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Adult Performance in Naming Spatial Dimensions of Objects

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Most work on acquisition of lexical meaning in developmental psycholinguistics is based on the idea of the relevance of the adult model, which is generally described in relation to certain theoretical semantic analyses. Up to the present, adult behavior itself has not been examined and its validity as a model for children has been taken for granted. This paper analyzes the knowledge of spatial terms, namely dimensional terms, shown by a group of 20 adults. The results show that the adult subjects used in our study - supposedly linguistically competent - committed errors, significantly varying their strategies for naming dimensions from one case to another, and showing a lack of consistency between them. The results are discussed in terms of assumed theoretical validity with regard to theoretical semantic analysis, as well as the methods of research about the acquisition of lexical meaning.
Key words: dimensional term, naming, acquisition of meaning

Gran parte del trabajo sobre la adquisición del significado léxico en psicolingüística evolutiva suele tomar como referencia el modelo adulto de respuesta, el cual se define en relación con ciertos modelos semánticos teóricos. Según esto, la conducta adulta no se suele examinar empíricamente, dándose por supuesta su validez como modelo con el que comparar la conducta de los niños. En este artículo se analiza específicamente el conocimiento de términos espaciales, más concretamente, adjetivos dimensionales, mostrado por un grupo de 20 adultos. Los resultados muestran que los sujetos adultos de nuestro estudio, supuestamente competentes desde el punto de vista lingüístico, cometían errores, variaban significativamente sus estrategias al nombrar las distintas dimensiones y mostraban un buen número de inconsistencias entre ellos. Se analizan estos resultados en función de la validez teórica asumida en relación con los modelos semánticos teóricos y su repercusión con respecto a los métodos de investigación en la adquisición del significado léxico.
Palabras clave: términos dimensionales, denominación, adquisición del significado

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The most commonly used method in experimental research on lexical semantic development has been to compare the information obtained from child subjects in their early years with a pre-set model of adult competence. More specifically, as Abkarian (1982) pointed out: "the child's lexicon has been studied by evaluating the degree to which child word knowledge is congruent with (if not isomorphic to) adult knowledge, or by tracing the specific status of the child's lexicon at various points on the journey to adult linguistic competence" (p. 229). However, according to the same author, the nature of the normal adult semantic system or subsystem has usually been defined *a priori* and without specific empirical support by language researchers. Although this strategy seems useful from a methodological point of view, some literature on the subject raises doubts about it.

In fact, the above-mentioned author, when examining the adult subject's comprehension of instructions containing the spatial prepositions *ahead of, in front of, in back of,* and *behind,* found that adults were very inconsistent in their answers. These did not coincide with the predicted response pattern in the theoretical semantic models on which his study was based (Abkarian, 1982). Cox and Richardson (1985), Piérart (1977), and E.V. Clark (1980), who investigated these terms, found similar results. Because of these results, Abkarian suggested the need to submit the purely linguistic intuitions of theoreticians to empirical testing and not rely on presuppositions about mature levels of performance. Although their conclusions are limited to a small group of spatial prepositions of a deictic nature, they could be applied to other lexical items.

In this work, we examined this issue together with spatial terms, and more specifically, dimensional terms (*tallness, length, width,* etc.). Even though this possibility has never been tested in this semantic field with these terms, various considerations support our decision. After an exhaustive review of the experimental investigation of the acquisition of the meaning of these terms, Carey (1982), like Abkarian (1982), emphasized the theoretical nature of the semantic analysis used to define their meaning - referring specifically to the componential analysis of Bierwisch (1967) - and of the semantic features revealed by that analysis. Carey (1978) suggested that even adults may not be able to master fully the system of underlying features in the semantic field of dimensional adjectives because of its great complexity.

The main purpose of this paper was to analyze the linguistic performance of adult subjects in relation to dimensional terms in a task where they were supposed to put their dimensional knowledge into practice by producing these terms. We were trying to establish a connection between the empirical data obtained from psycholinguistic research and a formal theoretical semantic description.

The examination of adult performance is important in the semantic field of dimensional terms because of its traditional characterization. Traditionally, a componential structure has been presupposed for the meaning of the dimensional adjectives, within a classical framework of meaning (Carey, 1982). According to such a view, the meanings of words can be broken down into a combination of smaller units (components or semantic features), that are collectively necessary and sufficient to determine their reference. In the same way, psycholinguists have basically assumed that words differ in their degree of semantic complexity, which has generally been defined as the number and generality of the components which define them (E.V. Clark, 1973; H. Clark, 1973). Based on these suppositions, these terms are relatively simple to arrange according to their semantic complexity (Ravn & Gelman, 1984). Supposedly, one could predict the order in which these terms are acquired during the childhood process of vocabulary acquisition; for example, the least complex would be acquired first.

One way to determine the psychological reality of the theoretical claims is to observe the process by which children acquire the meaning of words; the irregularities in the nature and order of this acquisition should reflect the complexity and structure of these terms (Carey, 1982; Huttenlocher, Smiley, & Ratner, 1983). However, as the latter authors also indicated, such irregularities should reflect the way in which adults present these terms during linguistic interaction with children. In this case, "their meanings would reflect the range of instances that adult name, and the order of acquisition of the different words would reflect the frequency of their use" (Huttenlocher et al., p. 210). Thus, testing adult subjects in relation to their use of dimensional terms would provide an essential baseline with which to compare child acquisition of these terms and, therefore, serve as a guide for future investigations. This testing is even more important if we take into account that experimental investigation of child acquisition of these terms has revealed highly contradictory results (Carey, 1978, 1982; Galeote, 1995; Richards, 1979).

A necessary element in our work is the description of dimensional terms, as well as predictions based on these descriptions, that would allow us to describe adult performance. Both aspects are fundamental to guide our empirical research.

Spatial dimensional adjectives (*big/large, high/tall, long, wide, thick, deep,* and their corresponding antonyms) have been studied from various perspectives (morphological, syntactic, semantic, linguistic processing, etc.). One of the problems was what sort of analysis should be applied to describe the meaning of the terms as they are applied to the various dimensions of the objects.

The componential semantic analysis of Bierwisch (1967) has been the most widely used in psycholinguistics. However, this analysis revealed a number of inconsistencies, which led us to reject the description of the terms made by that author. In particular, albeit complex, the description is excessively rigid with regard to the features of objects to whose dimensions adults apply these terms. This has been shown in various works by authors who have analyzed these adjectives (H. Clark, 1973; Corrales, 1977; Goede, 1989; Greimas, 1970;

Lang, 1989; Lyons, 1980; Teller, 1969). Contrary to our expectations, important differences were found among the works of these authors. Moreover, analyses describing all of the terms pertaining to this semantic field are scarce.

This made the choice of analysis difficult. However, we decided to base our study on Lyons (1980), who offered an alternative descriptive analysis which seemed fairly complete. According to Lyons (p. 631), the dimensional designation depends on the dimensionality, the orientation, and on some of the relevant characteristics of the objects (entities) or spaces. However, in spite of the importance of the relevant characteristics of the objects, some of these characteristics were not taken into account. For this reason, Lyon's description was improved by suggestions from other authors.

According to Lyons (1980), a key factor prior to dimensional designation is whether or not there are different extensions in the dimensions of the objects. If an object such as *ball* does not have a maximum dimension, no dimensional designation is possible. In such cases, general adjectives must be used, such as *big/little*, indicating global size without referring to the object's shape or dimensionality. On the other hand, if it is possible to distinguish different extensions among the dimensions, then the dimensional designation depends on the orientation of the object, space, or some other characteristic, such as its shape, consistency, etc.

Referring to the orientation of objects and spaces, Lyons (1980, p. 632) distinguishes between oriented objects and spaces (conferring primacy to vertically oriented objects), and objects or movable entities not inherently oriented toward any dimension (that is, if they are not in some unstable position). Based on this, Lyons applies the word *length* to the dimension with the greatest extension in all cases when referring to non-oriented entities and spaces. If the object is significantly extended in one of the other dimensions, then this dimension is called *width*. The designation of the third or less extended dimension depends on the characteristic of the object in question. Thus, if an object is hollow, this dimension is called *depth*. If an object is solid, this dimension is called *thickness*. Even though Lyons does not refer specifically to this, the type of objects based on the prior dimensional designation are the three-dimensional shapes of rectangular parallelograms.

With reference to objects such as *stick*, which do not present any extension differences regarding length in the rest of their dimensions, both dimensions would be joined by applying the term *thickness*. Thus, one could say that the stick is *long* and *thick*. Although Lyons (1980) makes no explicit reference to this case either, he seems to be referring to solid cylindrical objects. Moliner (1990) and Corrales (1977) state more clearly that *thickness* refers to the diameter of a solid cylindrical object, so that one can mention the thickness of a tree, a column, etc. On the other hand, there is a basic dichotomy between the solid or hollow characteristic of a cylindrical object, as in the case of *stick* and *tube*, with the same consequences for dimensional designation. As Moliner points out, the term *width* in these cases refers to the diameter or measurement of an opening, hollow, or the dimension of the circular section of a hollow cylindrical body (Corrales).

The same general criteria about shape and maximality of spaces or two-dimensional figures would be valid, according to Lyons (1980). The maximum dimension is named *length* in all cases. In the second dimension, the term *width* or *thickness* is applied, depending on the importance of this dimension. Thus, a *line* is said to be *thick* if we are only interested in a one-dimensional characteristic, whereas a *street* is given the term *width* because, in this case, this dimension is important.

The vertical dimension, referred to by the terms *tallness* and *height*, always has primacy over maximality in all cases of vertically oriented objects. Thus, this dimension is always named first, dominating the other dimensions regardless of their extension. A key factor, when assigning terms to the horizontal dimensions of three-dimensional parallelogram-shaped objects, is whether the object has a front or not. This front could be either inherent or canonical.[1] In either case, if the object has a front, the frontal-horizontal dimension is called *width* (from side to side), whereas the lateral-horizontal dimension (front to back) is called *thickness* or *depth*. If the object does not have a front, the largest dimension is called *length* and the smallest dimension, *width*. This can lead to some ambiguity, according to Lyons (1980), so that a building might be described as *long* and *wide*, or as *wide* and *deep*, depending on whether it is considered to have a front or not.

Although, based on the above description, Lyons (1980) seems to suggest an indistinct application of thickness and depth for the lateral dimension of objects with a front, the application of either term would not be random. On the

[1] According to Lyons, an inherent front means the front shown by humans, animals, and in general, all self-propelled entities and not merely movable ones (Lyons, 1980,p. 632). Two factors come into play concerning the determination of the canonical front: the notion of facing or canonical perspective and the direction of motion. The notion of canonical perspective has to do with the face-to-face position of the speaker and the listener, a short distance from one another when a conversation or some other type of interaction is begun. From the canonical perspective, the front of a house would be the part or extremity which is usually faced, such as the front of a piano, a desk, or a wardrobe. Finally, in the case of the majority of the self-propelled entities such as trains, cars and ships, the criterion seems to be the direction of motion and not the notion of facing which allows the identification of the canonical front (Lyons, 1980, p. 633). Nevertheless, as can be seen, Lyons' formulation is ambiguous with regard to the inherent or canonical character of the frontal part of self-propelled entities.

contrary, the distinction between solid and hollow objects, established by Lyons himself for three-dimensional non-oriented objects with a rectangular parallelogram shape, could be the key to the differential application of these terms. The term *thickness* would be used in the first case, and *depth* in the second. A basic criterion is that an object must always have an inner space in order to apply *depth*.

There are a few distinctions which coincide with the those made for the case of non-oriented objects and spaces within the category of vertically-oriented objects, and which were not taken into consideration by Lyons (1980). Thus, the vertical dimension is always *height* for three-dimensional cylindrical objects. The terms used for the rest of the dimensions depend on whether the object is solid or hollow. *Thickness* is used in the first case, and *width* in the second. In two-dimensional vertically oriented objects, such as *pictures*, the word *width* refers to the horizontal dimension (Moliner, 1990), as these objects are considered to have a front.

In short, there is a definite categorization of physical objects underlying the above description, based on their orientation, dimensionality, and other inherent characteristics. More specifically, the following taxonomy can be established to help clarify this description, keeping in mind all the characteristics and factors which seem to be of key importance in dimensional designation (one-dimensional entities where the term *long* would be used, such as in *line*, have been excluded):

a. Orientation: vertical and non-orientation.

b. Dimensions: only two- and three-dimensional objects.

c. Shape: cylindrical and rectangular parallelogram for three-dimensional objects, and rectangular for two-dimensional objects.

d. Consistency: solid and hollow.

e. Frontality: with a front and without a front.

There were some general restrictions in this work: (1) the more general size terms (*big-small*) were not examined because of the lack of specificity in their application to a particular dimension; (2) only hard and undeformable objects with variations in all their dimensions were taken into account; and (3) only the reference to the different object dimensions of these terms, specified by their nominal use, was taken into account. As a result, the terms that were tested for dimensional knowledge by adult subjects were (English terms in brackets): *altura-alto* (height-high/tallness-tall), *longitud-largo* (length-long), *anchura-ancho* (width-wide), *grosor-grueso* (thickness-thick), and *profundidad-profundo-fondo* (depth-deep-bottom or back).

Taking into account that our main goal is the examination of adult linguistic performance related to the above description, we predict that adults will name the dimensions of the objects according to this established description. Together with this general prediction, it would be interesting to make a series of specific predictions, considering the greater or lesser complexity of terms according to their description. This would be particularly useful to predict possible errors adults might make, contrary to their assumed competence. However, this revealed another problem, as the authors on whose work we based our description offered no indications in this regard. Nevertheless, we decided to make some predictions based on the following criteria: (1) *restrictions in the usage of terms*, meaning the conditions the terms must comply with in order to be applied, according to Bierwisch (1967), H. Clark (1973), and H. Clark and E.V. Clark (1977). Thus, as H. Clark (1973) pointed out, whereas the use of the term *wide* presupposes the previous application of the term *long*, referring to the object's longest dimension or greatest extension, *wide* is more complex than *long* because *wide* requires more conditions to be met before it can be used. (2) *The inherent ambiguity of some of the terms*, as we have been able to verify in their description when applied to different dimensions of the objects, depending on their characteristics. And (3) *the perceptual prominence of the dimensions* to which the terms are applied, prominence meaning the greater or lesser degree of extension or, as Lyons (1980) states, their maximality, with the exception of verticality that always has primacy with priority over maximality. When referring to objects with a front, the front would show the greatest perceptive prominence. However, care should be taken with these criteria, and they should be considered only as guidelines.

If these criteria were applied to our terms, *height* and *length* would probably be considered the least complex. Both these terms seem to have few restrictions of use and therefore the objects' characteristics would have little effect on their application. Thus, *height* would always be applied to the vertical dimension, regardless of its extension, and *length* would be applied to the maximum non-vertical dimension

Other perceptual criteria can be added to the linguistic ones. Thus, verticality holds a prominent place in a number of tasks and ages, as numerous studies have shown (Bomba, 1984; Bornstein, 1982, 1988; H. Clark & E.V. Clark, 1977; Essock, 1980; Hayes & Watson, 1981). A similar status is granted by H. Clark and E.V. Clark, Corrales (1977), and Lang (1989) to the horizontal dimension, expressed as *length*, in relation to other horizontal dimensions. In spite of this, the participants could have more difficulty when applying *length* because of the ambiguity factor mentioned by Lyons (1980) with regard to objects with a front.

The rest of the terms (*width*, *thickness*, and *depth*) seem more difficult, as their use has been mainly confined to secondary and tertiary (smaller) dimensions, probably less perceptually salient than the dimensions where the terms *height* and *length* are applied (verticality and maximality of the non-vertical axis). They also present greater use restrictions, as they are only used after the terms *height* and *length* have been applied. Furthermore, various characteristics of the objects have to be taken into account in their application, such as whether they have a front or not, their consistency (solid or hollow), etc.

The application of *width*, for example, depends mostly on various characteristics of the objects. The ambiguity

factor mentioned by Lyons (1980) may be added when applied to objects with a front. Furthermore, *width* has greater use restrictions than *height* and *length,* as it depends on them in order to be applied. Because of this, we consider *width* more complex than the above mentioned terms.

The term *deep* has greater use restrictions because the term *width* is applied before. In addition, *deep* could be just as ambiguous as *width* when applied to objects with a front. Finally, *deep* has been relegated to a tertiary dimension, related to volume (H. Clark, 1973), being of less extension in most cases. Because of this, this term could also be considered more complex.

Lastly, even though the use of *thickness* is invariably relegated to dimensions of lesser extension or to tertiary dimensions related to volume, with greater use restrictions, the exclusive application of *thickness* to solid objects could reduce ambiguity, making it less complex. However, the application of *thickness* to cylindrical objects, where the hollow/solid nature has to be taken into account, could lead to some difficulty. This can also apply to *width*, with regard to its use for this type of object. In short, we believe that *thickness* could be considered less complex than *deep* and more so than *width.*

In relation to the above, we have formulated the following working hypotheses:

1. As knowledge of these terms will be examined in presumably competent adults, there will be no errors.

2. If, contrary to the above prediction, the subjects commit errors, the rate of error will be adjusted to the established predicted complexity of terms, i.e.: height < length < width < thickness < depth.

Along with the number of errors, within- and between-subject consistency in the answers was analyzed in order to verify possible irregularities in naming the different object dimensions. The examination of these consistencies is important because it will allow us to verify whether the subject's errors are totally random or whether, on the contrary, they follow some characteristic pattern.

Method

Participants

The participants in the study were 20 adult subjects (13 women and 7 men), from an average medium-low socioeconomic level. All the participants had at least primary education. They were between 28 and 40 years old, with an average age of about 32.

Materials

The material used in the experiment (see Figure 1 and Appendix A) consisted of photographs or pictures of everyday objects. As can be seen in Figure 1, these objects were chosen taking into account the key factors for their dimensional naming (that is, for applying the dimensional adjectives: orientation, dimensionality, shape, etc.) according to previous descriptions. In all cases, the three-dimensional objects were shown in perspective in order to show all their dimensions. Although, at first, we had included more objects in each category than indicated in Figure 1, we decided to eliminate some of them to avoid subjects' saturation and tiring. However, we included more objects in the categories which we thought could present a higher degree of ambiguity, according to the descriptive analysis of Lyons (1980), such as objects with a front. In addition, the objects with a front varied in two ways. On the one hand, different ratios between their dimensions varied, so that the horizontal-frontal dimension presented different extensions. On the other hand, in some of these (e.g., wardrobes and buildings), the perspective was altered (that is, they were presented more or less facing the subject), in order to determine a possible influence of this factor when applying dimensional terms. Finally, no terms relating to non-oriented rectangular-parallelogram-shaped objects with interior hollow spaces were examined because of the difficulty of clearly showing the horizontal dimension on the bottom.

Procedure

An important aspect in this study was to decide upon an appropriate experimental procedure. In fact, one of the most difficult problems in linguistic production testing is eliciting the appropriate terms. This is because of the subject's tendency to use general terms. This is more problematic in our case because the general terms concerning size, *big-small,* usually act as supraordinates of the rest. To ask the participants to simply name the dimensions of a series of objects that were going to be presented to them could be insufficient, because many of them might omit some of the dimensions. This is especially true in the case of some of the three-dimensional objects, where the third dimension could be considered less salient in the terms established for this work.

One way to avoid these difficulties would be to ask the participants to specify, by subjective guess, the measurements of every dimension of the objects presented; this procedure would allow the specification-designation of the dimensions to be made naturally.

Adopting this procedure, the instructions were: "We are going to show you a series of photographs and drawings of objects that we normally see and use everyday. What you have to do is tell us what are the measurements of each of the dimensions. In other words, you should estimate their measurements. For example: let's imagine a rug in the living-room. Of course it's big, but what are its specific measurements? You have to do the same thing with the

OBJECT CHARACTERISTICS				
dimensions	shape	consistency	front	
	Non-Oriented Objects			*Objects*
three dimensions	Parallelogram	solid	0	wooden block-1
	Cylindrical	solid	0	pencil
		hollow	0	tube
two dimensions	Rectangular	0	0	road
	Vertical-Oriented Objects			
three dimensions	Parellelogram	solid	yes	door
		hollow	yes	building-1 and -2, wardrobe-1, -2, and -3, chiffonier, sofa, bus, and *truck*
		0	no	wooden block-2 and table
	Cylindrical	solid	0	palm tree
		hollow	0	glass
two dimensions	Rectangular	0	0	picture-1 and -2

Figure 1. Objects used in the experiment, indicating their category. The cells with a 0 indicate that the characteristic is not affected by the object in question or that the dimension is not pertinent to that object.

objects we're going to show you. Do you understand? Let's begin". In case of doubt, we would go back and repeat the example encouraging the subject to name each of the dimensions of the rug. All of the subjects understood the task perfectly.

The test took place in a quiet area in each one of the participants' homes. All the objects were shown in random order during 2 sessions, with a 2-week interval to avoid fatigue and so that the answers of the first session would not interfere with subsequent answers. All the named dimensions were noted, as well as their order. Participants were asked to point to each of the dimensions they were naming, so the tester would be sure which dimension the participant was referring to.

Scoring

The dependent variable chosen for this study was the number of errors committed by the adult subjects. The failure to produce a predicted term for a specific dimension (for example, the use of *long* instead of *tall* for the vertical dimension) was considered an error. In addition, the production of the following terms was also considered an error: (1) terms which cannot be metrically quantified (such as *fat*, *skinny*, etc.), because metric quantification is a principal criterion so a spatial term can be considered dimensional; (2) those terms requiring notions of area or volume (*square*, *capacity*, etc.); and (3) the elicitation of negative terms about each dimension, as these do not allow nominal use (for example, it is anomalous to say a rug is 50 cms short).

Results

Global Analysis of Errors Made by Subjects

In agreement with the specified criteria and contrary to our predictions, the adult participants showed a high rate of error (25.12% of the possible responses - see Table 1), which was statistically highly significant, $Z'_k = 16.581$, $p < .001$. Most of these errors were due to the failure to produce the predicted term for each dimension (86.41%). The rest of the errors (13.59%) were distributed as follows: 10.68% consisted of terms that could not be metrically quantified; 0.97% consisted of terms requiring notions of area or volume; and 1.94% consisted of the elicitation of negative terms about each dimension. A special case was created by omissions produced by the participant's consistently responding *I don't know* (1.34%). In order to be consistent with what might be qualified as unforeseen answers with adult subjects, these omissions were considered errors. Finally, the objects *bus*,

building-2, and *wardrobe-2* and *-3* were not included in the data analysis because their response pattern was practically identical to the objects *truck*, *building-1*, and *wardrobe-1*. As can be seen in Table 1, these errors were not randomly distributed. On the contrary, they tended to depend on the different complexities predicted for the terms.

Order of Complexity

Generally considering the terms, regardless of the objects to which they are applied, the rate of error more or less coincided with the predicted complexity (see Table 1). Thus, the term *height* was statistically different from the terms *length* ($Z'_k = -2.931$, $p < 0.001$), *width* ($Z'_k = -6.645$, $p < 0.001$), *thickness* ($Z'_k = -6.748$, $p < 0.001$), and *depth* ($Z'_k = -11.191$, $p < 0.001$). *Length* was also significantly different from *width* ($Z'_k = -2.772$, $p < 0.002$), *thickness* ($Z'_k = -3.312$, $p < 0.001$), and *depth* ($Z'_k = -7.069$, $p < 0.001$). Also, significant differences between the terms *width* and *depth* were revealed ($Z'_k = -5.860$, $p < 0.001$), although the former term was not significantly different from the term *thickness* ($Z'_k = -1.254$, $p < .1050$). Finally, *thickness* and *depth* were significantly different ($Z'_k = -3.434$, $p < 0.001$). In short, based on the above results, the order of difficulty found was as follows: *height* < *length* < *width* = *thickness* < *depth*.

The only result that did not comply with our predictions involves the term *thickness*. It seems less complex than we had thought. A possible explanation of this could be the exclusive application of this term to solid objects, causing greater consistency in the subjects' answers.

Dimensional Terms and Kinds of Objects

The result was similar when the various kinds of objects were considered overall (see Table 1). For example, this effect was more pronounced in the case of three-dimensional rectangular-parallelogram-shaped objects (*block-1, block-2, table, building-1, wardrobe-1, chiffonier, sofa, truck,* and *door:* more specifically, 28.15% of errors for this kind of object, vs. 19.29% for the rest). Finally, some objects, such as *road*, *glass*, etc. produced almost no errors. However, these general results require new specifications, because of the different rate of errors of dimensional terms according to the type of objects to which they are applied. Therefore, each term will be analyzed in detail below.

As seen in Table 1, the term *height* presented no difficulty, as the participants hardly ever committed errors. Most of the errors appeared in just two objects, *palm tree* and *picture-1*. In both cases, the errors seemed to be because of the participants' slight preference for the term *long* for

Table 1
Number of Errors Made by Adult Subjects on Various Experimental Objects in each Dimension

	Terms					
Objects	Height	Lenght	Width	Thickness	Depth	Total
Block-1	—	3	3	5	—	11
Block-2	0	11	11	—	—	22
Table	0	5	5	—	—	10
Building-1	0	—	10	—	13	23
Wardrobe-1	0	—	8	—	8	16
Chiffonier	2	—	4	—	8	14
Sofa	0	—	15	—	14	29
Truck	0	—	0	—	19	19
Door	0	—	3	5	—	8
Palm tree	6	—	—	10	—	16
Glass	0	—	4	—	—	4
Pencil	—	0	—	9	—	9
Tube	—	0	12	—	—	12
Picture-1	5	—	0	—	—	5
Picture-2	2	—	5	—	—	7
Road	—	0	1	—	—	1
Total errors	15	19	81	29	62	206
%	6.25	15.83	28.93	36.25	62.00	25.12

Note. The number of subjects who committed a certain type of error appears in each cell. The global percentages of errors were obtained by dividing the total number of errors by the total number of possible responses, taking into account that there are 20 observations in each cell.

the vertical dimension (10 out of 11 errors involved this term). In these objects, the vertical dimension, had one of the highest verticality-horizontality ratios of all the objects. The rest of the errors made with this term are similar, even though the ratio between dimensions is smaller with the objects *chiffonier* and *picture-2*.

Length led to a greater number of errors. However, most of these errors occurred in rectangular-parallelogram-shaped objects, mainly in *block-2* (see Table 1). This seemed to be because of a preference for the use of *wide* for this dimension, reserving the term *long* for a maximum dimension. These errors could indicate that the participants may have considered this object as having a front because of the probable ambiguity of this term (according to Lyons, 1980). This could also explain the errors made by the subjects with the term *table*, where this dimension (frontal-horizontal) had the greatest extension in relation to the others.

Considering the term *width*, the rate of error differed for different objects. This effect was greater in rectangular-parallelogram-shaped objects, although *tube* and *picture-2* also showed a large number of errors (12 and 5, respectively). One explanation for the high error-rate in rectangular-parallelogram-shaped objects is, again, the participants' preference for the use of the term *long* for the most extended dimension of horizontal dimensions, particularly if it is more extended than the vertical dimension. This effect was clearly seen in the object *sofa* (15 errors), where this dimension (frontal-horizontal) was really the most extended. For the same reason, but in the opposite direction, *chiffonier* led to very few errors in the application of *width*, as the maximum horizontal dimension was much smaller than the vertical dimension. Finally, the similarity in size of these two dimensions in *building* and *wardrobe* caused participants to divide their answers between *long* and *wide* (see Table 2). The errors occurring in *picture-2* follow the same pattern. The opposite occurred in *picture-1*, where the horizontal dimension is clearly inferior in extension to the vertical one, and the term *wide* was applied without hesitation (0% error). The only object that does not fit this description is *tube*. A source of error could presumably be the difficulty of its hollow/ solid nature, which has to be taken into account when applying the term. In fact, a large proportion of the errors made by the participants consisted in the use of the terms *thick* and *fat*, more appropriately applied to solid cylindrical objects, as well as in the use of the term *diameter*, regardless of the solid or hollow characteristic of this type of object.

The rate of error was, again, different, depending on the type of objects to which the term *thickness* was applied. Thus, in the objects *door* and *block-1*, errors were scarce and, moreover, the term was applied very consistently. A possible explanation could be the size ratio of this dimension in relation to the rest, so that its tertiary status was very clear. There were greater difficulties when this term was applied to cylindrical solid objects. An important proportion of the errors was because of the use of *wide*, which, in this case, seems to support our idea about the hollow/solid nature of these cylindrical objects, and which could cause some ambiguity. This coincided with our statements about the application of *width* to hollow cylindrical-shaped objects

Finally, the term *deep* revealed a high error-rate in all objects where it was examined. In most cases, this error was because of the participants' confusion about which term was appropriate for this dimension. This became even clearer in objects where the word *wide* had previously been applied (*building*, *wardrobe*, and *chiffonier*). On the other hand, in the case of *sofa*, where participants showed a preference for the term *long* when referring to the most extended horizontal dimension, errors were due to the use of *wide* instead of *deep* for the lesser-extended horizontal dimension. Yet another sign of the participants' preference for the term *length* applied to the object's most extended dimension, was clearly seen from the use of this term (19 cases) instead of *deep* for the *truck*, contrary to Lyons' (1980) predictions. However, this could have another explanation, according to the criterion mentioned by Lyons for the determination of the frontal part in these types of objects. The key factor in the assignation of *width* to the front of self-propelled vehicles, such as trains, ships, etc. was the direction of motion. This could be caused by a special consideration for these types of objects, and more so when taking into account that the horizontal-lateral dimension is usually the most extended.

Strategies Followed in Naming Dimensions

The analysis of the strategies employed by participants offers a clearer explanation than the above results. Two

Table 2
The Number of Times that the Terms "Wide" and "Long" were Used to Describe the Horizontal-Frontal Dimensions of the Indicated Objects

	Objects			
Term	Building-1	Wardrobe-1	Sofa	Chiffonier
Long	9	8	15	4
Wide	10	12	5	16

different systems appear in the naming of the objects' dimensions. The first is based on quantification (lesser or greater extension of the dimensions), and the second, on the frontality of the objects with regard to the participants' normal interaction with them. However, on examining the strategies used by the participants, this basic difference is slightly modified, with subsequent effects on the order in which terms are produced, especially in the case of parallelograms with a front, where the two systems clash most frequently. For this reason, we will focus the analysis of strategies used with these objects.

Basically, we were able to identify two strategies employed by subjects regarding these objects. In the first one, some subjects named the horizontal-frontal dimension of the objects' *length*, applying the term *wide* to the horizontal-lateral dimension. In the second strategy, they named the horizontal-frontal dimension *width*, coinciding with Lyons' (1980) predictions. However, they were confused about the third dimension, and a high between-subject inconsistency was observed (some participants hesitated, and even said, "I don't know"). However, few participants maintained these strategies throughout the test. On the contrary, the number of subjects who adopted these strategies varied with different objects, depending on the various size-ratios of their dimensions (see Figure 2). So, if the horizontal-frontal dimension was prominent because of its extension, there was a tendency to apply the less complex term *long*, reserving the use of *wide* for the smallest dimension. If the horizontal-frontal dimension was not prominent, the subjects preferred to apply the more complex term *wide*, which created greater difficulties about which term to use for the horizontal-lateral dimension. Subsequently, there was a preference for applying *long* to a large-sized dimension, within the general strategy in which quantification predominated. This would explain the error pattern mentioned above for the terms *wide* and *deep*. However, the strategy of naming the frontal part of objects *wide*, regardless of their size, should not be ignored. Moreover, the strategy even included other objects without a front, such as *table* and *block-2*, as was seen in the analysis of errors made with the term *long*.

As for the rest of the objects, we also found a wide variety of strategies. Nevertheless, in some objects (*truck*, *road*, and *glass*) there was high consistency in the strategies followed by the participants (see Appendix B for a more detailed analysis).

To sum up, the analysis of the strategies followed by the participants clarifies the above results based on their errors, as well as revealing how complex dimensional designation is.

Within-Subject Consistency

A final aspect that was taken into account was the within-subject consistency. We examined the degree to which the participants maintained the same name for the dimensions of the objects belonging to the same class. This consistency could be assessed in those cases in which different examples of the same object (*pictures*, *wardrobes*, *buildings*, and *vehicles*), or different objects from the same category (*block-2-table* and *building-wardrobe-sofa-chiffonier-door-vehicle*) were shown. In the first case, except for *picture-1* and *picture-2*, participants were highly consistent (in fact, this was one of the reasons why these objects were eliminated from the data analyses carried out). Specifically, 19 participants were consistent in their answers to the dimensions of the objects *bus-truck*, 16 to *buildings*, and 15 to *wardrobes* (see Appendix B). This result is important because it indicates that the ratio between dimensions is predominant. In fact, these ratios were practically identical in all the objects (except for *picture*), so that the only thing that varied was their orientation in relation to the subject (more or less facing the subject). In spite of the fact that the presentation of different perspectives of the object didn't seem to be a determining factor - contrary to what Greimas (1970) stated regarding French, where the application of *long* and *wide* depends on the perspective from which the subject observes the object - nevertheless, some participants looked for a perspective from which to observe the object ("from where should I look at it?"), although this aspect requires fresh research.

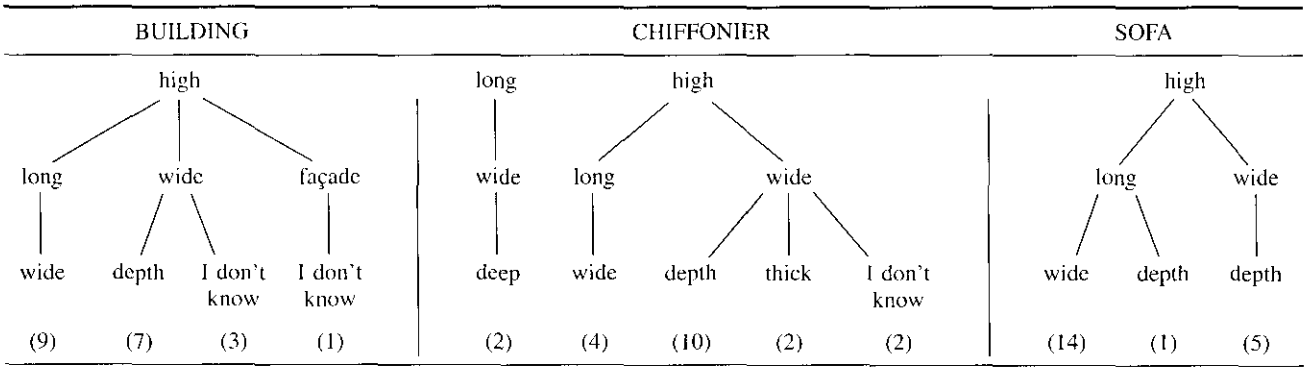

Figure 2. Strategies the participants followed when naming the dimensions of the indicated objects (number of subjects in brackets).

On the other hand, wherever these ratios were not maintained (as was the case with *picture*), greater inconsistency was observed. This can be explained by the participants' preference for the use of *long* for the objects' largest, usually horizontal dimension, especially when its extension is greater than the other dimensions. This same factor would explain the large number of inconsistencies observed with all the objects having a front. Thus, when taking all these objects into consideration, only one participant was consistent in all his answers to the dimension of the different objects (*door* was excluded because its horizontal-lateral dimension would be named *thick* due to its solid consistency and this distinguishes it from the rest of the objects, where it would be named *deep*). Similarly, only 6 participants were consistent in their answers, after eliminating *truck* (because of its special status as indicated earlier in the analysis concerning the term *deep*). A similar effect was found with *table* and *block-2*, even though the participants were somewhat more consistent in their answers (11 participants).

Discussion

As revealed from our above results, the adult participants in our study - supposedly linguistically competent - made mistakes, significantly varying their strategies of naming dimensions from one case to another, and showing a good number of inconsistencies between them. In fact, many adults who participated in the experiments said that the task "wasn't as easy as they had first thought", and were confused in many cases (having to ponder, doubting, etc.). The data about their inconsistencies indicate, in addition, that even if we had applied a different descriptive system from the available ones, the results would have been similar. This lends itself to at lest two interpretations: (1) the description of the dimensional terms does not capture all the regularities regarding the use of these terms in adult language, or (2) perhaps our subjects were not linguistically competent adults.

There are some indications that support the first interpretation, taking into account the possible theoretical nature of these semantic descriptions. Along these lines, Carey's (1982) statements about the componential analysis of Bierwisch (1967) can be considered. As Berndt and Caramazza (1978) also point out, in reference to componential analysis, the semantic components underlying a lexical item, if they actually exist, have probably not been captured in their entirety. Thus, our data suggest that, at least in the semantic description of these terms, something more is required than just the quantification or extension of a particular dimension, or the subject's assigning a frontal part to objects. Therefore, in a semantic description like this, perhaps other factors should also be taken into account, such as those relating to the global characteristics of the objects, the dominant relationships of certain dimensions, the subject's interaction with them, their functionality, etc. Although new research is needed, this coincides with the levels of semantic description pointed out by Aurnague, Borillo, and Vieu (1991) - geometric, functional, and pragmatic - for other spatial terms (specifically *dans* and *sur*). Nevertheless, these levels present new frames of reference in the semantic analysis, where various sociocultural aspects of the interaction of humans with their environment, which have not been taken into account in the traditional description of dimensional terms, should be considered here. These aspects could have different implications in the processing of these terms, as well as in their acquisition.

Regarding the second interpretation, similar results were obtained in the pilot task carried out prior to this investigation, in which additional participants from different sociocultural status were studied. However, this present study must not be considered final. Indeed, new studies must be completed, increasing the number of participants, as well as the number of objects, and varying the different inter-dimension ratios, together with their orientation on the three spatial axes, etc., in a more deliberate fashion than was considered here.

However, whatever the explanation may be, our results are important and support Abkarian's (1982) statements. So, while recognizing the importance of stating a theory to understand the interrelationships between the linguistic elements and psychological structures and processes, it is nevertheless necessary to test empirically the purely theoretical intuitions of linguists. This is especially important when evaluating those responses of subjects who supposedly do not master the adult's normal semantic system, as is the case with children. In this sense, the methodological implications are obvious.

A final aspect to consider are the possible implications of our investigation relating to important topics for developmental psychology and cognitive psychology, such as the structure of meaning and concepts, as well as their origin. Although we advise caution, our results are highly significant. As a large part of research on the acquisition of these terms has shown (see Carey 1978, 1982; Galeote, 1995; and Richards, 1979, for an extensive review), children also have greater difficulties in the same cases we have identified in adults. More specifically, the adjectives corresponding to the dimensions of *width* and *thickness* (*wide-narrow* and *thick-thin*) are those which children require more time to acquire. Even though this analysis cannot be extended to the corresponding adjectives of the *depth* dimension, because no experimental data are available, the results are nonetheless surprising. In various studies where these terms were examined (Bartlett, 1976; Donaldson & Wales, 1970; Eilers, Oller & Ellington, 1974), there is no indication that children made more errors with some objects used in the test than with others, or that they made the same errors. As a consequence, comparisons cannot be made with the findings of our study with adult subjects, where the different characteristics of the objects were taken into account. In any

case, our data suggest that this aspect should be considered in studies examining the acquisition of these terms in children. Similarly, our data could have implications regarding the theory proposed by Carey (1978, 1982) about the acquisition process of these adjectives. Thus, as Carey suggests, children acquire the meaning of these terms in an idiosyncratic way, depending on their accidental encounters with the word in the presence of specific objects. However, adults probably supply the learning cues, depending on the objects to which the dimensions are applied, as can be observed by their lack of consistency when using the terms. Thus, that process would not be as fortuitous and hazardous as Carey suggests and, therefore, we could identify an intimate correspondence between adult and child language. In other words, children would not acquire these terms in an idiosyncratic, asystematic fashion, but rather they would adjust to the language they were hearing.

This correspondence, if it exists, could be highly revealing, suggesting an influence on the environmental linguistic input or, more specifically, the model that adults offer to children, which is one of the variables that could explain the regularities of this process (Huttenlocher et al., 1983). Numerous authors from various fields also point out certain effects of the linguistic input directed at children during their linguistic and conceptual development (Anglin, 1977; Blewitt, 1983; Callanam, 1985, 1990; Shipley, Kuhn, & Madden, 1983). In spite of this, because both children and adults seem to have difficulty with the same type of terms, our results could also suggest identical forms of treating and categorizing the world. The degree to which learning these words is restricted by the influence of the linguistic environment, or by the innate processes of the organism, requires new research.

Indeed, before making such assumptions, more data is necessary, and not only data such as that presented here. Researchers should examine the way adults name these terms in the presence of children, together with child linguistic performance, identifying possible regularities and correspondences. These aims are part of our larger research project. Thus, the work presented here should be taken as just one step within a general research strategy, in an attempt to overcome some of the limitations of previous studies.

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