Conceptual information on objects' locations

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Abstract

According to traditional views, basic and subordinate concepts elicit perceptual information, superordinate concepts abstract information. Two experiments showed that also superordinate concepts activate perceptual and contextual information. In Experiment 1 participants evaluated the adequacy of Scene- and Object-like locations ascribed to basic and superordinate concepts. Superordinate concepts were judged faster when paired with Scene-like locations, where many exemplars can coexist, than with Object-like locations. The results were replicated and extended in the second experiment with a location production task. Theoretical accounts for the results are discussed.

Key words: categorization – concepts - scenes – conceptual organization – hierarchical level – embodied cognition – situated cognition –

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INTRODUCTION

Literature on categorization shows that special attention has been paid to the hierarchical structure of conceptual knowledge organization. Traditionally, it has been assumed that the hierarchical relations linking superordinate level concepts, e.g. ‘animal’, to basic level concepts, e.g. ‘dog’, and these last to subordinate level concepts, e.g. ‘hound’, allow storing general information, e.g. ‘it is a living being’, only at the upper level. Specific information, e.g. respectively, ‘it barks’ and ‘it chases’, being stored only at the lower levels. Moreover, subordinate level concepts convey information concerning the superficial properties of the objects they refer to, such as texture and color. Basic level concepts convey information on the parts and components of objects (Biederman, 1987; Tversky & Hemenway, 1984). Superordinate level concepts convey both functional information (Tversky & Hemenway,1984; Tversky, 1989) and general knowledge (Barsalou, 1991) about the objects they refer to. Both basic and subordinate level concepts, such as ‘dog’ and ‘hound’, refer to concrete entities, i.e. entities that can be perceived through the senses and mentally represented in a single image. Instead, superordinate level concepts, such as ‘animal’, refer to sets the entities of which can greatly differ in shape, like a butterfly and a lion, and cannot be mentally represented in a single image.

Thus, in this view there is a sharp distinction between superordinate level concepts that yield functional and abstract information and both basic and subordinate level concepts that yield perceptual information (Tversky & Hemenway, 1984; Tversky, 1989). Moreover, a special status has been granted to basic level concepts (Jolicoeur, Gluck, & Kosslyn, 1984; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). In fact, basic level concepts are referred to by the terms that adults use most often and children acquire first (Rosch & al., 1976; Anglin, 1977; Mervis & Crisafi, 1982). There is also evidence in support of the so-called “basic level effect”. According to this effect, objects’ pictures are categorized and verified faster when they represent basic, e.g. a saxophone, rather than superordinate level concepts, e.g. several musical instruments together such as a

saxophone, a violin, a piano, a guitar (Jolicoeur, Gluck & Kosslyn, 1984; Murphy & Wisniewsky, 1989). This has also been found in artificial categories categorization tasks, in which familiarity, length and word frequency are controlled (Murphy & Smith, 1982).

Recently, however, a different view of concepts has been advanced according to which concepts convey perceptual information independently of their hierarchical level (Barsalou, 1993; 1999; Barsalou, Simmons, Barbey, & Wilson, 2003; Glenberg, 1997; Goldstone & Barsalou, 1998). Thus, Smith & Heise (1992) and Jones & Smith (1998) have shown that perceptual information helps to distinguish between different kinds of superordinate level concepts as both textural information and information concerning movement, i.e. biological vs. not-biological movement, characterize very general superordinate concepts such as 'artifacts' and 'natural kind' concepts.

Convergent with this more articulated view of conceptual knowledge is evidence on the 'instantiation principle' (Heit & Barsalou, 1996, De Wilde, Vanoverberghe, Storms, & De Boeck, 2003) according to which, when a superordinate level concept is activated, information on its exemplars is activated as well. Studying artificial categories, in a picture categorization task Murphy and Smith (1982) have found that superordinate level concepts are responded to more slowly than basic level concepts because their activation also triggers the activation of several exemplars of the category characterized by perceptual information. This finding has been replicated in natural categories as well. In a property generation task, superordinate level concepts elicited the exemplars of the category more frequently than lower level concepts (Borghi & Caramelli, 2003).

As objects are usually perceived not as isolated entities, but as occurring within spatial contexts, perceptual information on the objects referred to by concepts should encompass information on their locations also. The role of locations in object identification has been widely studied in literature on how objects are perceived within scenes (Mathis, 2002). It has been shown that people do not identify isolated objects, but activate contextual information as well (Biederman, 1981; Biederman, Mezzanotte & Rabinowitz, 1982). It has been questioned whether objects' identification depends on top-down information extracted from scenes or whether scenes affect

object identification quite late, after associated semantic information has already been accessed, as recent behavioral and neurophysiological evidence suggests (Ganis & Kutas, 2003; Hollingworth & Henderson, 1998). In order to test the effects of scene contexts on object identification, participants usually have to detect a target object within a briefly presented pictured scene (Biederman, 1972). After the scene has disappeared, a spatial cue hints at where participants have to look for the target. When semantic or physical violations occurred in the scene, the detection of the target object is impaired as it requires more time than when there was no violation.

An interesting variation of this paradigm was used by Murphy & Wisniewsky in a categorization study. Murphy and Wisniewski (1989) have shown that, when pictures of objects are presented within a scene in which there are many exemplars of the category, improbable contexts affect the recognition of the exemplars of superordinate level concepts more often than those of basic level concepts. i.e. there is no 'basic level effect'. In their Experiment 4, participants were presented with a category name, either at the basic (e.g. saxophone) or at the superordinate level (e.g. musical instrument). The name was followed by a picture of a scene which the depicted objects could either fit in, e.g. a stage, or not, e.g. a camping site. Afterwards, a dot was presented in the same position as that in which there was an object in the scene and participants had to judge whether the cued object was a member of the named category or not. Murphy & Wisniewsky found that inappropriate scenes affected participants' performance more often when the name referred to superordinate level concepts than when it referred to basic level concepts. The authors explained this result by arguing that superordinate level concepts activate relational information as to where their exemplars can be found, i.e. information referring to the scenes that link the exemplars together. Even if they acknowledged that 'scenes relations' are not properly 'part of' an object concept, they referred to Biederman et al.'s (1982) findings that scene perception occurs in parallel with object recognition and that semantic relations affect object identification.

While the mentioned literature deals with object identification, the present research aims at testing whether information about objects' locations is elicited by concept nouns, i.e. when

participants are presented with concept nouns referring to objects and locations instead of their pictures. In other words, the hypothesis to be checked for in this research is whether concept nouns referring to objects elicit perceptual information on their locations (Borghi & Caramelli, 2003).

In fact, recent evidence on encoding processes of objects and locations suggests that words activate perceptual information, i.e. object naming elicits information not only about object identity, but also about their location (Köhler, Moscovitch & Melo, 2001). Treisman (1998) has argued that, if object naming elicits an attentional focus on the entire object, then the activated perceptual representation includes all of its perceived attributes, including its present location. In the same vein, studies on words and sentence processing have shown that words may activate perceptual information concerning objects' shape, their spatial orientation and also location. So, for example, Zwaan, Stanfield, & Yaxley (2002) have found that the sentence "The ranger saw the eagle in the sky" lead to a faster recognition of a picture of a bird with outstretched wings than that of a bird with folded wings. With an eye-tracking methodology, Chambers, Tanenhaus, Eberhard and Philip (2002) have recently found that, while following instructions such as 'Put the book inside the box`, participants focused their visual search on those objects in the array that were container-like. These studies suggest that concept nouns and sentences activate perceptual information about the objects they refer to, including visual information on their locations. If this is the case, then superordinate and basic level concept-nouns should differ in the kind of perceptual information they elicit on the locations of the objects they refer to.

EXPERIMENT 1

In order to replicate Murphy & Wisniewski's (1989) result in a location verification task with verbal materials, the hierarchical levels of concepts and the kinds of location their referents can fit in, i.e. Scene-like Vs. Object-like locations, were manipulated in the following experiment. In particular, the following hypotheses can be advanced:

1. If both basic and superordinate level concepts activate perceptual and contextual information, the well-known 'basic level effect', i.e. the advantage in processing of basic over

superordinate level concepts, should not take place. Accordingly, Murphy & Wisniewski's (1989) results should be replicated with linguistic stimuli, instead of pictures, and with a different task, i.e. with a location verification task. More specifically, in evaluating the aptness of the location of concept's referents, basic level concepts should require response times that should be either the same as or longer than those required by superordinate level concept nouns. The same trend is expected in accuracy rates as well.

2. If superordinate level concepts refer to objects that greatly differ in shape and cannot be mentally represented in a single image, i.e. the exemplars of the concept *vehicle* are cars, planes, trains etc., they should fit better in wider locations apt to contain several exemplars of the category than lower level concepts. In other words, if count superordinate level concepts activate their instantiations (Murphy & Smith, 1982; Heit & Barsalou, 1996; De Wilde, Vanoverberghe, Storms & De Boeck, 2003), then the activated locations should be wider than those activated by lower level concepts. These last, in fact, refer to exemplars belonging to only one type, i.e. the exemplars of the concept *dog* are several tokens of the same type. Thus, when prompted by superordinate level concepts, the evaluation of the locations should be faster and more accurate with Scene-like than with Object- like locations. With the term "Scene-like locations" we refer to locations where many exemplars can coexist and events can take place in, e.g. 'garden', while with the term "Object-like locations" we refer to locations where things can be located 'in' or 'on', e.g. 'box' or 'table' that are containers or supports.

Method

Materials and design

Twelve superordinate level concepts were selected. All of them were count nouns so that their exemplars were characterized by a proper class inclusion relation (Markman, 1985; Wisniewski, Imai & Casey, 1996). To each superordinate level concept, e.g. 'toy' and 'bird', one of its basic level exemplar, e.g. 'doll' and 'swallow', was added. Each of the 24 concept nouns thus obtained was paired with two adequate locations, either of the Scene-like kind (e.g. 'swallow/bird-

sky', 'doll/toy-nursery') or of the Object-like kind (e.g. 'swallow/bird-nest' or 'doll/toy-box'). In order to check for the adequacy of the distinction between the Scene- and Object- kinds of locations, an independent sample of 9 participants presented with the randomly ordered list of the locations devised was asked to evaluate whether each location was of the Scene or the Object kind. As 8 out of 9 participants distinguished the kinds of location according to the distinction made by the experimenters, all the devised locations were entered into the experimental materials.

Thus, the experimental materials consisted of 48 pairs of concept nouns the first of which was either a natural kind or an artifact concept noun at either the superordinate or the basic level. The second noun of each pair was a location noun that could be either of the Scene- or of the Object- like kind. As in Murphy & Wisniewsky's study, each location was presented twice, once paired to a basic level concept and once paired to a superordinate level concept. Thus the same locations were tested for the two hierarchical levels. All the concept and the location nouns were used in their singular form. The 48 pairs of concept nouns and locations thus prepared did not differ in length in Italian.

In order to check for familiarity of the selected locations and to verify that there were not pre-existing semantic associations between the concept nouns and their locations, two preliminary studies were carried out. In the first study, an independent sample of 12 students at the University of Bologna volunteered for their participation. They evaluated the familiarity of the concept-nouns associated with both the Scene- and the Object- like locations presented in two different random orders on a 7-point scale (1 meaning 'not familiar' and 7 'very familiar'). Participants were reminded to use all the points of the scale. The results obtained showed that the mean familiarity rating for the locations was 5.08, with Scene- and Object- like locations not differing in familiarity. In the second study, aimed at checking whether superordinate level concepts were not associated more to Scene- than to Object- like locations and basic level concepts more to Object- than to Scene- like locations, another independent sample of 17 students at the University of Bologna volunteered for their participation. They were individually presented with a list of the concept nouns

in different random orders and they had to write the first five terms that came to their mind. No mention of location was made in the instructions. In most of the cases, the selected locations were not produced among the first five terms associated to the stimuli. For the selected locations which were produced among the first five associated terms, both their frequency and the order of production (first, second, etc.) were calculated. Two Anovas, one performed on the frequencies and the other on the average production order of the locations, showed that there was no significant difference between the kinds of location and the hierarchical levels of concepts and that no interaction was significant. Accordingly, it was possible to conclude that the selected superordinate level concepts were not semantically associated to the selected Scene-like locations more than the selected basic level concepts were, and that these last were not semantically associated to the selected Object-like locations more than the selected superordinate level concepts were. Thus, the materials were suitable for the verification task.

To the 48 critical pairs, 48 new pairs were added to be used as fillers. In these pairs the first concept noun was the same as in the critical pairs, but it was associated to two inadequate locations, one of the Scene- and the other of the Object- like kind (e.g. ‘doll/toy-desert’ vs. ‘swallow/bird-saltcellar’). As in the critical trials, each inadequate location was presented twice, once paired to a basic level concept and once paired to a superordinate level concept. None of the locations in the inadequate trials was used in the adequate ones. Thus, the experimental materials amounted to a total of 96 experimental trials. The hierarchical levels of concept (superordinate vs. basic) and the kinds of location (Scene-like vs. Object-like) were manipulated within participants as two independent variables.

Participants

Thirty-two students at the University of Bologna, not involved in the preliminary studies, volunteered for the experiment.

Procedure

The experiment was run with the MEL program. Each trial began with a fixation point (a red cross) displayed for 2000 msec in the center of the screen. A timer started when each pair of nouns appeared on the screen and stopped when the participants pressed the response keys. Participants were instructed to attend to the pairs of nouns presented on the screen and to press one key if the presented location was apt to the object, and another key if it was not. They were asked to respond as quickly as possible. They were instructed to respond 'apt' only if the place was really apt to the object, not if it was just a vaguely possible location for the object: for example, a 'rose' can be located in a 'pool', but 'pool' is not an apt place for a 'rose'.

The experiment began with 16 practice trials of the same kind as that of the experiment followed by the 96 experimental trials presented in a different random order for each participant. The random orders were arranged in order to avoid repetition effects. The response key order was randomized across participants. Both response times and accuracy were recorded. The experiment lasted about 40 minutes.

Data Analysis and Results

Participants' RTs and errors were analyzed on the correct responses to the critical trials, i.e. only on pairs with the apt locations. RTs exceeding 3000 ms were removed (3% of the data). Mean error rate was 6.3 % of the critical trials. The data of one participant who made more than 10% errors was discarded.

Accuracy. A within-participants ANOVA was performed on participants' errors, the factors of which were the hierarchical levels of concepts (superordinate vs. basic), and the kinds of location (Scene- vs. Object-like). As predicted, the effect of the hierarchical levels of concepts was reliable, $F(1,30) = 14.06$; $MSe = .83$; $p < .01$. The higher number of errors made with basic ($M = 1.18$) than with superordinate level concepts ($M = 0.56$) supports the hypothesis that the 'basic level effect' did not take place (Murphy & Wisniewski, 1989). No speed-accuracy tradeoff was found.

Response times. A within-participants ANOVA was performed on participants' RTs the factors of which were the hierarchical levels of concepts (superordinate vs. basic), and the kinds of

locations (Scene- vs. Object-like). No main effect was significant. Thus, as in accuracy, the 'basic level effect' did not take place, as there was no significant difference between the processing times required by superordinate and basic level concepts. Crucially, the expected interaction between the hierarchical levels and the kinds of location was significant, $F(1, 30) = 6.84$; $MSe = 8046.98$, $p < .01$ (see Figure 1). Planned comparisons showed that superordinate level concepts were responded to significantly faster (78 ms) when paired with Scene-like rather than with Object- like locations ($p < .01$). Superordinate level concepts paired with Scene-like locations were also responded to faster than basic level concepts paired with Scene-like locations ($p < .05$). Instead, superordinate level concepts paired with Scene-like locations did not significantly differ from basic level concepts paired with Object-like locations.

Thus, according to the second hypothesis, the evaluation of the location of superordinate level concepts was facilitated when the location was of the Scene- rather than of the Object-kind, while that of basic level concepts was independent of the kinds of location. This result can be explained by the instantiation principle as only locations wider than those activated by lower level concepts can accommodate the instantiations activated by count superordinate level concepts the exemplars of which can greatly differ one from another (Murphy & Smith, 1982; Heit & Barsalou, 1996; De Wilde, Vanoverberghe, Storms & De Boeck, 2003).

Insert Figure 1 about here

Discussion

On the whole, these findings corroborate those obtained by Murphy & Wisniewski (1989) and specify them by distinguishing the kinds of location. In fact, similarly to Murphy & Wisniewski (1989), the 'basic level effect' was not found in accuracy nor in response times (for a review on basic level superiority see Lin, Murphy & Shoben, 1997). In fact, superordinate level concepts elicited fewer errors than basic level concepts and no significant difference was found in

response times between superordinate and basic level concepts (hypothesis 1). As expected (hypothesis 2), superordinate level concepts were responded to fastest when followed by Scene-like locations and slowest when followed by Object-like locations. Basic level concepts were responded to equally fast when their referents were located in either the Scene- or the Object-like locations, i.e. the evaluation of their location was independent of the kind of location.

Thus, these results show that information about the locations of the objects they refer to is more specific in superordinate than in basic level concepts. These last activate less specific information about location, as shown by the higher error rate obtained in both basic level/Scene-like pairs and basic level/Object-like pairs, possibly because they refer to objects that can fit equally well in both Scene- and Object- like locations. The objects referred to by superordinate level concepts, instead, elicit specific knowledge about the locations their referents can fit in, as shown by the error rate, which was lower in superordinate than in basic level concepts, and by their fitting better in Scene- rather than in Object- like locations.

That superordinate level concepts elicit a specific kind of location their exemplars fit in is supported by the view that they have 'plural force' and can be conceived of as ‘categories of categories’ (Callanan, Repp, McCarthy, & Latzke, 1994; MacNamara, 1982; Markman, 1985). There is also evidence that children typically refer superordinate labels to collections rather than to classes (Markman & Callanan, 1984; Markman, Horton & McLanahan, 1980) and that they understand them as hybrids between collections and classes (for a thorough review see Murphy, 2002). In many languages, superordinate level concepts are expressed by mass rather than count nouns (Markman, 1987; 1989). Moreover, Wisniewski, Imai & Casey (1996) have shown that there are two different kinds of superordinate level concepts. The first refers to sets the objects of which are characterized by proper class inclusion relations, i.e. the ‘kind of’ relation, which are linguistically expressed by count nouns such as ‘vehicles’. The second kind of superordinate level concepts, instead, refers to sets the objects of which are collections, i. e. they are characterized by

partonomic rather than taxonomic relations, which are linguistically expressed by mass nouns such as ‘furniture’.

That count superordinate level concepts elicit a specific kind of locations their exemplars can fit in can be explained by both the retrieval and the learning history of concepts theoretical frameworks. In the first, the retrieval-based one, the activation of superordinate level concepts triggers the activation of the variety of the exemplars they collect together as the instantiation principle suggests (Murphy and Smith,1982; Heit & Barsalou, 1996; De Wilde, Vanoverberghe, Storms, & De Boeck, 2003). In the second theoretical framework, based on concepts’ learning history, superordinate level concepts are learnt by children in the different contexts in which they experience them as hybrids between collections and classes (Murphy, 2002). Accordingly, the Scene-like kind of information elicited by superordinate level concepts is to be understood as a remnant of the various contexts in which their exemplars had been experienced. However, the results of the association pre-test suggest that the explanation based on concepts’ learning history might not be sufficient to explain our findings. In the free association production task performed on the experimental materials, Scene-like locations were not more strongly associated to superordinate level concepts than Object-like locations were. If the different response times required by superordinate level concepts when paired to Scene- and to Object-like locations depended only on past experience knowledge stored in memory, this difference could have emerged in the association production task as well, but it did not. Thus, if the pre-test on pre-existing associations between concept nouns and locations did not provide evidence for the interpretation based on concepts’ learning history, this cannot be ruled out.

Experiment 1 mainly addressed the replica with verbal stimuli of Murphy & Wisniewski’ s finding, i.e. the absence of the ‘basic level effect’ when location information is concerned. This replica was successful. Crucially, the results showed also a difference between basic and superordinate level concepts in eliciting information on the locations their referents can fit in. In fact, the referents of superordinate level concepts fit better in Scene- than in Object-like locations,

while no difference was found in basic level concepts. Experiment 2 was devised in order to better clarify with a production task which kind of information about objects' locations is conveyed by concept nouns at the different hierarchical levels.

EXPERIMENT 2

In Experiment 1 a difference was found between superodinate and basic level concepts in a location verification task. While the former were verified faster and more accurately in Scene- than in Object- like locations, the kinds of location did not differ in the latter. Experiment 2 consisted of a location production task. In fact, production tasks highlight both the stable and the variable dimensions of conceptual knowledge, which in the present research concerned information spontaneously elicited by concept nouns about the possible locations of the objects they refer to. In order to better assess whether each hierarchical level of concepts elicit a specific kind of information about the locations the objects they refer to can fit in, in the present study concepts at the subordinate level were also added.

Thus, in Experiment 2, participants had to produce possible locations for concept-nouns at the three hierarchical levels, i.e. superordinate, basic and subordinate levels. While in Experiment 1 the kinds of location, i. e. the Scene- and the Object- like locations, were considered relying on the distinction by Murphy & Wisniewski, in Experiment 2 also the relations linking the referred to objects to their locations were considered. In fact, literature on the cognitive semantics of space suggests three kinds of spatial relations:

(a) Ground relations, i.e. the setting where the object is located (Talmy, 1983; Landau & Jackendoff, 1993; Jackendoff & Landau, 1991), e.g. 'in the garden';

(b) Containment-Support relation, i.e. the container or support of the object, e.g. 'in the vase'/ 'on the table' (Mandler, 1992);

(c) Adherence-Continuity relation when the object is contiguous to its location, e.g. 'ring-finger' (Bowerman, 1991).

Hence, participants' productions were coded according to both the kinds of location produced, i.e. Scene- vs. Object- like locations, and the kinds of the relation between the to be located object and its location, i.e. Ground vs., Containment-Support vs. Adherence-Continuity relations.

Method

Participants

Twenty students at the University of Bologna who did not participate in any part of Experiment 1 volunteered for the experiment.

Materials

Nine concept-nouns of the artifact and natural kind were selected, each of which was presented at superordinate, basic and subordinate level as, for example, 'vehicle', 'car', 'sports car' and 'animal', 'dog', 'hound'. The 27 concept-nouns thus obtained were presented in their singular form. All the superordinate level concepts were countable nouns. In order to avoid priming effects the order of presentation was aptly randomized for each participant.

Procedure

Participants were interviewed individually. After explaining the task, the experimenter read aloud one concept-noun at a time to the participant, who was asked to say where the object referred to by the concept noun could be located. Participants could produce any location that came to their mind and no mention was made of aptness of the locations to be produced. They could produce as many places as they wanted for each concept-noun. The sessions were tape-recorded and each session lasted about 15 minutes on average.

Coding

In order to code participants' productions, the following norms were devised (see Appendix):

Number of exemplars produced. To be used when, before producing the location, the participant named a more specific object than that referred to by the concept-noun presented. For

example, when presented with the concept-noun ‘animal’, she/he first said ‘cat’ and then possible locations where cats can be found, e.g. ‘garden’.

Kinds of location. Locations were coded as:

- Scene: when the place was a scene or a setting, i. e. broad enough locations to allow actions to take place in them, e.g. ‘dog - field’;

- Object: when the place was well delimited and rather profiled, i.e. locations characterized by either clearly marked contours (Langacker, 1986; 1987; 1991) or locations embedded in wider contexts; e.g. ‘dog - kennel’.

Number of the exemplars that a location could contain. There were three cases:

- Many: when the place typically contained several exemplars of different categories, e.g. ‘food - grocery store’;

- One: when the place typically contained one or only a few exemplars belonging to different categories, e.g. ‘steak - plate’;

- Indeterminate: when the place could contain many exemplars of a category, but usually this is not the case, e.g. ‘table - house’. Due to its structural properties a house can contain many tables, but usually there are only a few of them.

Aptness of the location to the exemplars of the categories. There were two cases:

- Apt to one category: when the place was apt to exemplars belonging to only one category, e.g. ‘animal - kennel’;

- Apt to many categories: when the place was apt to exemplars belonging to many categories, e.g. ‘vehicle -road’.

The difference between the code ‘Aptness of the location’ and ‘Number of exemplars that a location could contain’ can be highlighted by an example. A ‘kennel’ usually contains many exemplars of the same category, i.e. only ‘dogs’, so it would be coded as a place containing many exemplars (code Number of exemplars: many) but apt to the exemplars of just one category (code Aptness of the location: apt to one).

Relations between the object and its location. There were three cases:

- Containment-Support relation. Following Mandler (1992), the image-schema of Containment consists of an object in a partially occluded space (e.g. flower-vase) and that of Support is an object lying on a surface (e.g. doll-shelf). Here, both Containment and Support relations were coded together.

- Ground relation. This is simply the 'setting' where the object was located. Some Ground relations, for example rooms in a house, could be considered also as a Containment-support relation. However the Ground relation differs from the Containment-support relation in these respects: (a) In Ground relation the observer, and not only the object, is inside a location from which s/he can see what is outside only through holes such as doors or windows; (b) In Ground relation the hole is not located on the top of the container but on its sides; (c) The Ground relation is characterized by its being a ground, e.g. 'hill', while in Containment-support relation the place is characterized by its function, i.e. to contain or to support something, e. g. 'vase'/ 'table'.

- Adherence relation. When the object and the place were contiguous, e.g. 'necklace - neck' (Bowerman, 1991). If the production task parallels the verification task, superordinate level concept nouns are expected to elicit more Number of exemplars, more Scene-like locations that contain Many exemplars and that are Apt to many categories, and more Ground relations than lower hierarchical level concept nouns.

Data Analysis and Results

Participants' productions were transcribed and coded according to the aforementioned norms by two independent judges, one of which was blind to the research aims. The two judges agreed on 91% of the codes and disagreements were solved after brief discussion. Both of them also agreed to omit 3,4% of the productions for the code Number of the Exemplars that a location could contain and 1,5% of the productions for the code Aptness of the location to the exemplars of categories as these cases were unclear.

Either Chi Square analyses or Correspondence Analyses were performed on the frequencies of the codes in order to assess whether their distribution depended on the different hierarchical levels of the concepts. Correspondence Analysis was performed when there were at least 6 groups of frequencies, 3 for each group of variables, necessary to define the coordinates of the points on the graph.

In Correspondence Analysis, based on the Chi Square test, the frequencies of the relations produced give rise to a broad data matrix allowing the identification of their weight and their graphical representation as points in a multidimensional space. On the graph, the geometrical proximity of the points shows the degree of their association and the similarity of their distribution (Hair, Anderson, Tatham & Black, 1992; Greenacre & Blasius, 1994).The aim of the Correspondence Analysis is to represent the rows and the columns of a two-way contingency table (profiles) as points in corresponding low-dimensional vector spaces. In order to project the observed points onto a low-dimensional subspace, it is necessary to define the Chi Square metric as the distance in the space of the profiles. In fact the distances between the points are the weighted distances (Chi Square) between the relative frequencies and not the simple Euclidean distances (Hair et al., 1992). Thus, the logic underlying the Correspondence Analysis is quite similar to that of Factor Analysis. Similarly to Factor Analysis, the first dimension explains a Total Inertia higher than that explained by the further dimensions. The maximum number of dimensions is the minimum between the number of columns minus 1 and the number of rows minus 1. In this research only the first two dimensions were selected because together they explained more than 99% of the variance. The first dimension will always be discussed because it explains most of the variance, while the second dimension will only be discussed when it explains more than 10% of the variance.

Number of locations produced with concept nouns at each hierarchical level. The total number of locations produced is 1519 out of which 36,8%, 34,5%, and 28,6% were yielded respectively by superordinate, basic, and subordinate level concepts. The Wilcoxon test for

dependent samples performed on the frequencies showed that participants produced more locations with superordinate (M = 3.18) than with subordinate level concepts (M = 2.48), Z (20) = 3.73, p < .01. As to basic level concepts (M = 3.01), they elicited more locations than subordinate level concepts, Z (20) = 3.64, p < .01, while the difference between superordinate and basic level concepts in eliciting locations only approached significance, Z (20) = 1.88, p < .06.

Kinds of location (Code Scene- and Object-like location) (see Table 1). Among the locations produced, 76% were of the Scene-like kind, 24% of the Object-like kind. This result is not surprising because it is easier to think of general rather than of well specified locations. The former contain many more objects than the latter that contain only a few objects. Chi Square analyses were performed on the number of locations of the Scene- and of the Object-like kinds elicited by concepts at the different hierarchical levels. Superordinate level concepts elicited Scene-like locations significantly more often than subordinate level concepts. These last elicited Object-like locations significantly more often than superordinate level concepts, X^2 (1) = 9.20 ; p < .01.

Insert Table 1 about here

Number of exemplars that a location could contain (Code Many, One, and Indeterminate). A Correspondence Analysis was performed the factors of which were the number of exemplars that a location could contain, i.e. Many, One, and Indeterminate, and the three hierarchical levels of concepts (see Figure 2A). On the first dimension, which explains 97% of the total variance, superordinate level concepts, characterized by locations that contain Many exemplars, differed from basic level concepts characterized by locations that contain One exemplar or for which the number of the exemplars is Indeterminate.

Insert Figure 2 about here

Aptness of the location to contain one or many categories of objects

(Code Apt to one and Apt to many). Participants produced locations apt to many categories (71.2%) much more often than locations apt to one category (28.8%) (see Table 1). Chi square analyses showed a significant effect in the pair-wise comparisons between superordinate and basic level concepts and between superordinate and subordinate level concepts. Superordinate level concepts yielded locations apt to many categories of objects more often than locations apt to one category of objects, X^2 (1) = 63.25; $p < .01$. With both basic and subordinate level concepts the production of locations apt to one category of objects outnumbered that of locations apt to many categories of objects, X^2 (1) = 82.95; $p < .01$.

Relations between the object and its location (Code Ground, Containment-Support, and Adherence). As table 1 clearly shows, the production of Ground relations (67.2%) by far exceeded that of the other relations. Basic and subordinate level concepts yielded relations more similar to each other than superordinate level concepts because they yielded more Adherence and less Ground relations than superordinate level concepts. Subordinate level concepts yielded Ground relations more often than basic level concepts. A Correspondence Analysis was performed the factors of which were the hierarchical levels of the concepts and the kinds of relation linking the object to its location. The first dimension, which explained 57% of the total variance, showed that superordinate level concepts were not characterized by the Adherence relation. The second dimension, which explained 43% of the variance, showed that basic level concepts, characterized by the Containment-support relation, differed from subordinate level concepts characterized by the Ground relation (see Figure 2B).

Discussion

These results complemented with a production task those obtained in Experiment 1 with a verification task. The different hierarchical levels of concepts conveyed different information about the possible locations, which the object they refer to can fit in as to both the kinds of locations and the relations between the to be located object and the locations produced. Moreover, they differed in

their eliciting location information as both superordinate and basic level concepts elicited more locations than subordinate level concepts.

Superordinate level concepts yielded Scene-like locations, which many exemplars can fit in and that are apt to many categories of objects. The relation between the object to be located and its location was of the Ground or the Containment-Support, but not of the Adherence kind. On intuitive grounds, one could object that Scene-like locations are produced more often with superordinate than with lower level concepts because Scene-like locations are more apt to many exemplars of the category than Object-like ones are. This intuition, however, is not grounded. In fact, Object-like locations as, for example, a shelf or a table are not less appropriate to many tokens of the concepts ‘doll’ or ‘toy’ than the Scene-like location ‘nursery’ is. Thus, the results concerning superordinate level concepts are twofold. Superordinate level concepts elicited a specific kind of locations which the objects they refer to can fit in, i.e. Scene-like locations. Moreover they activated locations apt to many categories of objects, while basic level concepts activated locations apt to only one category.

Basic level concepts yielded both Scene- and Object- like locations, where there can be only one exemplar of the category and that are apt to only one category of objects. The relation between the to be located object and its location was of the Containment-Support, but not of the Ground kind. Thus, basic level concepts yielded both the kinds of locations, i.e. the locations their exemplars can fit in were undifferentiated, when compared to the kinds of location elicited by concepts at the other hierarchical levels. In contrast, the kinds of relations between the to be located objects and their locations were differentiated, as they could be of both the Containment-Support and Adherence, but not of the Ground kind. Subordinate level concepts elicited locations of the Object-like kind, like basic level concepts did, and relations of the Ground kind, like superordinate level concepts did. Thus, it can be concluded that the asymmetry in eliciting information on locations between superordinate and basic level concepts found in the verification task was replicated in the production task.

GENERAL DISCUSSION

The results of this research replicate and extend those of Murphy & Wisniewski (1989) with verbal, instead of pictorial, materials and in both a location verification and a location production tasks, instead of in an improbable-context recognition task. In fact, Experiment 1 shows that in a location verification task superordinate level concept nouns elicited less errors than, and were responded to as fast as, basic level concepts were, i.e. no 'basic level' effect was found. The lack of the basic level effect in response times and the lower error rate in superordinate than in basic level concepts corroborate the hypothesis advanced by Murphy & Wisniewski that superordinate level concepts convey relational – and thus contextual – information better than basic level concepts. Moreover, when superordinate level concept nouns are paired with Scene-like locations, i.e. locations where many exemplars can coexist, the evaluation of the location as apt is faster than when they are paired with Object-like locations and it requires less time than that required by basic level concepts. In basic level concepts, instead, the same evaluation is independent of the kind of location, i.e. whether the location is of the Scene- or of the Object- like kind. Addressing the kinds of information spontaneously produced about location, Experiment 2 showed that concept nouns at each hierarchical level yielded a specific pattern of information about the location of the objects they refer to.

Superordinate level concepts elicited Scene-like locations, i.e. location that are suited to contain many exemplars of different categories. The relations linking exemplars and locations can be of both the Ground and the Containment-support, but never of the Adherence kind. These findings support and integrate the 'instantiation principle' (Heit & Barsalou, 1996, De Wilde et al., 2003) as well as the claim that superordinate level concepts have 'plural force', activating multiple instances at the same time (Markman, 1989; Murphy, 2002). Basic level concepts yielded generic information on the kind of location their referents can fit in, i.e. information of both the Scene- and the Object- like kind in both the verification and the production tasks. However, in the production task, basic level concepts yielded specific information on spatial relations. The relations binding the to be located basic level object to its location were of both the Containment-Support and

Adherence, but not of the Ground kind. As to subordinate level concepts, they elicited the Object-like kind of locations like basic level concepts and the Ground kind of relation between the to be located object and its location like superordinate level concepts.

The advantage of superordinate level concepts over the other hierarchical levels in eliciting information about their exemplars' locations highlighted by the reported studies can be accounted for by both the aforementioned theoretical perspectives. In fact, the category retrieval view can explain this result by assuming that, when prompted by superordinate level concept nouns, participants instantiate category exemplars. Because the exemplars can greatly differ one from another as to shape, participants activate Scene-like locations in which to embed the exemplars in a spatial relation of the Ground kind. Accordingly, superordinate level concepts are verified faster in Scene- than in Object- like locations and elicit Scene-like locations and spatial relations of the Ground kind.

In the category learning view of conceptual knowledge organization, the information concepts can elicit about the objects they refer to has to be traced back to the experiences which concepts were learnt from. In this view, conceptual information retrieval is straightforward because this kind of information is already stored in memory. As the objects belonging to the same superordinate level concepts greatly differ in types, they are experienced and learnt in locations that can accommodate all of them, i.e. Scene-like locations, and this information is stored just like their other properties. Accordingly, superordinate level concepts are verified faster when located in Scene- rather than in Object- like locations. The objects referred to by basic level concepts, instead, being tokens of the same type, are experienced in locations of both the Scene- or the Object- like kind, which are stored in memory and retrieved when the concept is activated.

Although plausible, the learning history of categories view by itself does not seem to account for some of the present results without being complemented by the instantiation view. In fact, if information about objects' location were already stored in memory, we should have found preferential association between superordinate level concepts and Scene-like locations also in the

free association task carried out in the pre-test on the experimental materials, but we did not. This suggests that superordinate level concepts' exemplars are instantiated in order to be located. Moreover, this view does not account for the asymmetry between the locations yielded by superordinate and basic level concepts in the production task. In fact, it does not explain why basic level concepts elicit proportionally more Object-like locations than superordinate level concepts, as the objects referred to by basic level concepts are experienced in Scene-like locations as well.

Overall, the evidence provided by this research does not allow for one to establish whether the instantiation or the learning history point of view can, by itself, definitively account for our results. It may be more constructive to conceive of these theories as complementing one other, rather than as being in conflict, in order to account for the present results. In fact, it may be precisely the learning history of superordinate level concepts which is responsible for the subsequent instantiation of their located exemplars at retrieval. This hybrid view nicely accommodates the present results and it is compatible with theories on conceptual organization according to which conceptual knowledge is grounded on perception, i.e. concept nouns activate perceptually driven information about size, shape, orientation and location of the objects they refer to (Borghi, 2004; Pecher, Zeelenberger & Barsalou, 2003; Setti, Caramelli, Borghi, submitted; Zwaan et al., 2002). When prompted by superordinate level concept nouns, in both verifying a location and locating the objects they refer to, the instantiated exemplars re-activate online the stored perceptual properties, particularly shape information, of the category exemplars. This can explain why superordinate level concepts, the exemplars of which greatly differ in shape, mainly elicit locations of the Scene-like kind across the tasks.

This suggests that shape information on category members is not filtered out, but it is maintained in concepts along with information on the locations in which conceptual referents are typically experienced. Future research has to deepen the role of information on locations in conceptual knowledge in order to assess whether location information is automatically retrieved or not.

References

Barsalou, L. W. (1991). Deriving categories to achieve goals. In G. H. Bower (Ed.). *The psychology of learning and motivation, vol. 27* (pp. 1-64). San Diego: Academic Press.

Barsalou, L. W. (1993). Flexibility, structure, and linguistic vagary in concepts: Manifestations of a compositional system of perceptual symbols. In A.F. Collins, S. E. Gathercole, M.A. Conway, P.E. Morris (Eds.). *Theories of memory* (pp. 29-101). Hillsdale, NJ: Erlbaum.

Barsalou, L. W. (1999). Perceptual Symbol Systems. *Behavioral and Brain Sciences, 22,* 577-609.

Barsalou, L.W., Simmons, W. K., Barbey, A.K., & Wilson, C.D. (2003). Grounding conceptual knowledge in modality-specific systems. *Trends in Cognitive Science, 7*, 84-91.

Biederman, I. (1972). Perceiving real-world scenes. *Science, 177*, 77-80.

Biederman, I. (1981). On the semantics of a glance at a scene. In M. Kubovy & J. R. Pomerantz (Eds.), *Perceptual organization* (pp. 213-253). Hillsdale, NJ: Erlbaum.

Biederman, I. (1987). Recognition-by-components: A theory of human image understanding. *Psychological Review, 94*, 115-147.

Biederman, I., Mezzanotte, R. J., & Rabinowitz, J. C. (1982). Scene perception: Detecting and judging objects undergoing relational violations. *Cognitive Psychology, 14*, 143-177.

Borghi, A.M. (2004). Object concepts and action: Extracting affordances from objects' parts. *Acta Psychologica, 115, 1,* 69-96.

Borghi, A.M. & Caramelli, N. (2003). Situation bounded conceptual organization in children: From action to spatial relations. *Cognitive Development, 18*, 40-60.

Bowerman M. (1991). The origins of children's spatial semantic categories: Cognitive vs. linguistic determinants. In J.J. Gumperz e S.C. Levinson (eds.), *Rethinking linguistic relativity.* Cambridge: Cambridge University Press.

Chambers, C.G., Tanenhaus, M.K., Eberhard, K.M., Filip, H., & Carlson, G.N. (2002). Circumscribing referential domains during real-time language comprehension. *Journal of Memory and Language, 47,* 30-49, 2002.

Conway, M. A., Kahney, H.B., Bruce, K., & Duce, H. (1991). Imaging objects, routines, and locations. In R.H. Logie & M. Denis (Eds.), *Mental images in human cognition.* Amsterdam: Elsevier Science.

De Wilde, E., Vanoverberghe, V., Storms, & De Boeck, (2003). The instantiation principle re-evaluated. *Memory, 11,* 533-548.

Ganis, G. & Kutas, M. (2003). A electrophysiological study of scene effects on object identification. *Cognitive Brain Research, 16,* 123-144.

Glenberg, A. M. (1997). What memory is for. *Behavioral and Brain Sciences, 20,* 1-55.

Goldstone, R., & Barsalou, L.W. (1998). Reuniting perception and conception. *Cognition, 65,* 231-262.

Greenacre, M., & Blasius, J. (Eds.) (1994). *Correspondence analysis in the social sciences: recent developments and applications.* London: Academic Press.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1992). *Multivariate data analysis.* New York: MacMillan.

Heit, E., & Barsalou, L. W. (1996). The instantiation principle in natural categories. *Memory, 4,* 413-451.

Hollingworth, A. & Henderson, J.M. (1998). Does consistent scene context facilitate object perception? *Journal of Experimental Psychology: General, 127,* 398-415.

Jackendoff, R., & Landau, B. (1991). Spatial language and spatial cognition. In D.J. Napoli (Ed.), *A Swarthmore Festschrift for Lila Gleitman*. Hillsdale: Erlbaum.

Jolicoeur, P., Gluck, M.A., & Kosslyn, S.M (1984). Picture and names: making the connection. *Cognitive Psychology, 16,* 243-275.

Jones, S.S. & Smith, L.B. (1998). How children name objects with shoes. *Cognitive Development, 13,* 323-334.

Köhler, S., Moscovitch, M., & Melo, B. (2001). Episodic memory for object location versus episodic memory for object identity: Do they rely on distinct encoding processes? *Memory & Cognition, 29*, 948-959.

Landau, B. & Jackendoff, R. (1993). 'What' and 'Where' in spatial language and spatial cognition. *Behavioral and Brain Sciences, 16,* 217-265.

Langacker, R.W. (1986). An Introduction to cognitive grammar. *Cognitive Science, 10,* 1-40.

Langacker, R.W. (1987). *Foundations of cognitive grammar: Vol.1. Theoretical prerequisites.* Stanford, CA: Stanford University Press.

Langacker, R.W. (1991). *Foundations of cognitive grammar: Vol. II. Descriptive applications.* Stanford, CA: Stanford University Press.

Lin, E. L., Murphy, G. L., & Shoben, E. J. (1997). The Effects of Prior Processing Episodes on Basic-Level Superiority. *The Quarterly Journal of Experimental Psychology, 50A, 1,* 25-48.

Mandler, J. M. (1992). How to build a baby: II. Conceptual primitives. *Psychological Review, 99,* 587-604.

Markman, E. M. (1985). Why superordinate category terms can be mass nouns. *Cognition, 19,* 311-353.

Mathis, K.M. (2002). Semantic Interference From Objects Both In and Out of a Scene Context. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 28,* 171-182.

Murphy, G.L. (2002). *The big book of concepts.* Cambridge, MA: The M.I.T. Press.

Murphy, G. L., & Wisniewski, E. J. (1989). Categorizing objects in isolation and in scenes: What a superordinate is good for. *Journal of Experimental Psychology: Learning, Memory and Cognition, 15,* 572-586.

Pecher, D., Zeelenberg, R., & Barsalou, L.W. (2003). Verifying conceptual properties in different modalities produces switching costs. *Psychological Science, 14,* 119-124.

Rosch, E., Mervis, C.B., Gray, W.D., Johnson, M.D., & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology, 8,* 382-439.

Setti, A., Caramelli, N., & Borghi, A.M. (submitted). Conceptual information about objects' size.

Smith, L. B., & Heise, D. (1992). Perceptual similarity and conceptual structure. In B. Burns (ed.), *Percepts, concepts and categories*, (pp.235-272). Amsterdam: Elsevier Science Publishers.

Talmy, L. (1983). How language structures space. In H.L. Pick & L. P. Acredolo (eds.), *Spatial orientation: Theory, research, and application,* (pp.225-282). New York: Plenum Press.

Treisman, A. (1998). The perception of features and objects. In R.D. Wright (Ed.), *Visual attention* (pp. 26-54). New York: Oxford University Press.

Tversky, B. (1989). Parts, partonomies, and taxonomies. *Developmental Psychology, 25,* 983-995.

Tversky, B., & Hemenway, K. (1984). Objects, parts, and categories. *Journal of Experimental Psychology: General, 113,* 169-193.

Wisniewski, E. J., Imai, M., & Casey, L. (1996). On the equivalence of superordinate concepts. *Cognition, 60,* 269-298.

Zwaan, R., Stanfield, R. A. & Yaxley, R. H. (2002). Do language comprehenders routinely represent the shapes of objects? *Psychological Science,13,* 168-171.

APPENDIX

Experiment 1 - Materials

Hierarchical Levels	Concepts	Scene-like locations	Object-like locations
Superordinate	Food	Kitchen	Pan
Basic	Steak	«	«
Superordinate	Drink	Store	Bottle
Basic	Beer	«	«
Superordinate	Toy	Nursery	Shelf
Basic	Doll	«	«
Superordinate	Jewel	Jeweller's shop	Casket
Basic	Necklace	«	«
Superordinate	Weapon	Barracks	Holster
Basic	Gun	«	«
Superordinate	Clothing	Laundry	Mannequin
Basic	Skirt	«	«
Superordinate	Bird	Sky	Nest
Basic	Swallow	«	«
Superordinate	Flower	Meadow	Pot
Basic	Primrose	«	«
Superordinate	Fruit	Countryside	Basket
Basic	Orange	«	«
Superordinate	Vegetable	Field	Plate
Basic	Artichoke	«	«
Superordinate	Fish	Sea	Fishing-Net
Basic	Tuna	«	«
Superordinate	Animal	Zoo	Den
Basic	Wolf	«	«

Table 1

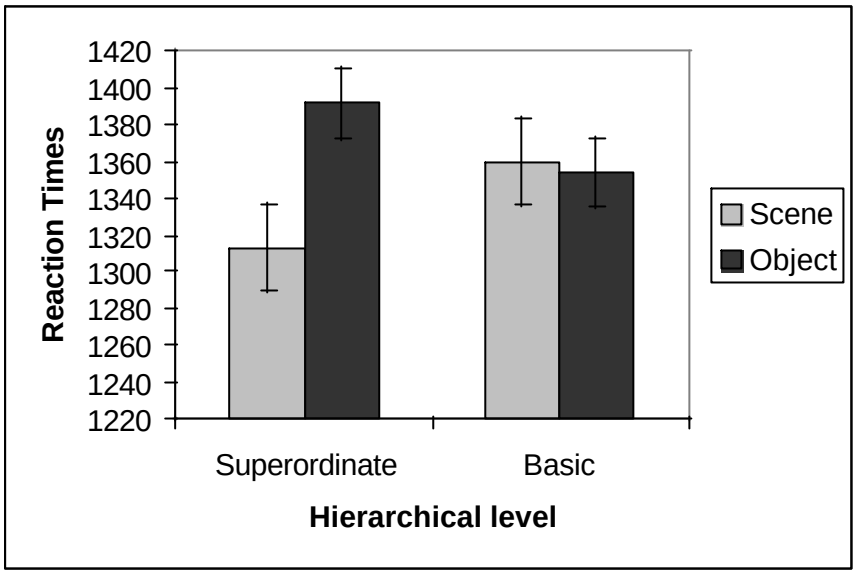
Experiment 2a. Percentages of the kinds of Location and the kinds of Relations Produced

Kinds of Location				
	Superordinate	Basic	Subordinate	Total
Scene	79.96	75.24	71.72	75.97
Object	20.04	24.76	28.28	24.03
Apt to One	14.10	35.26	39.72	28.83
Apt to Many	85.90	64.74	60.28	71.17
Kinds of Relation				
	Superordinate	Basic	Subordinate	Total
Ground	70.66	64.19	66.44	67.21
Containment/Support	26.30	27.81	24.83	26.40
Adherence	3.04	8.00	8.74	6.39

Figure Captions

Figure 1. Experiment 1. Interaction between the kinds of concept and the hierarchical levels in RTs.

Figure 2. Experiment 2. Correspondence Analysis performed on: A. the number of exemplars that a location can contain and the concepts' hierarchical levels (dimension 1 = 97%, dimension 2 = 3% of the variance); B. the kinds of relation and the concepts' hierarchical levels (dimension 1 =57%, dimension 2 = 43% of the variance).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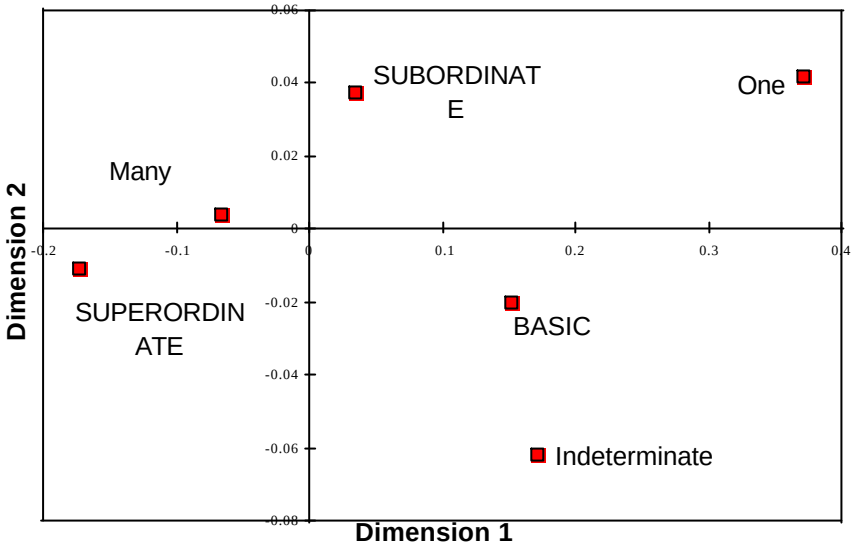
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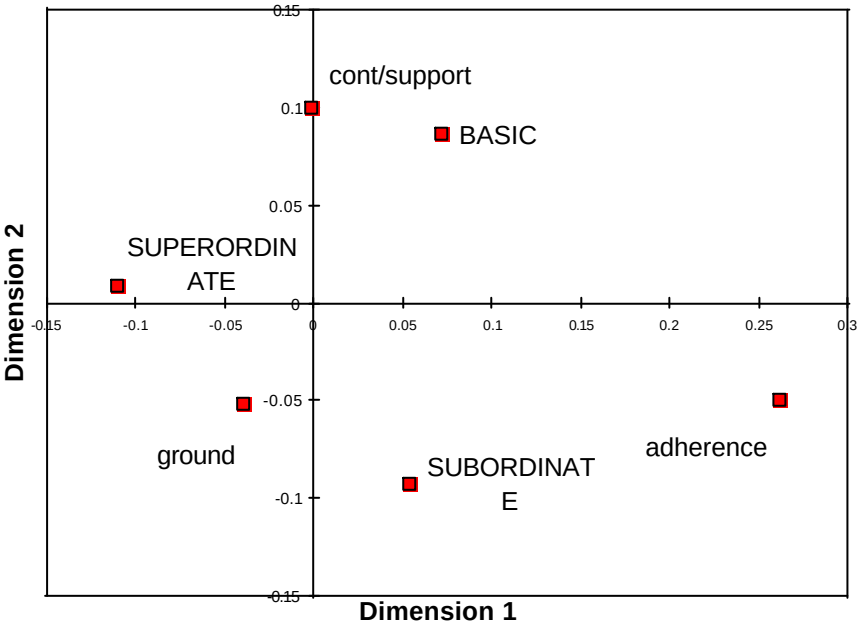
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