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Different Domains in Abstract Concepts

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Abstract

This study is a first attempt to unravel the almost unexplored domain of abstract conceptual knowledge. Four kinds of abstract concepts (*nominal kinds*, *states of the self*, *cognitive processes*, and *emotion* concepts) were investigated in two experiments. Emotion concepts displayed a specific pattern in both concreteness/abstractness and imagery ratings (cf. Altarriba et al., 1999), as did the other considered domains of abstract knowledge (Experiment 1). In Experiment 2 we highlighted the specific pattern of information (taxonomic, thematic, attributive, etc) these different abstract domains elicited in a definition production task.

Keywords: Conceptual knowledge; abstract concepts; abstract conceptual domains.

Introduction

Concrete concept nouns, such as *chair* and *book,* differ from abstract concept nouns, such as *freedom* and *language*. While the former refer to entities that are perceivable and spatially constrained, the latter refer to entities characterized by properties that are neither perceivable nor spatially constrained. Paivio's (1971; 1986; Paivio, Yuille, & Madigan, 1986) Dual Code Theory was a first attempt to explain this difference. In this perspective, while abstract nouns are coded only by the verbal system, concrete nouns are coded by both the verbal and the imagens systems, and this explains why concrete nouns, which are more imageable, are also remembered better than abstract ones. In fact, while the former may benefit from two memory codes, the latter benefits from only one (cf. Paivio, 1983 for a review of dual code empirical evidence).

Although the different degree of imageability can explain a good deal of the processing differences between abstract and concrete nouns, it is not enough to fully clarify them. Studying word context availability, Schwanenflugel and Shoben (1983) showed that it is more difficult to find an appropriate context for abstract than for concrete words. Accordingly, when abstract and concrete words were preceded by an appropriate context, no difference between them was found in reading time. Moreover, context availability ratings were shown to correlate with both concreteness (Schwanenflugel & Shoben, 1983; Altarriba, Bauer & Benvenuto, 1999) and imageability ratings (Wiemer-Hastings, Krug & Xu, 2001) and to be a good predictor of lexical decision performance (Schwanenflugel, Harnishfeger, & Stowe, 1988).

As Altarriba, et al. (1999) remarked, the correlation between concreteness ratings and the other dimensions of concept nouns, such as imageability and context availability, has often been calculated contrasting the ratings obtained on the whole set of abstract and concrete nouns. This might have obscured possible effects due to their sub-domains. This is suggested by the fact that, in their research, while imageability did correlate with concreteness in the overall analysis, it did not when the sets of concrete, abstract and emotion words were analyzed independently. The analysis of emotion words showed that they were considered significantly less concrete than abstract words. Moreover, their context availability was lower than that of abstract words, and they were rated as more imageable than abstract words, but less imageable than concrete ones. The authors interpreted these results as evidence that concrete, abstract and emotion words belong to different domains with emotion concept nouns differing from other abstract concept nouns, contrary to what is usually assumed. In a subsequent study, after replicating these results, Altarriba & Bauer (2004) also found that concrete, abstract and emotion words differed in a free recall task and in a lexical decision task with a priming paradigm. Similarly, both Nelson & Schreiber (1992) and Wiemer-Hastings, Krug & Xu (2001), with a concreteness rating task, found that while concreteness ratings were distributed into two general clusters, referring to concrete and abstract items, different degrees of concreteness were present within each cluster.

Thus, the same difference between concrete and abstract concept nouns, which seems intuitively obvious, apparently is not so clear-cut, as the different concreteness ratings, observed between abstract and concrete concept nouns (Wiemer-Hastings et al., 2001), and the results obtained with emotion concepts (Altarriba et al., 1999) have shown. Furthermore, while words referring to concrete objects usually studied are nouns, abstract terms are nouns, verbs, adjectives and adverbs. While concrete concept nouns usually refer to two distinct kinds of entities, i.e. natural kinds and artefacts, the variety of abstract concept nouns is large and unknown. While the domains of both natural kinds, e.g. plants and animals, and artefacts, e.g. tools and vehicles, are well differentiated (see Keil, 1989), the domain of abstract concept nouns, instead, has been scarcely explored thus far, emotion words aside. Nevertheless, it is possible to suppose that the overall domain of abstract concepts can also be distinguished in sub-domains. In fact, on intuitive grounds, some abstract concepts seem to be

"less abstract" than others like, for example, *entrance* and *idea*.

The aim of this study was to provide evidence that the overall domain of abstract concepts can be divided into different sub-domains. It is worth noting that we do not aim to produce an exhaustive taxonomy of abstract concepts. In fact, our starting point was the set of abstract concepts already studied as an homogeneous domain in previous works, with the aim to show that some well differentiated types can be distinguished into it.

Therefore, in Experiment 1 participants were asked to rate a set of abstract concept nouns, which were supposed to belong to four different domains (*cognitive processes*, *emotions*, *nominal kind* and *states of the self*), on four dimensions (concreteness, context availability, imageability and abstractness) in order to check whether the considered abstract conceptual domains are differentiated along these dimensions. Moreover, as many studies on concrete concepts have shown that different types of information characterise their kinds, it is possible to suppose that also the domains of abstract concepts are characterised by information of different types. Hampton (1981), for example, suggested that the features elicited by abstract concept nouns describe situations (i.e. agents, actions and goals). Recently, Barsalou & Wiemer-Hastings (in press) found that all the concepts elicited situational information by comparing abstract (truth), intermediate (a cook), and concrete concepts (a bird) in an oral characteristic-production task. Concrete and abstract concepts, however, differed in the type of situations elicited. While the situational content of concrete concepts consisted primarily of situations referring to agents, the content of abstract concepts consisted in events and introspective statements. Analysing the linguistic contexts provided by the verbs with which abstract words co-occur, Wiemer-Hastings & Graesser (2000) showed that abstract concepts may be better conceived of as being defined by the 'abstract structure' of the situations in which they are used. This abstract structure is derived from the multiple situations, which abstract items can fit into, and it is similar to a script because it specifies the relations linking the entities involved in a particular situation (causal, temporal, and spatial relations). Wiemer-Hastings, Barnard & Faelner (2003) identified the main organizing principle of abstract knowledge in thematic relations. They found that concrete and abstract concepts differed in their exemplars' degree of distinctiveness. That is, the exemplars of abstract categories were judged as more similar to the exemplars of other categories than the concrete categories ones. They also found that, while concrete concept similarity evaluations were based on taxonomic relations, those provided for abstract concepts were based on thematic relations. Moreover, the crucial role of thematic knowledge in abstract concepts was also found in children (Caramelli, Setti, & Maurizzi, 2004) as well as in five groups of people differing in the type of expertise (Setti, Borghi, Caramelli, submitted).

In this theoretical framework, Experiment 2 was carried out in order to verify whether concrete and abstract concepts are characterized by different patterns of conceptual information as well as whether the different domains of abstract concepts already studied in Experiment 1 differ in the types of conceptual information they elicit.

Experiment 1

This study consisted in two parts. The first was aimed at selecting the concept nouns belonging to distinct domains of abstract knowledge and the second at verifying with rating tasks whether these domains differed along the dimensions usually assumed to discriminate abstract and concrete concepts (concreteness, context availability and imageability). Also the dimension "abstractness" was added, as it was supposed to provide further information than that provided by the concreteness dimension**,** and, thus, to better discriminate the domains of abstract concepts. In fact, it cannot be given for granted in advance that the abstractness and concreteness dimensions are symmetrical.

We hypothesised that if the selected abstract concepts belonged to different conceptual domains their ratings should differ along the considered dimensions (cf Altarriba et al., 1999).

Part 1. Abstract concepts selection and familiarity assessment.

A wide set of abstract concept nouns was created, taken from both Altarriba et al. (1999) and Oatley and Johnson-Laird (1987). Following their intuition, the two experimenters divided all the collected abstract concept nouns into ten different appropriately labelled categories. Among these, only the four categories that included the largest amount of items were retained for further study. In order to corroborate the experimenters' intuition, 3 independent judges, who were blind to the hypotheses, were asked to part the stimuli into the four categories: *cognitive processes*, *states of the self*, *nominal kinds* and *emotions*. The judges substantially agreed with the experimenters' partitions and the few cases of disagreement were solved following brief discussion. The set of abstract concept nouns thus obtained consisted of 135 items. The familiarity assessment was carried out on this set of 135 concept nouns, out of which 25 belonged to the domain of cognitive processes (e.g. thought), 25 to that of states of the self (e.g. childhood), 25 to that of nominal kinds (e.g. error), and 60 to that of emotions (e.g. fear). The 135 selected concept nouns were divided into 2 lists with the number of each type of concept balanced among the lists. In each list the concept nouns were arranged in 2 random orders. Ten participants for each one of the four lists rated "how much the meaning of these words is familiar/known" on a 7-point scale. In total the data of 20 super-subjects were collected. The most familiar concept nouns belonged to the domain of *cognitive processes* [M = 6; SD = 0.6], followed by that of *states of the self* [M = 5.95; SD = 0.5], that of *nominal kinds* [M = 5.79; SD = 0.9] and that of *emotions* [M = 5.72; SD = 0.8].

Part 2. Assessment of concreteness, context availability, imageability, and abstractness

Method

Participants One hundred and sixty university students took part in this experiment as volunteers. All of them were Italian native speakers.

Materials and Procedure From each of the four abstract domains (*cognitive processes*, *states of the self*, *nominal kinds* and *emotions*) 18 concept nouns, the familiarity of which was balanced, were selected as the experimental set. To these 72 concept nouns, 60 concrete concept nouns (30 natural kind and 30 artefacts) were added as fillers. The total set of 132 concept nouns thus obtained was divided into two lists, in each of which the types of concept nouns were balanced. In each list the concept nouns were differently randomized. This procedure was repeated for each one of the four ratings. Eight different groups of participants were asked to rate the imageability, or the context availability, or the concreteness, or the abstractness degree of the items on a 7-point scale (e.g. "Please evaluate how concrete is x on the scale, where 1 = not at all and 7 = very much. Please use also the intermediate steps of the scale"). Thus, each participant evaluated half of the experimental materials on only one dimension.

Results

An Analysis of Variance was performed on the ratings with Rating scale (concreteness, abstractness, context availability, and imageability) as the within items variable and Abstract conceptual domains as the between items variable. The factor Rating scale was significant: F (3,204) = 113.3; MSe = .41; $p < .001$, while the factor Abstract concept domain showed only a trend toward significance: F (3,68) = 2.3; MSe = .56; $p < .08$. The interaction was significant: F (9,204) = 12.8; MSe = .41; $p < .001$. As for the main effect of the Rating scale, context availability and abstractness obtained the highest ratings (respectively M = 4.4 and M = 4.7), followed by imagery ratings (M = 3.7) with concreteness obtaining the lowest ratings (M = 2.9). All the differences were significant at the post hoc Newman-Keuls analysis ($p < .01$).

Table 1: Mean rating for each kind of concepts on each scale (Standard Deviation in brackets).

Kind of concept	Concr	Abstr	C A	Imag
Cognitive proc	2.5(.4)	5(.7)	4.7(.4)	3.2(.5)
Nominal kinds	3.3(.6)	3.8(.8)	4.4(.9)	3.6(1.1)
States self	3.5(.8)	3.9(.6)	4.8(.9)	4(.6)
Emotions	2.3(.2)	4.9(.4)	4.9(.4)	3.8(.5)

As Table 1 shows, concreteness and abstractness ratings displayed an opposite trend in the interaction, as expected. *Cognitive processes* and *emotion* concept nouns were judged as less concrete, and more abstract, than *states of the self* and *nominal kind* concept nouns (Newman-Keuls, $p < .01$). The abstract conceptual domains did not significantly differ in their context availability, although, on average, *nominal kinds* led to lower ratings (M = 4.4) than *emotion* concepts (M = 4.9). *Cognitive processes*, that were judged as the most abstract (and less concrete), were also less imageable (M = 3.2) than *states of the self* concept nouns (M = 4.07) (Newman-Keuls, $p < .01$). Thus, at least to some extent and apart from context availability, each of the abstract conceptual domains investigated was differently characterized by the dimensions considered.

Discussion

The results of Experiment 1 verified the hypothesis that the overall abstract concepts domain can be split into more specific domains. Not only concreteness and abstractness ratings showed an opposite trend, i.e. these dimensions are symmetrical, but also the 4 selected abstract conceptual domains were differentiated on the dimensions considered. In particular, *cognitive processes* and *emotion* concept nouns differed from both *states of the self* and *nominal kind* concepts with the former rated as more abstract and less concrete than the latter. Moreover, *cognitive processes* concept nouns were rated as less imageable than *states of the self* concept nouns, which were the most imageable and obtained a relatively high concreteness rating. Since the relevance of relations in conceptual knowledge has been widely recognized as a means for distinguishing between the kinds of concrete concepts (Barsalou, 1993; Lin & Murphy, 2001; Markman, 1989; Borghi, Caramelli & Setti, 2005), Experiment 2 was carried out in order to identify which relations are elicited by the 4 abstract conceptual domains differentiated in the rating tasks. In fact, it is possible to suppose that, if *cognitive processes*, *emotions*, *states of the self*, and *nominal kind* concept nouns differ, they should convey different patterns of conceptual information as expressed by the relations upon which their definitions rest.

Experiment 2

In this experiment a definition production task was used in order to verify the following hypotheses: a.1. Abstract concepts should differ from concrete ones as far as the information their definitions rests on is concerned. a.2. As the concrete concept domain is articulated in different sub-domains characterized by eliciting specific types of information, so should the abstract concept domain; b. In the four sub-domains of the abstract concepts considered, *emotion* concepts should elicit a different pattern of relations from those elicited by the other abstract domains as they were already shown to differ in both rating and lexical decision tasks (Altarriba & Bauer, 2004).

Method

Participants Eighteen university students who did not take part in the preceding experiment volunteered for this experiment.

Materials and Procedure From the materials used in Experiment 1, 10 concepts for each group were selected so that familiarity was balanced (*cognitive processes* M = 6.3; *nominal kinds* M = 6.1; *states of the self* M = 6.1; *emotions* M = 6.3). Twenty concrete concepts (10 natural kinds and 10 artefacts) were added to these 40 concepts, bringing the total set of materials to 60 concept nouns, arranged into two differently randomised lists. Under each concept noun a few blank lines were left free for responses. Participants were asked to provide a definition for each concept noun.

Data coding The definitions produced were transcribed and parsed into their constituent components (joy – mental condition/ favourable and pleasant). The components of the definitions thus obtained were coded according to the type of relation linking the components to the given concept

noun (in the preceding example 'mental condition' – taxonomic superordinate; 'favourable and pleasant' – attributive). The coded relations were the following:

1. *Taxonomic relations*: establishing the hierarchical structure of conceptual knowledge. They included: the Superordinate level (fear - feeling); the subordinate level (mind - consciousness); and coordinate level (worry – state of anxiety).

2. *Thematic relations*: linking objects that co-occur in the same situation or event. They included: spatial relation (mind – in the brain); temporal relation (impression – in one moment); means relation (comprehension – the way we understand); cause relation (disappointment – due to someone or something); effect relation (hunger – look for food), function relation (memory – for maintaining mental information); action relation (attention – to concentrate); event relation, i.e. the description of a situation resulting from different actions, (for example: profit – to receive something as compensation for an accomplishment).

3. *Attributive relations*: referring to the physical characteristics or qualities of objects. They included perceptual property relations referring to texture, shape, colour, and evaluations (profit - advantageous).

4. *Stereotypes*: used for conventional associations (mind-genius) and idiosyncratic associations (creativity – to go further).

5. *Examples*: used for objects/people considered by the participant as an instantiation of the given concept (bother – itchiness) (see Barsalou and Wiemer-Hastings, in press).

6. *Other*: This code was used for general comments and simple repetitions of the concepts.

Data Analysis and Results

One participant's data were excluded from analysis because of failure in responding to most of the stimuli. Overall, taxonomic relations were the most frequently produced in participants' definitions. This result was expected as in their educational curriculum students are trained to provide formal definitions such as "A is a kind of B". However, thematic relations were the second most produced in all the conceptual domains considered. Thematic relations were produced more often in abstract concepts definitions (M = 29%) than in concrete concepts ones (M = 26%). This result replicated in adults that obtained with an associations production task in children (Caramelli, Setti & Maurizzi, 2004).

In order to establish which relations characterized the definitions of the different kinds of concepts, the Correspondence Analysis was used. In Correspondence Analysis 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.

Two analyses were performed, one on all the types of concepts studied and the other on the different domains of abstract conceptual knowledge only.

(A) Analysis on all the concept types. A Correspondence Analysis was performed, the variables of which were all the kinds of concepts (*cognitive processes*, *states of the self*, *nominal kinds* and *emotion* concepts *natural kinds* and *artefacts*) and the sub-sets of the different kinds of the relations produced (superordinate, subordinate and coordinate levels of Taxonomic relations; spatial, temporal, means, cause, effect, function, action, and event relations of Thematic relations; Perceptual and Evaluative relations of the Attributive relation; Stereotypes, and Examples). The productions coded Other amounted only to 2.8%, thus they were not further analysed.

As shown in Figure1, on the first dimension, explaining 53% of the total variance, *natural kind* and *artefact* concepts, which yielded definitions based on super-ordinate, perceptual, spatial and function relations differed from *states of the self* and *nominal kind* concepts, which yielded definitions based on event and coordinate relations and examples. This dimension highlights the distinction between concrete concepts (*natural kinds* and *artefacts*) and abstract concepts (*nominal kinds* and *states of the self*). On the second dimension, explaining 21% of the total variance, *emotion* concepts and *natural kinds*, which yielded definitions based on cause, evaluation and super-ordinate relations, differed from *artefacts*, which yielded definitions based on function, mean and subordinate relations. This dimension highlights the relations that distinguish *natural kinds* and *emotions* from *artefacts*. The former elicited taxonomic information of the super-ordinate type, while the latter elicited taxonomic information of the subordinate type and information on their function. Moreover, while *artefacts* are defined relying on their functions, this kind of information is not involved in defining neither *emotion* nor *natural kind* concepts. In this set of concepts, those referring to *cognitive processes* are defined by a pattern of relations that is not specific.

(B) Analysis on abstract conceptual domains. A Correspondence Analysis was performed, the variables of which were the abstract conceptual domains (cognitive processes, states of the self, nominal kinds and emotion concepts) and all the sub-types of the relations produced, as in Analysis (A).

As figure 2 shows, on the first dimension explaining 47% of the total variance, emotion concepts, which yielded definitions based on super-ordinate and cause relations,

differed from nominal kinds, which yielded definitions based on coordinate relations and examples. On the second dimension, explaining 41% of the total variance, emotion concepts, which yielded definitions based on evaluative relations differed from cognitive processes, which yielded definitions based on spatial, function, means, perceptual and subordinate relations.

Thus, while the domain of concepts referring to states of the self is not defined by a specific pattern of relations different from those of the other domains of abstract conceptual knowledge, that of nominal kind, emotion, and cognitive processes concepts were. The definitions of nominal kinds were characterized by the coordination taxonomic relation and by examples. That is why the concept "travel" was defined as "a shift of position" (coordinate) and the concept "flight" by "of the birds", an example. Emotions' concepts were defined by reference to their causes ("disappointment" was defined as "due to unrealised expectations") and to evaluations ("anxiety" – was defined as "deep and strong"). The definitions of cognitive processes concepts rested on a great variety of relations mainly of the thematic kind (action, mean, function and space relations) and, thus, they differed from those provided for both nominal kind and emotion concepts.

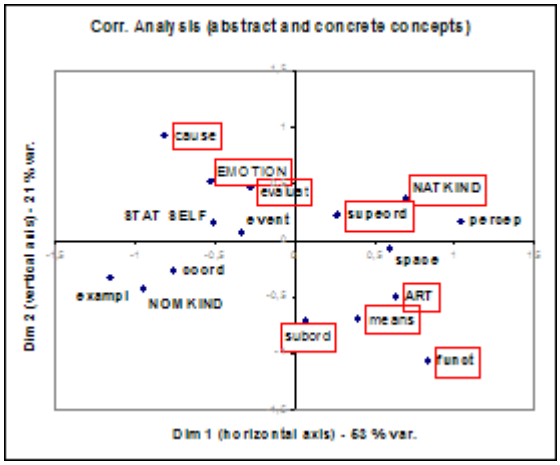


Figure 1. Dim.1 in bold, Dim. 2 in frame, types of concepts in capital, relations in lowercase.

Discussion

Overall, analysis (A) and (B) have shown that the definitions of the exemplars of both the concrete and the abstract sub-domains of conceptual knowledge are shaped by specific kinds of conceptual information. Moreover, they also have shown that emotion concepts differ from concrete concepts as well as from the other types of abstract concepts considered, thus replicating Altarriba et al.'s (1999) and Altarriba & Bauer's (2004) findings with a different methodology.

Conclusions

The domain of concrete concepts has been divided in artefact and natural kind concepts, and many studies have widely explored the different types of conceptual information shaping these two kinds. On the contrary, abstract conceptual knowledge includes a heterogeneous set of concepts, the differences among which, to our knowledge, have been largely unexplored, with the exception of emotion concepts. This study was an attempt to reduce this gap by investigating four abstract conceptual domains (states of the self, cognitive processes, nominal kinds and emotions). Experiment 1, with a rating task on the dimensions of concreteness, context availability, imageability and also abstractness, shows that the domains of abstract conceptual knowledge identified differ on these dimensions. Thus, Altarriba et al., 's (1999) and Altarriba & Bauer 's (2004) results that emotion concepts give rise to a knowledge domain independent from both concrete and abstract knowledge domains were replicated.

Experiment 2 with a production task has specified these differences as due to the specific conceptual information underlying the definitions of emotion concept nouns as they rest on their causes and on evaluations. Moreover, it has also highlighted the different types of conceptual information that characterize other sub-domains of abstract concepts. The definitions of nominal kinds, which are judged relatively highly concrete and imageable, were characterized by examples and coordinate taxonomic relations, which allow reference to concrete objects and situations. Concepts referring to cognitive processes elicited thematic information that refer to the specific contextualised events in which they take place. States of the self concepts, while characterized by events when contrasted with concrete concepts, when contrasted with abstract concepts did not show any specific pattern of information.

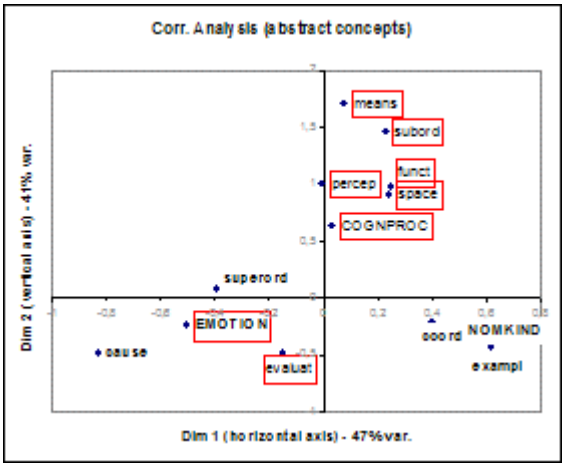


Figure 2. Dim.1 in bold, Dim. 2 in frame, types of concepts in capital, relations in lowercase.

In conclusion, besides replicating and extending Altarriba et al. (1999) findings on emotion concepts, this study, has begun to uncover the partitions that distinguish abstract conceptual domains. Further research will allow to test whether the domains of abstract knowledge we focused on are differently processed in on line tasks. Moreover a larger

range of abstract concept will be taken into account. Overall these results can be nicely accounted for by theories that assume conceptual knowledge as a continuum in which different types of concepts can be distinguished tank to the different kind of information they elicit (Barsalou, 1987).

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