition B; obligation = If condition A occurs, then action B must be fulfilled). In both cases, we have an approach which predicts performance in "social" terms. And yet these interpretations do not seem to be sufficient, if we wish to explain the action of factors such as: 1) source bias: the negative stereotype attributed by a member of an outgroup; 2) the influence of the different viewpoints

of promisor and promisee in checking a promise (Politzer and Nguyen-Xuan, in press; Manktelow & Over, 1990b); 3) the different behaviors of promise agents according to character (selfish, nepotistic, etc.) and thus of their relations with promisees (Light et al., 1990); 4) the controller's perspective, according to whether we have "unilateral cheating options" or "bilateral cheating options" (Gigerenzer & Hug, 1990, p. 47).

In the light of these recent results, the psychology of reasoning must develop further explanations integrated with what we already know from social psychology, mainly from the research tradition called *social marking* (Doise, 1990, pp. 121-124). Until now, with the abandonment of the elegant formalist illusions, the psychology of reasoning has followed a path which may be compared to evolution from the classic Piagetian framework. Here too, starting from a rigorously logicistic approach, we have passed to a phase of exploitation of social factors such as social marking (Doise & Mugny, 1981). Social marking consists in showing how children's knowledge of social rules can facilitate their performance in traditional concrete-operational Piagetian tasks (Doise, 1985). As social rules direct cognitive functions in children (Doise, 1990, p. 121), interpretation in terms of social exchanges makes "intelligible" hypothetico-deductive tasks which would otherwise be complex even for adults. However, in the tradition of adult reasoning psychology, we have perhaps accepted such a framework for too long, so that a logical task becomes "easy" when filled with "social content". On this basis, and in the light of experimental results obtained using special situations, we have tried to give credit to over-general theoretical models. In other cases, the action of social contents has been reduced to the role of retrieving knowledge. For example, this is Johnson-Laird and Byrne's (1991) interpretation of the facilitating effects of selection tasks framed as permissions.

The theoretical path of reasoning psychology runs in the opposite direction to that followed in the first section of this review. Precisely for

this "rhetorical" reason, we preferred to start with analysis of an apparently simple experimental task solved by 11-year-old children. Behind this apparent simplicity, performance can only be explained thanks to the action of complex mechanisms. And, even during a task faced and resolved individually, 11-year-olds do show themselves capable of imagining the consequences of a social situation. In order to solve the task, the social scenario is processed by bearing in mind the goals of the various actors involved (goals not declared explicitly but inferred from personal characteristics). This is a very difficult task if it is interpreted according to a formalist perspective like that of "natural deduction" or in Piagetian terms. And in fact, once a formalist approach is accepted, the changes in reasoning competence from child to adult are explained as involving domain-general changes such as changes in speed or representational power of the mind. Carey (1990, p. 170) has convincingly demonstrated that domain-general changes of this type play almost no role in the description of cognitive development.

Today the psychology of reasoning is half-way across the river. It has left the bank of logic but has not yet reached the other side. In order to do so, it is probably not enough to demonstrate the action of representation in social terms in the framework of single experimental paradigms. It may require integration, as we began to do when speaking of "perspectives", with research tradition on social representations (see Doise, 1990).

Paolo LEGRENZI,
Dipartimento di Psicologia
Università degli studi di Trieste
Via dell'Università, 7
34123 TRIESTE (Italia)

Maria SONINO LEGRENZI,
Dipartimento di Psicologia

Università di Padova

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