

**Children's communicative abilities revisited: verbal  
versus perceptual disambiguating strategies in  
referential communication\***

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ABSTRACT

The way seven- and nine-year-old French children and adults interpret ambiguous object descriptions was studied in four experiments. All four experiments followed the same basic procedure and consisted of two phases. During the training phase, plastic blocks varying in shape, colour and size were associated with fruit names. Some objects were always given just one label, the generic term, whereas others could be given either the generic or the specific label. For example, large circles were referred to as 'pommes' ('apples'), and large BLUE circles as 'reinettes' (a kind of apple). Still others were given no name at all. During the test phase of the experiment, subjects were presented with referentially ambiguous messages and asked to point to a given object (Experiments 1, 2 and 3) or to draw an object (Experiment 4). The messages consisted of either a generic term preceded by an article (e.g. 'la pomme' - 'the apple') or a verbal description based on a colour adjective (e.g. 'le bleu' - 'the blue one'). When presented with the generic term, older children and adults persistently chose the object for which no specific term had been given during the training phase. When

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presented with an adjective description, they chose the referent for which no fruit name had been given during the training phase. Younger children's choices depended on whether the article preceding the description was definite or indefinite. These results are consistent with the Gricean approach to referential communication proposed by Jackson & Jacobs (1982) and with an extended version of the principle of contrast proposed by Clark (1987, 1988).

## INTRODUCTION

The way objects are verbally described typically depends on the referential context in which they are perceived. A given animal that we usually call a 'dog' will be referred to as a 'spaniel' in the context of a dog show for example. When necessary, additional contrastive features, such as colour, size, location, etc. will be introduced in the description in order to provide the listener with an unambiguous message, e.g. 'the big yellow spaniel over there near the door'.

This ability to adapt verbal descriptions to the information requirement of the situation seems to be specific to adult speakers, however. Young children may fail to produce unambiguous definite descriptions. When asked to describe a target referent so that a listener will be able to identify it among a set of similar objects (the so-called "Referential Communication" paradigm), even seven-year-olds typically produce two- or three-word messages, regardless of the number of relevant features in the referential field (Ford & Olson, 1975).<sup>1</sup> Moreover, when presented with referentially ambiguous messages, they tend to consider them as acceptable (Flavell, Botkin, Fry, Wright & Jarvis, 1968; Asher, 1976; Ironsmith & Whitehurst, 1978). When explicitly encouraged to ask for more information if they find the message inadequate, second-graders only make general requests (Ironsmith & Whitehurst, 1978), although specific requests about the attributes that distinguish among the potential referents are often made by fourth-graders.

Children's difficulty in dealing with object descriptions has generally been accounted for in terms of 'communicative inability', whatever meaning this expression has been given in the literature: Piaget's notion of 'egocentrism'; difficulty in taking account of the 'listener's point of view'; ignorance of the principles governing conversation, etc. (Ackerman, 1978, 1981; Robinson, 1981; Singer & Flavell, 1981).

[1] Since the number of relevant features ranged from one to five in this experiment, it must be concluded that children sometimes produced redundant messages, providing the listener with MORE information than necessary. Children do not seem to use redundancy in the way adult speakers do, however (see Sonnenschein, 1988). Whitehurst & Sonnenschein (1978) suggested that young children conform to the Principle of Least Effort, arguing that less cognitive effort is expended in reporting all the features available in the referential field than in determining those that are necessary for identification.

This notion of communicative inability has been challenged, however, by the results of an experiment conducted by Jackson & Jacobs (1982), which will be referred to below as 'the clown experiment'. First- and third-graders were presented with a large card bearing drawings of six clowns differing in facial expression and the possession of flowers (see Fig. 1) and were told, for example: "I'm thinking of the happy one; which one is that?". Results indicate that in such a situation, third-graders tend to choose clown D (the happy one with no flower) rather than clowns A or F, which also would be consistent with the description 'the happy one', but have an extra feature (presence of a flower) that is not mentioned in the message. These results were replicated by Bredard (1983, 1984, 1987) with children ranging from 6;1 to 9;1 and more recently by Surian & Job (1987).

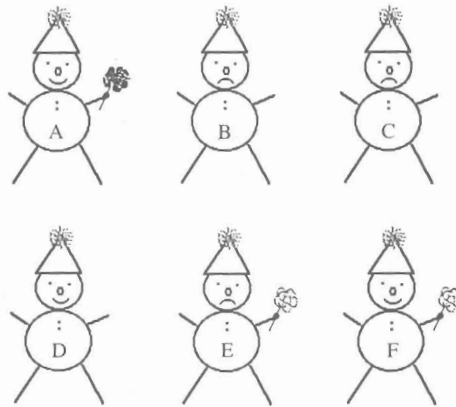


Fig. 1. The typical material used in the clown paradigm (Jackson & Jacobs, 1982).

In order to account for these results, Jackson & Jacobs proposed a two-stage model in which children were supposed first to isolate a subset of potential referents that were consistent with the message (e.g. clowns A, D and F in the above example) and then to eliminate A and F on the basis of 'possible messages that might have included other descriptive attributes' (p. 215). More precisely, the child is assumed to apply the following kind of counterfactual reasoning: 'The target referent is not A since, if it were, the speaker would have said "The happy one with a red flower" instead'. This interpretation is corroborated by the justifications given by the children. Among those choosing clown D, one first-grader said: 'Cause you didn't say he had a flower in his hand' (p. 214). Such an interpretation contrasts with those who assume children's inability to deal with object descriptions reflects communicative weakness. Indeed, in Jackson & Jacobs' perspective, children are in fact able to detect the ambiguity of messages and do take the speaker's

point of view into account. Moreover, they seem to make inferences based on the assumption that the speaker conformed with Grice's (1975) 'first maxim of quantity': 'Make your contribution as informative as is required by the current purposes of the exchange'.

Although plausible as far as third- and fourth-graders are concerned, such a hypothesis is doubtful in the case of six- and seven-year-olds. Indeed, there is some evidence that young children might not be able to draw inferences based on conversational maxims. For example, Ackerman (1981) found that children were not able to explain violations of conversational sequencing rules until they were eight or nine years old. Before reconsidering our conception of children's communicative competence, it is worth questioning whether another explanation is possible. The aim of the present paper is to consider alternative interpretations left open by experiments using the clown paradigm.

The first point to be considered is that the messages used in these experiments were NOT, strictly speaking, ambiguous. Indeed, the three alternative referents consistent with 'The happy one', namely A, D, and F in Fig. 1, are not equivalent. One of them, the target referent, very characteristically is lacking one element as compared to the other two, and this feature is very relevant for identifying it as the target referent. One can wonder whether a single-step comparison process, which would map the message to an appropriate representation of each object in the referential field, may be used in such a situation.

In order to make this argument clear, a more explicit account of the mechanisms involved in this kind of situation is necessary. In accordance with Deutsch (1985), we can consider the process leading to the comprehension of object descriptions to be a specific and complex case of the sentence-picture comparison paradigm (e.g. Chase & Clark, 1972). The following sub-processes can be distinguished: (a) The psycholinguistic processing of the definite description leads to (b) an abstract representation of its meaning, which (c) is matched against the representations of the visually perceived objects (Deutsch, 1985).

Moreover, we are going to assume, as stated in one of the models considered by Deutsch, that 'the addressee knows according to which dimensions and attributes the objects may vary which he/she will be shown in the experiment'.<sup>2</sup> As far as the clown experiment is concerned, this set of features could be determined by merely scanning the referential field. In the

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[2] Such an assumption may seem to contradict the Principle of Least Effort, which might suggest that young children do not analyse the referential field in terms of abstract features. However, since they use them in their descriptions (even if in a non-contrastive way), we have to assume that these features are available to them in some way. Moreover, children may act differently as listeners (the informational content of the message being determined by an adult speaker).

case of the Fig. 1 objects, for example, two features are relevant: the clown's face may look HAPPY or SAD, and the clown may hold a BLUE FLOWER a RED FLOWER or NOTHING in his hand (small capitals are used here in order to avoid confusion with the corresponding linguistic expressions *happy*, *blue flower*, etc. which appear in the messages). Accordingly, each drawing in Fig. 1 could be associated in the following way with an abstract description:

- A: (HAPPY, RED FLOWER)
- B: (SAD, NOTHING)
- C: (SAD, NOTHING)
- D: (HAPPY, NOTHING)
- E: (SAD, BLUE FLOWER)
- F: (HAPPY, BLUE FLOWER)

In order for the matching process to be effective, the two representations to be matched must have compatible formats. We are thus going to assume that the message is translated into a list of similar features (e.g. 'The happy one' would give HAPPY). Given this assumption, clown D can be recognized as the target referent of the expression 'The happy one' in one single comparison step between the description derived from the linguistic message and the descriptions associated to the objects in the referential field. (Note that the feature NOTHING must be assumed to be consistent with the absence of the corresponding feature in the list derived from the linguistic message). On the other hand, in the two-step model, the outcome of the comparison is not a single referent, but a subset of potential referents. In the above example, HAPPY would give rise to the following subset: HAPPY, RED FLOWER; HAPPY, NOTHING; HAPPY, BLUE FLOWER. Each abstract description would then be translated into its verbal counterpart and compared to the actual message. For example, the abstract description HAPPY, BLUE FLOWER would be translated into: 'The happy one with a blue flower in his hand' and the corresponding object rejected on the basis of the fact that this linguistic expression was NOT used by the speaker. Note that the linguistic description likely to be derived from HAPPY, NOTHING is probably 'The happy one with nothing in his hand', which is quite different from the actual message, 'The happy one'. Here again we must assume that the expression 'with nothing in his hand' will be considered as consistent with the absence of any further specification in the actual message. In this respect, the two-stage model is subject to the same criticism as the single-step one.

In order to contrast Jackson & Jacobs' proposal to the single-step model, we needed a situation in which children were presented with truly ambiguous messages, i.e. messages in which all the alternative referents in the referential field were equivalent in terms of perceptual features, but differed as far as potential linguistic descriptions were concerned. Unlike the clown paradigm (Jackson & Jacobs, 1982; Bredard, 1983, 1984, 1987; Surian and Job, 1987),

the task used in Experiment 1 fulfilled this requirement. As will become clear below, relying on potential verbal descriptions was the only way of solving the ambiguity in Experiment 1. The predictions for the two-step and the one-step models were as follows:

Two-step model: Children would be able to select the intended referent.

One-step model: Their choice would be made at random.

Experiments 2 to 4 explore two other possible interpretations left open by previous experiments using the clown paradigm. The general aspects of the method used in all four experiments are reported first. Specific aspects are later explained in the method section of each experiment.

#### GENERAL METHOD

The materials consisted of plastic blocks varying in shape (circle, rectangle and triangle), colour (blue, red and yellow) and size (large and small). Twelve objects were used: three large circles, three small circles, three big rectangles and three small triangles (one of each colour in each subset).

During the training phase of the experiment (see below), the blocks were associated with verbal labels, namely, large circles were referred to as 'pommes' (apples), small circles as 'prunes' (plums), the yellow rectangle as a 'banane' (banana), and the blue triangle as a 'figue' (fig). The other two rectangles (blue and red) and the other two triangles (red and yellow) were referred to as 'unknown fruits'. Moreover, two of the large circles and two of the small circles received specific names. The yellow apple was said to be a 'golden' (golden delicious) and the blue one to be a 'reINETte' (reNET), while the yellow plum was called a 'mirabelle' and the blue one a 'quetsche' (see Fig. 2). During the test phase of the experiment, the child was presented with these verbal labels and asked to point to the corresponding object.

We can consider how the one-step and two-step models apply to this kind of material. Firstly, the set of relevant 'abstract features' likely to be used includes shape (circle, rectangle, and triangle), size (large, and small), and colour (blue, red and yellow). The 'abstract perceptual descriptions' apt to be associated with all twelve objects in the referential field are listed below:

large, blue, circle	small, red, circle	yellow, rectangle
large, red, circle	small, yellow, circle	blue, triangle
large, yellow, circle	blue, rectangle	red, triangle
small, blue, circle	red, rectangle	yellow, triangle

Now, let us suppose that a subject is given the following message: *Montre-moi la pomme* ('Point to the apple'). Given the definition of 'apple' presented in the training phase, the message is supposedly translated into the following set of features: LARGE, CIRCLE. The outcome of the subsequent matching

REFERENTIAL COMMUNICATION

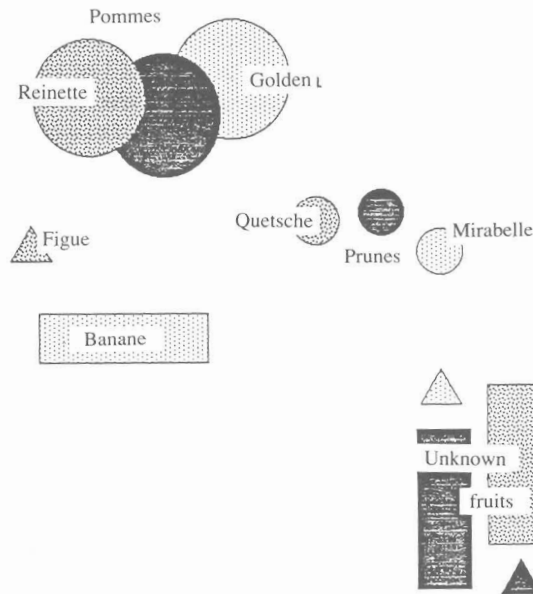


Fig. 2. The materials used in all four experiments. □, blue; ■, red; ▨, yellow.

process would be: LARGE, BLUE, CIRCLE; LARGE, RED, CIRCLE; and LARGE, YELLOW, CIRCLE. There is no way here to isolate ONE object solely on the basis of its abstract perceptual description. The one-step model simply does not work. Obviously, a second step is necessary in order to select a single referent from the above subset.

According to Jackson & Jacobs, the process here consists of finding out what verbal description a co-operative speaker 'would have used' for describing each of the objects selected during step 1. Not surprisingly, all three of the abstract descriptions considered below can be associated with the label 'pomme' (apple), which was used in the actual message. Two of them however can be associated with more specific labels, namely LARGE, BLUE, CIRCLE which corresponds to 'reinettes' (reinet) and LARGE, YELLOW, CIRCLE which corresponds to 'golden' (golden delicious). Since specific names are more informative than general ones, one can expect them to be used by a co-operative speaker conforming to the first maxim of quantity (see Cruse, 1977). As a consequence, we are left with the following labels: LARGE, BLUE CIRCLE: 'reinettes'; LARGE, RED, CIRCLE: 'pomme'; LARGE, YELLOW, CIRCLE: 'golden'. Only one of them 'pomme' (apple), matches the actual description. We are thus led to predict that the subject will pick up the large red circle. Note that the same reasoning applies to the small red circle when referred to as 'la prune' (the plum), the blue rectangle (referred to as 'le bleu': the blue

one), and the yellow triangle (referred to as 'le jaune': the yellow one), as indicated in Table 1. By contrast, if the single-step model is correct, children should be unable to find a single referent in this kind of situation. One can expect their choices to be made at random from the subset of candidates consistent with the message (e.g. any of the large circles when asked to point to 'the apple').

Note that the verbal description likely to be associated with BLUE, RECTANGLE is 'le rectangle bleu' (the blue rectangle), not 'le bleu' (the blue one) [the actual message]. Similarly, the description likely to be associated with YELLOW, TRIANGLE is 'the yellow triangle' and not 'the yellow one'. It can be assumed here that the comparison process is based on relative, rather than absolute, criteria (the chosen referent is the one whose description is closer to the description derived from the message). Indeed, 'The blue rectangle' is closer to the 'The blue one' than 'The fig' is, for example. Alternatively, it is possible to argue that the comparison process is dissymmetric (a given potential verbal description will be accepted provided it contains the features mentioned in the actual message, even if extra features not mentioned in the actual message are also present).

TABLE 1. *The selection process as hypothesized in the double-step model*

Message	Abstract description of potential referents	Verbal descriptions
la pomme (the apple)	LARGE, BLUE, CIRCLE	reINETte
	LARGE, RED, CIRCLE	←
	LARGE, YELLOW, CIRCLE	golden
la prune (the plum)	SMALL, BLUE, CIRCLE	quetsche
	SMALL, RED, CIRCLE	←
	SMALL, YELLOW, CIRCLE	mirabelle
le bleu (the blue one)	LARGE, BLUE, CIRCLE	reINETte
	SMALL, BLUE, CIRCLE	quetsche
	BLUE, RECTANGLE	←
	BLUE, TRIANGLE	figue
la jaune (the yellow one)	LARGE, YELLOW, CIRCLE	golden
	SMALL, YELLOW, CIRCLE	mirabelle
	YELLOW, RECTANGLE	banane
	YELLOW, TRIANGLE	←

*Note:* 'reINETte' = renet, 'golden' = golden delicious, 'quetsche' = blue plum, 'mirabelle' = yellow plum, 'figue' = fig, 'banane' = banana.



## EXPERIMENT 1

## METHOD

*Subjects*

Twenty-two second-graders (mean age = 7;10, S.D. = 4 months) and twenty-two fourth-graders (mean age = 9;9, S.D. = 5 months) participated in the experiment. They were taken from a school serving a middle-income area in Aix-en-Provence, France. There was approximately the same number of boys and girls in each age-group.

*Materials*

All sets used in Experiment 1 contained one exemplar of each object (e.g. one small blue circle, one small yellow circle, etc.). Either indefinite or definite articles were used in the training phase (e.g. 'this is a renet', 'group together all the plums', etc). During the test phase, they were referred to by their name, preceded by a definite article (e.g. 'la golden': the golden delicious). The subjects were presented with eight different messages, four of which were test messages:

1. la pomme (the apple)
2. la prune (the plum)
3. le bleu (the blue one)
4. le jaune (the yellow one)

Note that two test messages contained a noun ('apple' and 'plum') and two contained an adjective ('blue' and 'yellow'). The other four messages were aimed at checking whether children remembered the names learned during phase 1. These four control messages were:

5. la golden (the golden delicious)  
OR la reinette (the renet)
6. la mirabelle (the yellow plum)  
OR la quetsche (the blue plum)
7. la figue (the fig)
8. la banane (the banana)

Each message was presented twice.

*Procedure*

The procedure used in Experiment 1 was aimed at creating an acceptable 'communication situation' from the child's point of view, i.e. a situation involving co-operation between the child and the adult speaker, in order to perform a given task. To make the experiment more attractive, the task was

described as a competitive game involving two children. This made it possible to introduce arbitrary constraints into the task (concerning the length of utterances for example, see below), supposedly aimed at ensuring fair competition. Three adults were involved in the experiment, one playing the role of referee. Dyads of children were randomly taken from the classroom by the referee and conducted to the next room where the other two adults were waiting. Two teams, one child and one adult in each, were then formed. Each team was assigned to a specific location by the referee, and asked 'to agree upon a way of naming each object' (training phase of the experiment). The training phase continued until both children were able to name and recognize the objects associated with a specific name. This could take as long as 20 minutes in the case of second graders. Moreover, they were repeatedly asked to 'group together all the apples' to ensure that they were not forgetting generic names as well.

The test phase began by the referee explaining the game to both children. He emphasized co-operation within each team and competition between teams. (At the end of the game, the two scores would be compared and one team declared as the winner.). The referee then left the experimental area to go to another location in the experiment room, accompanied by one child. Each child was tested in separate sub-phases. The description below concerns only one of these sub-phases.

Let us call the child's team-mate 'Adult 1' (A1), and the child's opponent 'Adult 2' (A2). All three participants sat around a table as shown in Fig. 3. Two identical sets of objects, separated by a wooden screen, were displayed on the table. Set A was located between A1 and A2 and set B was in front of the child. The child's task was to guess which object A2 was pointing to in Set A (out of the child's sight). His/her answer was directed toward A2 and consisted of pointing to an object in Set B. A1 was allowed to help him/her by pronouncing 'one word' (actually, a noun or adjective preceded by a definite article). A typical trial proceeded as follows:

Adult 2 points to a set-A object (say, the large red circle).

Adult 1 helps the child by whispering: 'the apple'.

The child points to a set-B object.

His/her answer is recorded by Adult 2.

Each child was presented with four blocks of four trials. The blocks were presented in a fixed order (i.e. four control messages, followed by four test messages, followed by four control messages, followed by four test messages). The item presentation order within blocks varied pseudo-randomly across subjects.



Fig. 3. The experimental situation.

#### RESULTS AND DISCUSSION

As far as control messages are concerned, almost all subjects, whatever their age, reached a very high degree of accuracy (93% on the average for second-graders and 94% for fourth-graders). This suggests that the verbal labels used during the training phase were correctly memorized.

As for test messages, two types of message can be distinguished, namely: 'article + noun' and 'article + adjective'. Each type corresponds to four trials (two different messages, each presented twice). Each value presented in Table 2 is the mean number of subjects, calculated across these four trials. The first column (Cor) indicates the mean number of subjects who gave a correct answer (i.e. who chose an item that was consistent with the message, for example, pointing to a large circle of ANY COLOUR when the message 'the apple' was presented, or to a blue object of ANY SHAPE for 'the blue one'). The second column (Exp) indicates the mean number of subjects who pointed to the expected object (for example a large RED circle for 'the apple', or a blue RECTANGLE for 'the blue one').

Since three objects were defined as 'apples' during the training phase, the probability of choosing at random the large RED circle as an answer to 'the apple' (provided a large circle was to be chosen) was 1 out of 3. What we shall consider to be the chance level (Rdm in Table 2) for noun messages is thus the number of subjects who gave a correct answer divided by three. As for adjectives, the number of subjects giving a correct answer has to be divided by four, since four yellow objects and four blue objects were present in the

TABLE 2. *Experiment 1. Mean number of subjects who gave a correct answer (Cor), and an expected answer (Exp)<sup>a</sup>*

	Second-graders ( <i>N</i> = 22)				Fourth-graders ( <i>N</i> = 22)			
	Cor	Exp	Rdm <sup>b</sup>	$\chi^2$	Cor	Exp	Rdm	$\chi^2$
Nouns	19'00	10'50	6'33	4'12	20'50	16'25	6'83	19'48
Adjectives	22'00	12'25	5'50	11'05	22'00	16'50	5'50	29'33

<sup>a</sup> Pointing to a large circle of any color and to the large RED circle are a 'correct' and an 'expected' answer respectively to the message 'the apple'.

<sup>b</sup> Rdm = chance level.  $\chi^2$  = chi squared.

referential field. Actual performance was compared to this chance level by means of a chi-squared test ( $\chi^2$ ). As indicated in Table 2, the expected object was chosen significantly above the chance level ( $p < 0.05$ ) in all four cases (for both the noun and the adjective messages, and for both age groups).

A difference between the two age-groups is also apparent in Table 2. Fourth-graders gave more expected answers than second-graders. The statistical significance of this difference was tested by means of an analysis of variance. The dependent variable for each subject was the number of test trials (across the whole experiment) for which an expected answer was recorded. It turned out to be significant ( $F(1, 42) = 6.32, p < 0.05$ ).

The single-step model, as described in the Introduction thus appears to be wrong. The results of Experiment 1 suggest that children do rely on verbal descriptions likely to be associated with potential referents. Indeed, in the present experiment, all the potential referents for a given verbal description were equivalent in terms of perceptual features and could only be distinguished on the basis of whether or not another verbal label had been associated with them during the training phase. A natural account for these results is provided by Jackson & Jacobs' two-step model in which potential verbal descriptions are produced in a second step, as part of a counterfactual type of reasoning concerning what a co-operative speaker, conforming to the maxim of quantity, would have said if referring to such an object.

Note, however, that the results of Experiment 1 do not provide any evidence of the specific underlying mechanisms. They only show that verbal descriptions are involved in some way in the process. They do not tell us HOW a given verbal description is associated with each object. Why would children choose to label the large blue circle as 'the renet' rather than 'the apple' for example? We have been arguing so far that it is because 'renet' is more informative than 'apple', and that a co-operative speaker conforming to the first maxim of quantity, would consequently have used it. There is another possible answer, however. 'Renet' is actually the only possible label for the large blue circle if one wishes to establish a one-to-one correspondence

between labels and objects. Let us consider the set of large circles and their corresponding labels:

- large blue circle: pomme (apple) and reinette (renet)
- large red circle: pomme (apple)
- large yellow circle: pomme (apple) and golden (golden delicious)

Now, we can establish a correspondence between objects and labels such that each object receives one and only one label. Obviously, the label 'pomme' has to be associated to the large red circle (as the only possible label). Consequently, 'pomme' is no longer available for the large blue circle or the large yellow circle. The only remaining labels for these two objects are 'reinette' and 'golden' respectively. The same reasoning applies to small circles. What about the blue rectangle and the yellow triangle? Here again, a strategy based on object-label pairing and a strategy based on the maxim of quantity would have similar outcomes. The verbal description likely to be associated with the blue rectangle, for example, is again 'the blue rectangle' and not 'the blue one'. Indeed, 'the blue one' would not abide by the principle of one-to-one correspondence between descriptions and objects (since several objects fit this description). 'The blue rectangle', on the other hand, is consistent with such a principle, since only the blue rectangle fits this description.

Subjects could be induced to use an object-label pairing strategy in Experiment 1 due to the definite article, since it suggested that only one object fitted the verbal description provided in the message. It is worth noting that, in this kind of experiment, the ambiguity actually lies in a contradiction between the definite article and the scope of the verbal description that follows (which is consistent with several objects). The second-graders may have considered that there actually WAS a single referent consistent with the description. In other words, instead of trying to solve the contradiction between the definite article and the scope of the description, they may have chosen to deny the existence of any contradiction at all. Moreover, this strategy may have led them to think they had to look for a one-to-one correspondence between labels and objects WITHIN THE EXPERIMENT (and not only between the message and one referent).

In Experiments 2 and 3, we decided to replace definite articles by indefinite articles. Although the messages were no longer ambiguous in this way, reasoning based on the maxim of quantity could still be applied. In order to explore this possibility, we first set up a pilot study with a group of adult subjects.

## EXPERIMENT 2

## METHOD

*Subjects*

Eighteen adult subjects participated in the experiment. They were all native speakers of French and were studying psychology at the University of Provence.

*Materials and procedure*

The materials were similar to those used in Experiment 1 with the children, except for the presence of small rectangles and large triangles (consequently, there were small and large bananas, small and large figs, small and large blue rectangles, etc). Three exemplars of each category were present in the referential field (i.e. a total of 54 objects).

The training phase was similar to the one used in Experiment 1. The messages issued during the test phase included an indefinite article (e.g. 'an apple') instead of the definite article used in Experiment 1. Only one experimenter was present and subjects were tested individually. In order to make the task less trivial for adult subjects, they were asked to place objects on a board divided into nine squares. Moreover, the experimenter emphasized the locations where the objects were to be placed. A typical message was: 'Put an apple in the square at the upper right-hand corner of the board'.

## RESULTS AND DISCUSSION

The results are presented in Table 3. The same tendency that was observed in Experiment 1 was observed here with adult subjects presented with indefinite descriptions ( $p < 0.05$ ). Note that 96% of the control items were correctly answered.

The results of Experiment 2 suggest that using indefinite expressions does not prevent adults from relying on verbal descriptions for selecting a referent. They still tend to choose the referent for which no other verbal

TABLE 3. *Experiment 2. Mean number of subjects who gave a correct answer (Cor), and an expected answer (Exp)*

	Adult subjects ( $N = 18$ )			
	Cor	Exp	Rdm <sup>a</sup>	$\chi^2$
Nouns	18.00	13.00	6.00	8.92
Adjectives	18.00	12.25	4.50	14.50

<sup>a</sup> Rdm = chance level,  $\chi^2$  = chi-squared.

description than the one provided by the message is available. The aim of Experiment 3 was to find whether a similar tendency would be observed in children.<sup>3</sup>

### EXPERIMENT 3

#### METHOD

##### *Subjects*

Twenty-two second-graders (mean age = 7;5, S.D. = 5 months) and twenty-two fourth-graders (mean age = 9;10, S.D. = 5 months) participated in the experiment. They were taken from a different school serving the same area as the one used in Experiment 1. There was approximately the same number of boys and girls in each group.

##### *Materials*

The same objects as Experiment 1 were used. In order to prevent the use of an object-label pairing strategy, two exemplars of each object were present in each set instead of only one as in Experiment 1. For example, there were six apples; two red ones, two yellow ones and two blue ones. The linguistic material was similar to that used in Experiment 1, except for the presence of an indefinite article in the messages used in the test phase (e.g. 'an apple') instead of the definite article used in Experiment 1.

##### *Procedure*

The procedure was similar to the one used in Experiment 1.

#### RESULTS AND DISCUSSION

Both age-groups reached a high degree of accuracy on control items (92% and 95% correct answers respectively). As for test messages, the results are summarized in Table 4. No effect was observed in the group of younger children. Their choices seem to have been made at random within the category defined by the message. This suggests that Experiment 1 results for second-graders may be explained by the presence of a definite article in the messages and based on the use of a one-to-one correspondence strategy between objects and labels. A significant effect was observed, however, for

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[3] It has been shown that the difference between definite and indefinite articles is mastered (or partly mastered, see Power & Dal Martello, 1986) by children by the age of four. When asked to narrate a pictorially-presented story to another child (who cannot see the pictures), they correctly use the indefinite article on first mention of each referent, and the definite article on subsequent mentions (Emslie & Stevenson, 1981).

TABLE 4. *Experiment 3. Mean number of subjects who gave a correct answer (Cor), and an expected answer (Exp) <sup>a</sup>*

	Second-graders ( <i>N</i> = 22)				Fourth-graders ( <i>N</i> = 22)			
	Cor	Exp	Rdm <sup>a</sup>	$\chi^2$ <sup>a</sup>	Cor	Exp	Rdm	$\chi^2$
Nouns	20.00	7.25	6.67	0.08	20.50	14.75	6.83	13.77
Adjectives	22.00	4.50	5.50	0.24	22.00	12.25	5.50	11.05

<sup>a</sup> Rdm = chance level,  $\chi^2$  = chi-squared.

older children ( $p < 0.05$ ), suggesting a strategy consisting of reliance on potential verbal descriptions, in spite of the presence of indefinite articles in the messages. The difference between the two groups is significant ( $F(1, 42) = 20.61$ ,  $p < 0.05$ ).

Before further discussing the theoretical implications of such results for our conception of children's communicative competence, we shall turn to a second question left open by Experiment 1, which concerns the time course of the underlying processes. Exactly WHEN were verbal labels associated with objects in Experiment 1? We have been arguing so far that in order to be matched to the abstract descriptions associated with the objects present in the referential field, the message must be translated into a similar list of abstract features. But the only necessary assumption here is that the two representations must have similar formats. There is no need for the translation process to occur in the verbal-perceptual direction. Theoretically, the translation could occur the other way around and consequently, the comparison would be based on verbal rather than perceptual representations.

The conditions of the referential communication paradigm make such a hypothesis plausible. Since the whole set of potential referents is usually visible to subjects, a simple procedure available to them consists of successively naming (or verbally describing) each object and comparing their names (or verbal descriptions) to the actual name or description used in the message. This possibility will be referred to below as the 'verbal comparison model'. Applied to Experiment 1, the verbal comparison model suggests that the abstract description associated with each object was translated into its verbal counterpart from the beginning of the experiment (possibly from the beginning of the test phase), and that verbal descriptions were then compared to the actual message in a single comparison step. The procedure of Experiment 4 was aimed at preventing the use of such a strategy.

After a training phase similar to that used in previous experiments, subjects were merely asked to DRAW the objects corresponding to the names (preceded by an indefinite article). No potential referents were visible to subjects, and they were thus forced to rely on the 'meanings' of the words



used in the message (i.e. the definitions in terms of features given during phase 1) in order to select the correct shape, size and colour of their drawings. In other words, the task used in Experiment 4 involved production of perceptual features from verbal descriptions as stated in the first step of the two-step model.

Let us suppose a child is asked to draw 'an apple'. The corresponding definition, in terms of perceptual features is *LARGE, CIRCLE*. Now the subject has to decide the colour (in order to choose a pen) to actually make a drawing. Let us suppose his choice is *YELLOW*. He or she is now dealing with the following list of features: *LARGE, YELLOW, CIRCLE*. He or she could apply the following reasoning: 'If the experimenter had intended to refer to the object corresponding to this definition, he would have said 'une golden' (a golden delicious). He thus does not want me to draw a yellow circle'. The subject is assumed here to proceed as stated in the second step of the two-step model.

## EXPERIMENT 4

### METHOD

#### *Subjects*

Twenty-two second-graders (mean age = 7;8, s.d. = 5 months) and twenty-two fourth graders (mean age = 9;8, s.d. = 7 months) participated in the experiment. There were taken from the same school as the subjects in Experiment 1, but from different classrooms. None of them had participated in any previous experiment. There was approximately the same number of boys and girls in each age group.

#### *Materials*

The materials were similar to the ones used in Experiments 1 and 3. As in Experiment 3, two exemplars of each object were present in the referential field. They were no longer visible during the test phase. Indefinite articles were used in the messages given during the test phase.

#### *Procedure*

Children were taken from the classroom one at a time. The training phase was similar to the one used in the previous experiments. During the test phase, they were given a piece of paper and three pens (a yellow one, a red one, and a blue one) and asked to draw a series of objects. As in Experiments 1 and 2, the messages were composed of two words (article + noun or article + adjective). The four test items were asked for twice.

## RESULTS AND DISCUSSION

The percentage of correct answers to control items was 95 for both age groups. As far as test items are concerned, older children clearly favoured the referent for which no other verbal description than the one used in the message was available ( $p < 0.05$ , see Table 5). This result is consistent with the two-step model. As for younger children, a similar effect was observed for nouns ( $p < 0.05$ ), but not for adjectives.<sup>4</sup> Globally, the difference between the two age groups is not significant however ( $F(1, 42) = 3.78$ ,  $p > 0.05$ ).

TABLE 5. *Experiment 4. Mean number of subjects who gave a correct answer (Cor), and an expected answer (Exp)*

	Second-graders ( $N = 22$ )				Fourth-graders ( $N = 22$ )			
	Cor	Exp	Rdm <sup>a</sup>	$\chi^2$	Cor	Exp	Rdm	$\chi^2$
Nouns	21.00	12.00	7.00	5.36	21.50	13.50	7.17	8.38
Adjectives	22.00	4.75	5.50	0.14	22.00	11.25	5.50	8.02

<sup>a</sup> Rdm = chance level,  $\chi^2$  = chi-squared.

An obvious difference between noun and adjective messages, which could account for the results of second graders, concerns the specific feature involved in each case. Let us consider the noun 'apple'. The definition of 'apple' in terms of abstract features pertains to the SHAPE of the intended referent. The second step (involving potential verbal descriptions) thus involves the subject's choosing a colour. Now, let us consider the case of an adjective message such as 'a blue one'. Here the message provides the COLOUR of the intended referent, so that a pen can be selected at step 1 (when a set of potential referents is initially selected). The second step (labelling) is assumed to be performed without any concrete support (such as the choice of a pen). This difference in the procedures associated with the two types of message is likely to explain why younger children were apparently unable to complete step 2 in the case of adjective messages.

Another difference concerns the POTENTIAL verbal descriptions likely to be associated with each object during step 2. Adjective-based potential descriptions are more complex than noun-based ones and are thus less likely to be produced during step 2. Let us consider the (actual) message 'a blue one'. After having chosen a blue pen, the subject has to decide which specific shape

[4] A similar dissymmetry between nouns and adjectives was found by Taylor & Gelman (1988) in an experiment in which two-year-old children were asked to figure out new word meanings (e.g. 'Can you point to a zav?' vs. 'Can you point to a zav one?').

he is going to draw (either a blue triangle, a blue rectangle, a small blue circle or a large blue circle). On this step, the subject is assumed to associate a verbal description to each of these potential objects and decide which one matches the message (respectively, 'fig', 'blue rectangle', 'quetsche' and 'renet'). The interpretation being considered here is that a majority of second graders failed to produce 'blue rectangle' (because it contains two words instead of one) and were probably led to choose a given shape at random among the other three possibilities.

#### GENERAL DISCUSSION

The aim of the series of experiments reported in this paper was to explore the procedures used by children when they are confronted with referentially ambiguous messages. An important theoretical contribution to this question is Jackson & Jacobs's (1982) two-step model which states that children first isolate a subset of potential referents (consistent with the message) and subsequently eliminate non-referents by means of counterfactual reasoning concerning how a co-operative speaker, conforming to the first maxim of quantity, would have referred to each of them. Three aspects of this model were successively questioned.

(i) In accordance with Deutsch (1985), we have been arguing that the interpretation of an object description involves a comparison process based on 'abstract descriptions' derived from the message on the one hand, and associated with each object in the referential field on the other hand. In this framework, it is possible to account for Jackson & Jacob's results in a single step of comparison. The results of Experiment 1 are incompatible with this single-step interpretation, however. Indeed, the potential referents here were equivalent in terms of abstract representations and could only be distinguished on the basis of potential verbal descriptions.

(ii) We have been arguing that a strategy consisting of establishing a one-to-one correspondence between objects and verbal descriptions would have the same outcome as Jackson & Jacob's quantity-maxim-based procedure (by which verbal descriptions are assumed to be associated with each potential referent in the two-step model). Moreover, the presence of definite articles in Experiment 1 may have triggered such an object-label pairing strategy (by suggesting that only one referent fitted each message). In order to explore this possibility, indefinite descriptions were used in Experiments 2 and 3. A different pattern of results was found for second-graders (who were sensitive to the type of article used) and fourth-graders (who apparently continued to rely on potential verbal descriptions in spite of the presence of indefinite articles). It thus seems possible to argue that fourth-graders, unlike second-graders, do rely on the maxim of quantity for producing potential verbal descriptions. As for second-graders, the effect observed in Experiment 1 may

be attributable to the presence of a definite article (possibly by suggesting a one-to-one correspondence between objects and verbal descriptions).

Some further arguments in favour of this idea can be found in the literature concerning the development of lexical competence. According to a popular assumption, children originally tend to establish a one-to-one correspondence between names and concepts (Stern, 1914; Vygotsky, 1962; Ausubel, 1968). New emphasis has recently been placed on this notion by Clark (1987, 1988) who suggests that adult as well as child language relies on what she calls the 'principle of contrast', which is formulated as follows: 'Every two forms contrast in meaning' (Clark, 1987: 2).

Unlike the above notion of fixed pairing between concepts and names, the principle of contrast assumes only a one-way fixed relation. More precisely, a fixed correspondence is assumed to exist in the concept-to-name direction (a given concept cannot have several names) but not in the name-to-concept direction (a name can be shared by several concepts). This assumption was made necessary by the existence of many homonyms in most languages (e.g. bat, bank, etc, in English).

In young children, more specifically, such a principle has been shown to provide a powerful heuristic for learning new words. It thus seems likely that children tend to use it in a more strict way than adults do, and possibly extend its use to REFERENTS (and not only to meanings). If we accept this shift, we can formulate an Extended Principle of Contrast: 'Two different names necessarily refer to different objects.' This could explain young children's difficulty in dealing with object descriptions in general (see the Introduction). If a one-to-one correspondence is assumed to exist between names and concepts, verbal descriptions are less likely to vary according to context. The same principle also leads to the prediction that young children will perform quite well in the clown experiment or in any similar situation. Let us consider the message 'give me the vehicle' uttered in the presence of two potential referents, namely a very well-known vehicle like a car, and another (less well-known) vehicle like a carriage (the important point being that the subject is assumed to know what a carriage is, but not to know the noun 'carriage'). Since the car is called 'a car', it is no longer 'a vehicle' (extended principle of contrast). It follows that 'vehicle' is no longer referentially ambiguous and will be interpreted as referring to the carriage.<sup>5</sup> In other words, our results for second-graders could in no way be considered as a counter-example of young children's communicative inability. On the contrary, if the object-label pairing hypothesis is correct, these results would be a corollary of the

[5] It could be argued that a car is a more typical vehicle than a carriage, and that the car, not the carriage, would consequently be selected by children in such a situation (see White, 1982; Benelli, 1988; Job & Surian, 1989). Note however that we are dealing here with availability of labels not with typicality of referents. Clearly, these two factors are logically distinct, even though they may be difficult to manipulate independently.

inability of young children to consider the link between words and concepts as an essentially flexible one (i.e. likely to vary according to context).

(iii) The third aspect we have been considering concerns the time course of underlying processes. In the referential communication paradigm, subjects are typically presented with a set of potential referents which remains visible in the referential field for the whole experiment. Besides the set of relevant abstract features (minimally describing the set of objects), subjects are thus likely to determine a set of relevant verbal descriptions from the beginning of the experiment (whatever the precise mechanism involved) and to further compare each of these potential verbal descriptions to the actual message (the so-called verbal comparison model). In informal terms, the subjects' strategy would be as follows: 'Let us determine what the verbal labels are for each object and see which one fits the message'. The meaning of the message has no part in the process here. Once a verbal label has been associated with each object, the comparison is entirely based on these verbal labels.

Although the verbal comparison model is independent of the fixed-pairing hypothesis (considered above) at the empirical level, the two aspects are theoretically related. Indeed, the verbal comparison model can only work if a one-to-one correspondence is assumed to exist between verbal labels and objects. More precisely, it must be taken for granted that any difference in wording corresponds to a difference in perceptual features. Symmetrically, a fixed-pairing process between objects and verbal descriptions is better thought of as a general strategy, occurring once and for all, at the beginning of the experiment, and dealing with the whole set of objects at the same time, rather than as a recurrent process taking place during each trial.

In order to prevent the use of such a strategy, the referential field was removed in Experiment 4, and subjects were asked simply to draw the object corresponding to the message. Again, a clear tendency to choose the object for which there was no specific name was observed in the group of fourth-graders (and in the group of second-graders on noun messages). These results cannot be accounted for by the verbal comparison model. Since no referent was available in Experiment 4, a strategy consisting of associating a verbal label with each object (object-label pairing procedure) from the beginning of the test phase (and subsequently uniquely relying on these verbal labels) was not possible. A comparison process based on potential verbal descriptions was apparently involved (whatever the mechanism used), but only occurred in a second step, once the normal process (based on abstract descriptions derived from the message) had proved to lead to an ambiguity. The results of second-graders (lack of effect in the adjective message case) suggests that the situation used in Experiment 4 prevented them from using their usual strategy and triggered a two-step strategy (that they only partly succeeded in using, since they apparently failed to produce the more complex adjective-based potential descriptions).

It is worth noting that the procedure used in Experiment 4 can hardly be considered as a referential communication task. Although something was clearly 'communicated', no actual referent for the message was present in any referential field. What was communicated was actually a 'meaning' (i.e. a list of specifications or 'abstract features' for a specific drawing to be done), and not a referent.

This idea also shed some light on the results of Experiments 2 and 3 in which indefinite descriptions were used in the presence of potential referents. Indefinite descriptions in this case can be interpreted as denoting 'any of the referents that are consistent with the description'. Consequently, unbiased choices could have been expected. A clear preference for the referents with no other possible labelling than the one used in the message was still observed, however. A possible interpretation is that older children and adults used the MEANING of the messages for selecting a subset of potential referents, and only in a second step did they rely on potential verbal descriptions. In other words, they may have acted as in Experiment 1, even though the messages in Experiments 2 and 3 were not definite descriptions. We would have to admit that older children and adults actually handled the different steps of the two-step model 'in their head', before turning to actual objects in the referential field. The two-step model thus emerges as a very general scheme for interpreting noun phrases, whether the description is definite or indefinite, and whether potential referents are present or not.

In conclusion, we are led to hypothesize a clear developmental difference between second- and fourth-graders. While fourth-graders apparently produced potential verbal descriptions that a co-operative speaker conforming to the first maxim of quantity would have used, the results of second-graders are better interpreted in terms of a general heuristic based on the extended principle of contrast. This is in keeping with the results of other studies on the development of communication abilities, which suggest that unlike eight- or nine-year-olds, second-graders are not able to draw inferences based on the rules of conversation (Ackerman, 1981).

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