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ABSTRACT

The way that students use mental representations when acquiring new knowledge can be exploited more systematically in the teaching of language for special purposes (LSP). A variety of modes of representation exist, including those in the external sensory world, that are received through the different senses and individual representational systems. Each individual's unique system can be determined from his choice of words or eye movements. In addition to possessing different representational tendencies in different subjects, humans have dominant modalities for each of these problems. It is important in LSP teaching to find out the students' most widely used representational system, and the system that most favors the assimilation of concepts in the specific subject area. The role of representations in concept formation must be linked with the basic process of memory. The theory of semantic, as distinguished from episodic, memory has implications for the format of knowledge representation and its organization. The basic concepts of a language are acquired extentionally, associating linguistic symbols with events and accumulating associations with time, reinforcing concept storage. This is exemplified in the concept of derivatives in mathematics. (MSE)

MENTAL REPRESENTATIONS AND LSP* TEACHING

Carlos Inchaurralde

1. Introduction.

The peculiar nature of what LSP teaching involves makes it possible the resort to mechanisms which, conveniently exploited, can be easily put to the service of the teacher without requiring any additional effort on the side of the student, given the fact that they are already part of their basic conceptual baggage. This is the case with the way in which the student uses mental representations when acquiring new knowledge. The possibilities that such a reality presents for pedagogy are important, despite the fact that nowadays they are being used only in an intuitive and asystematic way.

The following sections pose two different questions related to this central topic: on the one hand, the existence of different representational modes and styles; on the other, how the process of conceptual construction can be conceived in a multirepresentational way, given its direct link to sensory experience. I shall deal with the first question in section 2, whereas handling the second in section 3. In both cases there will be additional commentary on possible pedagogical implications for the teaching of LSP.

2. The modes of representation.

Our starting point should be the external sensory world, from which humans gather perceptions that they store in their memory, setting up links among them. This takes place in the first years of their lives, but also along the whole experience of individuals.

It could be argued that there exist other information channels, since the human brain also collects internal stimuli coming from our own body. No doubt they may play an important role as filters of external stimuli, and they may even contribute to an association of concepts with linguistic symbols (e.g. 'to be hungry', 'to be thirsty', 'to have pain', etc.). Nevertheless, symbols are received externally, and their reception comes in association with external phenomena.

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* In this paper, LSP stands for 'Language for Specific Purposes'.

In the same way, we might also refer to the fact that there exists an internal capacity, independent of the exterior world, which makes the development of human language possible. This is the theory of linguistic innatism, proposed by Chomsky, which, however, deals only with general principles and does not contradict the need for external information that facilitates this development.

But not only do individuals receive information from the exterior world through the different channels of the senses. They may also favour one specific type of internal representation. According to neurolinguistic programming claims, individuals have different ways of perceiving, understanding and experiencing the world: visually, auditorily, or kinaesthetically (cf. Trocme, 1985: 320).

The representational system of every individual can be easily detected with suitable techniques. From the words used by a person when describing a situation or an event it can be seen which one his/her dominant system is ('see', 'look', etc. for a visual system; 'listen', 'hear', 'order', 'ask', etc. for an auditory system; 'bite', 'fall', 'hit', etc. for a kinaesthetic system) (cf. Jacobson, 1983: 163). The representational system in use can also be detected through the movement of eyes, which reflects the path used by individuals to access memory (Trocme, 1985: 328; Cameron-Bandle, 1978).

Not only have human beings different representational tendencies in different subjects. There also exist dominant modalities for each of these representational cognitive styles. Garrod and Anderson (1987) tell us about how in spatial discourse different subjects resort to different description schemata (path description, line description, figural description, coordinate description). It is predictable that these different schemata correspond to specific ways of mental representation for spatial information.

There are some important implications for LSP teaching: All these considerations make it necessary (a) to find out the most widely used representational system among the students and (b) to find out the representational system which most favours the assimilation of concepts in the specific subject area for the language under study. Most of the time, (a) and (b) should coincide if the students have the right background for the subject. From then on, the representations which have the most adequate format can be used as a support for the acquisition of linguistic contents (e.g. spatial representations help in the assimilation of mathematical language; tactile, motile

and visual experience are useful for anatomical terminology in medicine, etc.).

3. Cognitive semantics and prototipicality.

The second problem, the role of representations in concept formation, needs to be handled in connection with the basic mental process of memory.

In any discussion about long-term memory, it is commonly accepted a distinction between episodic memory and semantic memory (Tulving, 1979). This second type would comprise knowledge not linked to any moment or concrete circumstance and poses two main problems relevant to our argumentation: (a) the format of knowledge representation and (b) its organization.

As for the first point, how concepts are represented, there seems to be two main approaches, images versus propositional representations. In Anderson (1983), arguments for and against both positions are proposed. A very interesting suggestion is Anderson's (1983: 390) itself, which defends a dual verbal-figurative code, since every modality has its own advantages. There are also other alternative proposals, such as Johnson-Laird's (1984) mental models. We arrive here at a problem of collision between different planes of study: Are these representations on the same level of consciousness as those mentioned in section 2? (If the answer is affirmative, we would be providing contradictory information) Or, on the contrary, are they to be interpreted as lying on different levels? As an answer to this question we might say: The modality of permanent representation could be thought of as a different thing from the way the information coming from the senses is processed according to the representation itself.

As for the second problem, the organization of semantic memory, there are two major proposals available: network models and feature models.

In a semantic network model (cf. Quillian, 1968), concepts are organized hierarchically and a given concept can be represented as a node in a wider network. On the other hand, in a model based on features (cf. Rips, Shoben and Smith, 1973), concepts are stored as chunks of conceptual components.

Aside from other problems that do arise, there exists a common fault in both models: Categories are considered to be discrete entities which are easily delimited, despite the fact of our knowing that in the world around us there are both clear and not-so-clear specimens of any category. Category inclusion is something gradual, and the limits of a category are not clearly defined, since

they are fuzzy.

Rosch (1973, 1978) deals with this problem establishing the existence of prototypes and showing that our categorization of reality is done through the grouping of objects around the most representative members for their category. Apart from establishing the existence of prototypical concepts, she also showed the possibility of different degrees of prototypicality.

4. Cognitive intension vs. cognitive extension.

Drawing on the distinction between two types of long-term memory, I shall introduce two new concepts that arise from this twofold storage modality, which I call 'cognitive intension' and 'cognitive extension' (the terms 'intension' and 'extension' are used here in a slightly different way from that of lexicography and intensional logic). We need to go beyond what the linguistic message accounts for in order to see how these two terms allow for explanation of the mental representations necessary for coding and decoding such a message.

Cognitive intension manifests itself in an episodic file. This file contains a set of discrete experiences and has no apparent organization, being structured only in terms of spatial and temporal coordinates.

Within this file, experiences with elements in common associate little by little around concepts. Events turn into representative samples. Psychological theories of perception make us suppose there is discrimination of different elements within a multiple sensory event, allowing for progressive categorization of what is recorded through the senses.

e.g. 'to run' as a concept, associated with a very large number of experiences A_i:

$$\text{'to run'} = \bigcap_{i=1}^{n} A_i$$

Extensionally, in our mind the concept 'to run' is the intersection of n experiences A. This number n grows with time, since the number of experiences of individuals also grows. We say then that it tends little by little to an infinite number of experiences.

This in turn increases the probability of approaching an 'exact' concept. However, the number of experiences will always be finite and, yet worse,

different throughout the whole variety of individuals, both from a qualitative and quantitative point of view.

It is qualitatively different because the experiences are complex events, involving different variables, which in addition will always be relative in their values, since the point of view changes from individual to individual.

That is why, despite the interest presented by what has been suggested for the elaboration of a mathematical theory of concept construction, there appear some problems which complicate such a treatment.

The mentioned process may explain, in general, the most basic concepts of a language: they are acquired extensionally, associating linguistic symbols with events. Experiences accumulate with time, and this association is therefore being created along a chronological axis.

In this approach, prototypes appear as a result of the progressive cumulative association of stimuli with external events, making the existence of a theory of prototypicality possible since the concept is constructed extensionally in a flexible way, by gradual aproximation. When the concept is incorporated into semantic memory, it is stored according to an intensional representation -the 'prototype'- which is always linked to its extension -the actual events stored in episodic memory-, always subject to revision.

Although intensions can also be represented in a direct way (e.g. when we learn the definition of a new concept in a book or a dictionary), it is nevertheless the association of that concept with perceptions and sensory events which reinforces its storage.

5. An example of extensionalization.

The progressive extensionalization of concepts can be seen as an underlying process in well-known taxonomies of educational objectives such as Bloom's (1966). In these taxonomies a sequence of objectives is defined in which the superior ones comprise the complete achievement of others which are inferior.

Bloom established the following objectives: (1) memory, (2) comprehension, (3) application, (4) analysis, (5) synthesis and (6) evaluation. A given stage cannot be accomplished without the perfect achievement of the previous ones. That is to say, (2) needs (1) to be achieved beforehand; (4) needs (1), (2) and (3) to be already completed, etc.

With the above used terminology, a progression in the taxonomy would correspond to progressive extensionalization. In (1), concepts are acquired as intensions, in (2) concepts are extensionalized when relating them to other intensions, and in (3) concepts are extensionalized relating them to external experience. (4) and (5) are operations that can only be carried out once concepts are clearly defined. (6) requires further extensionalization, since it comes with contrast and subjective evaluation of different conceptual constructs.

I shall illustrate all this with an example. The concept of derivatives in mathematics can be expressed intensionally in a natural language (with only the addition of a few symbols) like this:

"If there exists $\lim_{x \to a} \frac{f(x) - f(a)}{x - a}$ (and it is finite) we call the value of this limit the derivative of f with respect to x=a, and we denote it by f'(a)."

A student of mathematics may learn this definition as it stands, without understanding it. We are then in stage (1). In order to move to stage (2), however, the student would need to establish relations among the concepts in the definition ('limit', 'finite', 'exists'). We might call this process internal extensionalization, since it simply handles concepts already known. It is in the third stage, application, that our student associates the linguistic symbol 'derivative' with a set of events. This should typically happen when working out solutions to mathematical problems with the help of derivatives. But we may also play here with different levels of abstraction vs. concretion. The student might work out derivatives for given expressions, without any relation to the real world -constructing the concept as a set of operational rules-, or solve problems of physics in which concepts were linked to situations taken from reality, or even experienced by the subject in question.

6. Final remark.

In this paper I have put forward some questions related to the central issue of mental representations and their relation to the learning of LSP. The subject area is not well defined and theories tend to be contradictory in most

cases. The approach presented does not intend to be conclusive, but rather tentative, inserted in the framework of a phenomenological epistemology which is incomplete and provisional. It needs to be completed with detailed complementary treatment of the processes that take place when man acquires knowledge. Nevertheless, I find it interesting since it reveals aspects of practical interest in pedagogical practice.

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