THE ROLE OF IMAGE VALUE, GENERALITY LEVEL AND SEMANTIC-CONCEPTUAL RELATIONSHIP IN SETENCE VERIFICATION

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RESUMEN

Papel de la virtualidad imaginaria, nivel de generalidad y relación semántico-conceptual en la verificación de sentencias. El propósito del presente experimento es obtener información acerca de los códigos que subyacen en las representaciones mentales. Más precisamente, se intenta corroborar que los tiempos de verificación de verdad o falsedad de sentencias escritas son reducidos en función en de su virtualidad imaginaria. También se quiere comprobar la implicación de otros tipos de variables, tales como las relaciones perceptuales, el contenido biológico/no biológico, y el nivel de generalidad. Las relaciones semántico-perceptuales se categorizan como clasificatorias, perceptuales y funcionales. Participan en el experimento 22 sujetos adultos. Las sentencias se presentan visualmente por medio de series de diapositivas —292— cuyos contenidos proceden de experimentos previos. Se ha empleado un cronoscopio LA-63013. Los resultados muestran que las sentencias de relación clasificatoria se verifican en menos tiempo que las perceptuales y funcionales. Se constatan asimismo otros resultados.

Palabras Clave: Verificación de frases, clases de relaciones conceptuales, valor de imagen, nivel de generalidad.

ABSTRACT

The purpose of the present experiment is to obtain information about the codes that underlie mental representations. More precisely it tries to corrobarate that the verificacion times of the truth or falseness of written sentences are shortened by their image values. We also want to verify if other kinds of varaibles, such as the conceptual relationships, biological versus non-biological content, and generality level, are also implicated. The semantic-conceptual relationships were categorized as classificatory, perceptual, and functional. Twenty two adult subjects participated in the experiment. The sentences were visually presented by means of a series of slides —292— whose content came from a previpus experiment. An LA-63013 chronoscope was used to measure the reaction times. The results showed that the sentences in which a classificatory relationship —"is a"— was implicated took less times to be verifies than the perceptual ones and these less than the functional ones (Student's "t" was used). On the other hand, the Sperman correlations used to verify if reaction times were correlated with image values were not significant, excep in the higt image value group —9 sentences only—. Finally, the reaction times for biological content sentences were shortes than for non-biological, and for basic-level sentences shortes than for superordinate (variance analysis). The interaction between category type and generality level was not significant.

Key Words: sentences verification, image value, types of conceptual relationships, generality level.

The present paper presentig tries to approach the question of the mental representation of a read sentence: whether il is processed resorting to a verbal code, that is, through words, whether it is translated or transformed into an image code or, on the contrary, whether it is processed in an amodal way, through abstract propositions.

It might well appear ambitious to present this subject in this manner, as it will pretend to solve such a central and at the same time polemic subject as analogical codes versus propositional formats underlying mental representations. But our goal, although evidently within the aforementiones framework, is far more modest; it is to analyze if the processing time to verify the truth or falsity of a sentence depends on the imagery value of that sentence, previously assessed on a scale, or depends on other variables such as the type of underlying relationship, level of generality and kind of the category: biological vs. non biological content.

One of the first work of this type was done by Jorgensen and Kintsch (1973). The methodology implemented in this study is not similar to ours, as sentences were ex-professo made for the test, generating two well differentiated groups according to their imagery value -high and low-. Other task varaibkes, were also different. Results clearly indicated an easier processing of the high imagery former sentences, which potentially were suitable to be converted into images, concretely, in verification tasks under temporal pressure. As the authours said, up to this moment the majoriry of tests evaluated the semantic relation in the L.T.M., but not taking into account imagery processes; they also suggested the need to analyze the interaction of imagery values and semantic relations underlined in the sentence.

On the other hand, Conrad (1972) emphasized the importance of the frequency variable through which properties of a concept or word are stored in memory and demonstrated its oimportance in the reaction times needed by ythe subject to verify the truth or falseness of a sentence set. Thus, he introduced several nuances in the Collins and Quiillian's model (1969) and showed the importance of the associative frequency of a feature with a concep when evaluating sentences.

Potter, Valian and Faulconer (1977), using an ingenious paradigman test, demosntrated that the sentence meaning is represented in an abstract format and is not mediated by images or words. They produced orally 96 sentences followed by a picture or test word to a group of individuals who decided if words and pictures were related or not to the sentence meaning. Significant differences in reaction times were not found for the test modalities. Neither was there interaction of test modelality —picture or word— and degree of imaginability of previously presented sentences.

Thorndyke (1975) had, nevertheless, confirmed the inverse relationship between sentence "imagery" values and their verification times. Likewise, he observed that reaction times in sentence understanding did not correlate with the sentence conceptual complexity, given the implicit assumption of Schank's conceptual complexity hypothesis.

More recently, Day and Bellezza (1983) analyzed, on the one hand, the visual image influence, the personal experiencie and on the other hand, the knowledge of specific types of objects and their interacting way in learning and remembering. They concluded that the visual image plays a more epiphenomenic role in these processes and does not explain in a consistentent way tyhe retention of associated words pairs.

Denis (1982, 1983a, 1986) from a differential point of view and previously clasifyng a group of individuals in high imagers (HIs) and low imagers (LIs), demonstrated

that the former, because of their higher tendency to elaborate images supporting semantic contens of what was read, took more time to read specific (descriptive-narrative) contents than did low imagers, and they also remembered it better. On the contrary, when what the read had an abstract content, there were no significant diferrences between both groups.

The consulted literature presents a dispariry of results; because of this, our goal was, in the firts place, to chech if the "i a" type sentences were evaluated without errors in more or less times than sentences with others implicit relation types.

The former express inclusion, classificatory and taxonomic relations, and the latter preceptual, functional or instrumental relations, which are more easily codified in visualimages (Denis, 1987b). The checking was done through a verification task of the truth or falseness of a sentence group, asserting the relationship between 18 natural and artefactual categories and their attributes, obtained empirically (Peraita, 1984), and that represented defferent types of underlying conceptual relations.

On the other hand, the aforementiones sentences, categories and their associated features, has an image value that a group university syudents assigned subjectively (Ferrándiz and Peraita, 1984); we tried also to analyze whether the processing access depends on imagery value as well as on the type of conceptual relationship.

We considered four groups of sentences depending on their image values; low, from 1.50 to 2; middle low, from 2 to 2.50; middle high, from 2.50 to 3, and high, from 3 to 3.50.

Finally we were interested in knowing if the verification task was faster when trying to evaluate features of natural categories: biological against artefactual, non-biological, and of super-ordinate categories against base-level categories (Rosch, 11976, 1987).

METHOD

Subjects

Thirty two studentes from the University of Madrid participated in the experiment. They were mainly from the Psychology Department, and were between 18 ans 23 years old (the mean being 21 years), half men and half women.

Materials

292 slides were used as items, 50% of which corresponded to sentences asserting a relationship between 18 names of categories and their properties listed by the already mentioned group of subjects. The rest were false meaning sentences matched through format, length, underlying relationship, etc., with target sentences. The verbal material was, actually, from a previous test and had been subdivided *post hoc*, according to their underlying semantic-conceptual relationship, into three gropup of sentences classificatory or taxonomic "is a" type (N = 49); a second group of sentences with perceptual relation "has" type (N = 43); and third, the functional "can, it can be used for" type group (N = 54).

The letters were block letters written in white on black background. The slides were all of the same size (35 mm.).

A LA-63013 model chronoscope was used to measure the RT.

Procedure

The eighteen categories and their corresponding list of features were divided into two groups, and within each group two types of randomized settings were made. The producing order of the categories as well as of the features was random.

Then, the group of 32 individuals was divided into four experimental groups of 8 persons, so as to present to each person in an aleatory way the slides of the categories and their features in four posssible differente ways.

Biological categories				Non-biological categories			
Superordinate		Basic level		Superordinate		Basic level	
Tree	1.06	Pine	0.88	Musical instrument	1.37	Guitar	1.12
Fish	1.11	Trout	0,85	Tool	1.31	Hammer	1,18
Bird	1.11	Aigle	1.01	Clothes	1.14	Trousers	1.19
Fruit	1.11	Apple	0.87	Furniture	1.20	Table	1.09
				Vehicle	0,96	Car	0.8
x	1.08		0.90		1,19		1,09

Tabla 1. Mean reaction times for each category and each hierarchic level.

The following process was carried out: firts, the slide with the category name, the sentence subject -advance information- was shown, followed by true or false sentences with related attributes to the category. The person had to press the lever answering at the same time "true" or "false".

The lever, connected to the chronoscope, stopped when it was pressed. Thus, the reaction times to verify the sentences were measured.

The instructions were as follows: "You should dècide on the truth or falseness of a sentence content in as quickly as possible way, trying to make ythe minimum amount of errors. Did you understand? We are going to produce an instance set. If you are right-handed, press the right lever, answering at the same time "True or false". Next, 10 instances were shown to them and they were asked again if they understood. If there was no problem, the test started.

RESULTS

Once each person's reaction times for each sentence were obtained, the means for each differente type of sentence (classificatory, perceptual, and functional) were calculated. We used "Student's t" and the results showed that sentences of "is a", classificatory type, take less time to be verified than "has" type sentences ($t = 2.448$; $P < .01$). In the same way, "can" sentences took more time to be verified than "is a" ones, ($t = 11.953$; $P < .005$). The differences between "S can P" os "S has P" sentences types were also significant ($t = 6.888$; $P < .005$), as the latter is more rapidly verified than the former.

On the other hand, Spearman correlations were carried out between reaction times and image values, one for each group of sentences classified according to the image value, low, middle low, middle high, and high. Only one negative significant correlation was obtained ($r = -.47$) in this last group which was the one to include the lowest number of sentences ($N = 9$). The correlations were not significant in any other group.

A variance analysis was also carried out from average scores in reaction time for every feature of each category in order to observe if the mean reaction time for biological and non-biological categories as well as for super-ordinate and basic levels were or not signioficantly different. The total reaction times in seconds was 0.9935 for biological categories, 1.1410 for non-biological catego-

Sources of variance	Sums of squares	Degrees of freedom	F	Probability
Variable A (biological vs. non-biological)	.09637	1	6.82572	.020
Variable B (superordinate vs. and basic level)	.08993	1	6.37004	.024
A x B	.00720	1	.51000	.487
(interaccion)Error	.19765	14		

Tabla 2. Variance analysis of reaction times.

ries, 1.1385 for superordinate level categories, 0.9960 for base level categories. The mean RT's for each category and each hierarchic level are shown in table 1.

We compared reaction times for biological and non-biological categories and obtained F (d.f. 1,14) = 6.8257 a significant difference, P < .02 (see Table 2). reaction times for non-biological categories were longer. Then, we proceeded to compare reaction times for super-ordinate and basic levels, obtaining F (d.f. 1,14) = 6.37004; the F is significant at a level of confidence of .02. Reaction times for super-ordinate level sentences were longer.

Third, we compared both varaibles (category type and generality level) obtaining F (d, f, 1, 14) = .51000; statistically we did not find any significant difference.

DISCUSSION

The following temporal sequence regarding our firts hypothesis was found: the classificatory-taxonomic semantic realtion, linguistically representes by predicate "is a", indicating inclusion into to a class of objects, is verified significantly faster than the perceptual or figurative relation that indicates property attribution or constitutive parts of an object, linguistically represented by "has", as Collins and Quillian (1969) discovered; the latter sequence, in turn, is verified quicker than the functional semantic relation (using this word in a large sense) linguistically representaed by "can", which firts indicates usefulness, way of use, purpose, and second, habitat, reproduction systems, potentioality to carry out certain actions, etc.

If we take into account the relativity entailed by all attempts of classification of attributes representing a concept, as well as the implicit difficulties to define the functional and the perceptual attibutes, this means to us, that the classificatory semantic relationship is maybe the most available for adult and adolescent subjects, when tryin to characterize through some category features. Said relationships are not available with the same strength —occurrence probability— for cate-

gories situated at different places in the sames taxonomy, non with the same availability in natural and artefactual categories. That is, the semantic-logical nexus indicating class inclusion, when that is known by the subjects and preferably at certain levels, seems to organize the knowledge we have we have of natural categories. It seem to determine or define as well basic ontologic categories (Keil, 1979) which, in spite of all, are only tagentially considered in our work, and in many other of this kind, as there are inclusions, living being, object, substance, animate, inanimate, etc. that due to excessive generality or to be considered obvious and redundant the subject does not use, not even in daily language, neither in tasks of free production of attributes.

The fact that sentences indicating perceptual prperties or constitutive parts of objects are verified faster than functional is due to the "necessity" relation or nexus of these properties with the objets they represent. It may not occur in some a specific sample of the category (in a given situation or context - tree without branches, without leaves, apple without skin, car without wheels and so on), but the representation of the category includes them and the diferent reaction times indicated different condictional probabilities (Smith and Medin, 1981). It did not occur the same with functional attributes where indetermination is much higher; the uses or functions of a table or a car, as well as the variability range of the habitat and way of feeding of birds and fish, are reflected in the processing times of the sentences in which are containes. The sunject does not find so quick an evidence as in previous cases.

With regard to the second hypothesis, we might conclude, fooolowing Glass, Eddy, and Schwanenflugel, (1980), and Glass, Millen and Edy (1985), the non-existence of a clear relationship between the image value of a sentence representative of a category property and the quickness with its content es verified (at least for sentences with low and middle image value, as un higt imagery value we found a relation).

In principle, these resulkts agree with others we found (Peraita and Ferrándiz, 1986); we did not find systematization betwee image value not between feature types. The same problems appear now; when we ask a subjects to evaluate on a scale the stength with which different linguistic input types can raise a visual spatial image, here the question is how to control what is being represented actually by the subject, and, futthermore, how the subject himself could know what aspect of the word or sentence were the one to be actualized or activated; "imageability", concretion versus abstraction, familiarity, associability, meaninsgfulness, etc.; Goldberg (1986), when trying to evaluate the validity of certain rating as predictors of the hierarchic level of 440 categories, found that "imageability" is related in no way with the hierarchic level. This author analyzes how in Toglia and Batting (1978) some word aspects supposedly measured by a rating set, were actually mixed and mixtured.

This author concluded, after some thorough statistical analyse, that when subjects are asked evaluate the word image value, they are actually evaluatinf familiarity, or at least that this dimension is interfering with their evaluation to some extent.

The facta that there was a higher familiarity level in the most general words and that it descended to reach the subordinate levels —reverse relation of hierarchic level and familiarity (Goldberg, 1986, . 338-339)— led us to suppose that the same effect can be found in the imagery value evaluation of different sentences types by the subjects of our test. A brief revision of some high image value features, compared with the low image value ones, seemed to demonstrate it, although the familoiarity varaible was not taken into account in our test and it was difficult to conclude it restrictively.

Glass, Millen and Eddy (1985) concluded from their experiments that automatism versus control colud be the factor or dimension explaining the divergent results obtained until now when evaluating high and low image of the sentences in verification tasks. They proposed to carry out a sentence classification not according to the image value but accordind to the posssibility to acces therir content automatically or throouhg control strategies to generate and inspect the visual image. According to their proposals, reaction times for sentences with specific content would be short whereas reaction times for abstract ones would be longer and the task more complicated (differential search, etc), excep in cases when the context provides a determined and specific representation, allowing automatic and rapid access possible again. As we actually notice, this coherently and easily explains the very divergent and even contradictory results in this field, but it does seem to us definitive. The same conbclusion of these authors togother with their affirmation of the facility to manipulate experimentally the quickness to access to a representation (Glass *et. al.*, 1980), and, we add, the difficulty to controlo the prior experience aobtained in daily life by experimental subjects, with different types of mental representation, contexts, etc., obliges us to raise the question, to which extent it can be said that, sentences or texts, or linguistic input in general, with high or low image value and manipulating these as independent varaibles in experiments, when subject's representations, world representation in the end, for a given content, could present a variability margin so large.

Taking other aspects into account, the easiest aspect to translate into images -against what has been said many times- may be the global shape, the figure, the abstract prototypical configuration; so, the higher socre obtained by classificatory attributes indicating class inclusion "is a", against what Hampton said in 1981. Assuming that images allow a wholistic computation, we can understand why some types of features concerning global configurations, closed figures, etc. seem to have higher image value (Medina, 1986).

Maybe, as Morris and Hampton (1983) indicated, images have a more arbitrary relationship with the objects they represent than what Kosslyn assessed, this allowing them more freedom to the subject when generating and building them, etc. Nevertheless, the tendencies of the image values, higher for basic levels than for super-ordinate ones, and higher for biological categories (they have larger number of perceptual features) than for artefactual ones (higher functional features) seemm to be in accordance with Hampton's (1981) thesis.

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