

Modelling second language processing

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There are various ways of attempting to understand and describe mental phenomena. Asking informants to introspect while they are thinking and to verbalize the thoughts that metacognitively seem to accompany their thought processes is one of them. This approach has been criticized for the reason that not all thought processes may be open to conscious inspection. Observing people what they do in the real world and infer the mental events that seem to have preceded or lead to their behaviour in order to cope with the real world problem, or asking them to imagine what they would do if they were confronted with a fictitious problem is another way. Giving people the task of how they theoretically perceive an open end event in a fictitious world and of what they are likely to do is having them construct a heuristic mental model of the task situation and its potential solution.

The construction of mental working models, however, is by no means necessarily an artifact of problem solution experiments, it rather mirrors an essential aspect of cognition in general. Whenever we deal with the world – fictitiously or ‘really’ – we only can do so on the basis of our model of the world. «You may see that you perceive the world directly, but in fact what you experience depends on a model of the world. ...Hence, the nature of the mind and its perceptual system exert a decisive effect on the world we perceive. ...In short, our view of the world is causally dependent both on the way the world is and on the way we are. There is an obvious but important corollary: all our knowledge of the world depends on our ability to construct models of it.» (Johnson-Laird 1983, p. 402)

Looking then at how people construct models of problem situations in the world and how they are likely to solve them theoretically opens up the window into how the mind works and provides insight into modelling the mind.

«If the organism carries a ‘small-scale model’ of the external reality and of its own possible actions within its head, it is able to try out various alternatives, conclude which is the best of them, react to future situations before they arise, utilise the knowledge of past events in dealing with the present and future, and in every way to react in a much fuller, safer, and more competent manner to the emergencies which face it.» (Craik 1952, p. 61)

For a number of years we have been looking at how various informants and groups of informants – mostly students of different age, linguistic and ethnic background, and scholastic standing – that is novices as well as in one or the other project experts construct mental models when theoretically confronted with various problem situations.

In this line of research we partially replicated W. Kempton’s famous study on home heat control (Kempton 1987). We had expected that the question we asked our students would refer to a comparatively well defined simple problem they would be used to solve by going back to their own experience with centrally heated rooms. We also had thought that they would have some idea of the function of thermostats acquired in their science courses which they had attended during their highschool years. What we found was an extremely wide range of

answers, most of them derived from rather naive folk models almost totally lacking an understanding of the real cause of the problem. A second feature of many proposals made was learned helplessness, in that at an early point of discussion they would claim to be totally incompetent and propose to look for someone to help them.

In a second elaborate study concerning the malfunctioning of automobile electrical systems and our students' identification of its cause we compared their answers with those of automobile electricians, the experts. This last group, consisting of young apprentices as well as highly trained and experienced masters almost unanimously proposed the same decomposition of the complex problem and sequence of search procedures, quite obviously due to their experienced frequency of the occurrence of errors.

Quite differently from the experts our students' models disclosed extreme variation ranging from total ignorance leading to a complete state of helplessness to some sort of semi-professional identification and solution of the problem.

In a small action research project a graduate Japanese student of mine presented the following problem to his informants, a group of Japanese teachers:

You are using a copying machine at school. The machine is not producing copies. All the sheets which come out are black. What do you do?

The answers which were given fall into three categories:

- i Some informants propose to fix the machine on their own. This proposal seems to imply two different procedures. Some informants suggest to construct a mental model of the system's function, preferably with the assistance of the written instruction given in the manual or the trouble indicator, and then to identify and repair the particular cause of the malfunctioning.
Other informants, the «bangers», without theoretically dealing with a model of the system, propose an unsystematic random trial and error procedure of pushing the buttons, not based on a decomposition of the problem, but an unspecified hope that it will do.
- ii Other informants, the helpless ones, suggest to get in touch with colleagues, secretaries or service personnel (the experts) and have them solve the problem.
- iii A third group of teachers propose to totally change their overall plan, give up their intention to copy the material for the course and use a different teaching style without the material.

The mental modelling of the malfunctioning of technical systems and its cause(s) gave us some preliminary insight into our students' modelling of problem situations and was meant to be a first step towards a deeper assessment and understanding of second language learners' modelling of language processing, provided that language processing is not wholly automatized and quite frequently confronts speakers and hearers of second languages with problems they are aware of. The problem solution paradigm, in other words, was the guiding theoretical framework for the study of the mental modelling of technical systems and language processing. We have, of course, been aware that there is a fundamental task difference between theoretically proposing the solution for an imagined 'real' problem in the world through mentally modelling it and the mental modelling of an inner mental problem state and process which may only partially be observed, adequately understood, and sufficiently verbalized. We have known,

in other words, that such modelling may be derived from and reflect second-hand knowledge taken out of the books or even be used to demonstrate such knowledge.

Thus the construction of models of language processing and of the interaction of languages as a reaction to the elicitation task *What goes on in my head when I speak Spanish (English, ... a second language)?* represents a very special case of mental modelling. It requires some minimal sensibility for or insight into mental phenomena and a minimal conceptual and lexical ability to verbalize such experience.

Mental modelling may be absent because of a lack of such experience and be substituted by an expression of helplessness:

(1) *I don't know what to write down. (Dechert 1992, p. 14)*

Or the elicitation cue *What goes on in my head?* may be misunderstood as shown in the following statement of a Spanish/German bilingual:

(2) *I find it quite normal to speak Spanish, therefore nothing is going on in my head. (Dechert 1992, p. 14)*

The most frequently constructed model in our as well as in G. Bartelt's corpus is derived from the translation metaphor:

(3) *First, I think in Japanese and then I translate to English. (Bartelt 1997, p. 26)*

As in this utterance the translation process quite often is decomposed in two or three stages, marked by *first, second, then or finally*:

(4) *First, I think out the sentence that I am trying to speak or write in Japanese. Second, I search for English words that have the same meaning as the Japanese in my head, and I check grammar and words in that sentence. Finally I begin to speak. (Dechert 1992, p. 15)*

(5) *First, I think what I should talk, then I try to speak or write in English way but if I don't know the English words then I think in my language first, afterward I try to translate them in English word which I know or make them easier for me. (Bartelt 1997, p. 26)*

More detailed models of L1 – 2 syntactic and lexical interaction, conceptualized as search and translation process are found in our as well as in Bartelt's corpus. It is only natural that the potential distance of the languages involved appears to cause difficulties for such translation as in the statement of an Arabic speaker of English:

(6) *Arabic is opposite English, so sometimes I translate the words by using the opposite. (Bartelt 1997, p. 27)*

And in some cases translation is denounced as an inadequate processing component and replaced by explicit memorization and retrieval of automatized formulaic units of processing:

(7) *The main problem is that when I translate in my mind the word or sentences, they don't make sense in most cases, so what I do I try to memorize some of the Idioms or expressions English has. (Bartelt 1997, p. 27)*

A much more elaborated version of the translation metaphor which obviously is the result of studies in second language acquisition theory may be seen in the following model of one of our graduate students:

(8) *In the beginning I memorize isolated words or short sentences, and, while doing this, I am always having the translation into another language in my head (i. e. I acquire words). Later on I acquire some easy rules of grammar so that I may use the words I have acquired to form sentences. In course of time I acquire more and*

more rules and words of this language, and in my head the connection between the new and the known language is beginning to be loosened so that I do not always begin with a translation when I form a sentence. (Dechert 1989, p. 220)

Second language acquisition, that is second language processing over time is modelled as a three stage process:

- i – In a first pre-productive stage formulaic L 2 units (isolated words or short sentences) are memorized and stored together with their L 1 translation equivalents.
- ii – In a second, now productive stage there is still interaction between L 1 and L 2. In addition, syntactic L 2 rules are acquired and used productively.
- iii – In a third stage the L 2 system is gradually developing and separating from the L 1 system. Interlingual processing decreases. The inventory of an independent L 2 system of vocabulary and grammatical rules increases.

Thus progress in the acquisition of a second language is characterized by a continuous decrease of translation processes, that is of interlingual processing.

Quite interestingly, in Bartelt's as well in our data there are few cases in which second language processing is modelled according to the human information processing model, as proposed by Newell & Simon in 1972, or the computer or computation model, as it is normally called:

(9) Whenever I try to write or speak in English, my mind works like a slow computer. As I have a topic to write about, my mind starts to scan up and down finding the right vocabularies to translate my thoughts to English. (Bartelt 1997, p. 26)

Lexical search and retrieval is still modelled as a translation problem, but the search as such as a scanning problem of finding the correct entries in the mental lexicon, that is the memory in the computation model. This statement only partially envisages the whole complexity of interlingual processing.

The following answer of an 11 year old male German learner of English, who surely has never heard of Newell & Simon exemplifies the full scale of the computation model. In his modelling of bilingual processing the translation image is dropped in favour of an anticipated unified multilingual system, which does not insist, as in statement 8, on the existence of two independent and isolated systems L 1 vs. L2.

(10) I guess in my head the same things occur as in a computer. There should be a memory in the head where everything I learn is stored and is taken out when I read or write. And (it is) processed no matter whether English or German. In this memory there should be space for different languages. And when I learn English now all stored items are taken out and processed. It is the same with German or any other language. And when the lesson is over the items that were taken out before are stored again.

Expertise in the mental modelling of technical systems, such as copying machines, undoubtedly contributes to the solution of technical problems occurring with the malfunctioning of these systems. In order to repair a copier and make it go again one must model the cause of its malfunctioning. Thus the Japanese teachers who suggested to consult the manual or the trouble indicator in order to acquire some theoretical understanding of the system, that is to construct a mental model of it, as well as those who proposed to get in touch with service people and thus share their expertise did the right thing.

What about the function of expertise in second language processing? Whether metacognitive knowledge and the ability to model processing when confronted with processing problems, such as lexical search, improves such processing, we do not know for sure. After all, first and second languages throughout the ages have been processed, been acquired and used wherever and whenever human beings have communicated with each other. Our 11 year old informant, though, happens to be a good language learner compared with his peers. Is his computation model the cause for his second language competence or is this model the consequence of a deeper insight into second language processing that goes along with his competence?

REFERENCES

- Bartelt, G. 1997, The ethnography of second language production. *International Review of Applied Linguistics*, 35, 23-5.
- Craik, K. 1952, *The nature of explanation*. Cambridge, Cambridge University Press.
- Dechert, H. W. 1989 Interlingual processing in students' mental folk models. In H. W. Dechert; M. Raupach eds., *Interlingual processes*. Tübingen, Germany, Gunter Narr, 211-228.
- Dechert, H. W. 1992 «The study of neurolinguistics made me notice what school grammar is.» In O. Leirbukt; B. Lindemann eds., *Psycholinguistische und didaktische Aspekte des Fremdsprachenlernens. Psycholinguistic and pedagogical aspects of foreign language learning*. Tübingen, Germany, Gunter Narr, 7-23.
- Johnson-Laird, P. 1983 *Mental models: Towards a cognitive science of language, inference, and consciousness*. Cambridge, Cambridge University Press.
- Kempton, W. 1987 Two theories of home heat control. In D. Holland & N. Quinn (Eds.), *Cultural models in language and thought*. Cambridge, Cambridge University Press, 222-242.
- Newell, A.; Simon, H. A. 1972 *Human problem solving*. Englewood Cliffs, NJ, Prentice-Hall.