Turn on your TAP: memory in language processing

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ABSTRACT. Memory has always constituted an important aspect of research on language acquisition and learning. Traditionally, this research looks at the processes involved in memorising language elements, that is, memory learning strategies in FL vocabulary acquisition or the processes involved in the recall of language, for example retrieval strategies. In descriptions of language processing, models created have highlighted ways of memory functioning at different stages of incoming data-processing, thus focusing on short term memory (STM) and long term memory (LTM) and the relations between the two. Individual learner differences at the level of cognitive styles have also been investigated in relation to memory as a significant variable in learning and language production. The above mentioned areas of research are most frequently investigated by means of different retrospective techniques.

This paper is also concerned with language processing and the ways STM is activated but on this occasion simultaneously with exposure to a language task to be performed. The main objective of the paper is to demonstrate how simultaneous introspection as a research method can inform us about these processes and the functioning of memory. It looks at selected research projects using simultaneous introspection and think-aloud protocols (TAP-s) as ways of collecting and analysing data in a multilingual context of language production. The aim of the paper is not however to discuss the findings and to answer the research questions posed in my own research over the period 1993-2005 but to show the general validity of TAP data in studying memory and language activation processes.

KEY-WORDS: short term memory, on-line processing, thinking aloud protocols, second language acquisition, language activation.

1 – Introspection as verbalised thoughts

1. 1 – Introspective methods and their characteristics

1.1.1 – Description

The use of introspective methods came into being with the challenge to the hegemony of behaviouristic theory, with its *STIMULUS – RESPONSE* formula seeking to explain the mechanisms and structure of cognitive processes of human mind. The inadequacy of S – R explanations led to the feeling of dissatisfaction among scientists and made them look for methods that would enable them to probe the subjects' internal states. Data obtained in those experiments have become fundamental in psychology, although there are still many doubts raised about "the new methods" of introspection, about their being highly speculative and subjective (Gabryś1995).

To be able to see the validity of these method it is necessary to describe the encoding process which transforms behaviour into data and then back from data into behaviour, indeed to describe cognitive processes of human mind. Ericsson & Simon (1984) claim that:

> Verbal behaviour is to be accounted for in the same way as any other behaviour, that is, by developing and testing an information-process model of how information is accessed and verbalized in response to stimuli.

Each verbalization comes from the cognitive process that under-lies it. Consequently, verbalization must comply with all the constrains that have been identified for cognitive processes. In turn, cognitive processes consist of a set of sub-processes, which follow one another and are being transformed under the influence of a series of information processes. Information is stored in short term memory (STM - with a limiting capacity of about 15-20 seconds) and in long term memory (LTM - with permanent storage but slow access time). Information just received is stored in STM and is easily retrieved and articulated at the time of performing a task.

Verbalization processes of which all introspective methods make use, reflect cognitive processes in two ways, either:

a. directly, i.e. the time of the task performance is concurrent with the verbalization

or

b. indirectly, i.e. the information is retrieved from STM or LTM after the completion of the task.

In both cases verbalizations become functions of time.

Verbalization of cognitive processes in thinking aloud takes place on three distinct levels of thought processing. Ericsson & Simon (1984) describe them as:

1. the level of the vocalization, i.e. articulation of oral encodings, where no thinking processes take place. In self-directed verbalizations (e.g. in the case of thinking aloud protocols -TAPs) they are individual and depend on the subject's interpretation of the instruction s/he is given or on the semantic content of the task;

2. the level of description or explication of the content, which means "labelling" information and recoding it in an idiosyncratic way, characteristic of a subject/informant;

3. the level of explanation of thoughts and ideas that rush through the subject's mind or any other, even emotional, reactions to the information (task) s/he is to solve. It involves a process of interpretation. (Gabryś1995)

Level 1 verbalization is a *direct* process in which information encoded is vocalized (articulated), i. e., in a language task a phrase or a sentence is pronounced or read aloud by the subject with no cognitive processes taking place. *Level 2* and *level 3* are encoded verbalizations where the information attended to by the subject (level 1) is modified by recording processes, i.e., the subject generates a verbal representation of the information s/he has got stored in his/her mind by means of filtering it for the purposes of the task.

On *level 3* the subject reports his/her ongoing thinking, embracing not only its verbal aspects, i.e. word associations and interferences

from L1 and L3 (for example) but also personal, emotional responses to the task.

The way one (a subject) verbalizes, i.e., the extent to which the above mentioned levels occur in the process of verbalization may be influenced by *the type of instruction* given to the subject. Here are some examples of instructions in various experiments, starting with the first TAP (thinking aloud protocol; all quotations come from Ericsson & Simon 1984):

> "*Try to think aloud. I guess you often do so when you are alone and working on a problem".*
>
> "*Think, reason in a loud voice, tell me everything that passes through your head during your work searching for the solution to the problem".*

To be able to receive a complete report of a thinking process, other types of information are essential, such as are requested in the following instructions:

> "*The chief thing is to talk aloud constantly from the minute I present a picture, for I want to get everything you happen to think of no matter how irrelevant it may seem".*
>
> "*I am not primarily interested in your final solution, still less in your reaction time but in your thinking behaviour, in all your attempts, in whatever comes to your mind, no matter whether it is a good idea or less good idea or a question. Be bold! I do not count your wrong attempts, therefore speak them all out.'*
>
> "*Do not plan what to say or speak after the thought, but rather let your thoughts speak, as though you were really thinking out loud".*
>
> "*In order to follow your thoughts we ask you to think aloud, explaining each step as thoroughly as you can".*
>
> "*Do not try to explain everything to anyone else. Pretend there is no one here but yourself. Do not tell about solutions but solve it."*

Each of the instructions, apart from their common intention to make the subject verbalize his or her thoughts, emphasizes a different aspect of the verbalization process. These instructions fulfil the role of a monitor in performing the tasks (Gabryś 1995).

1.1. 2 – Introspective methods in psychology

Man has always been interested in and speculated about the nature of the mind and thinking processes. As early as ancient times, philosophers and priests questioned the nature of the cognitive processes going on in the human mind. Pure observation used to be the only source of knowledge – and mostly, self-observation. However, observation has not been and often is still not considered to be a pure scientific method, even when it describes simple natural phenomena (to say nothing of the human mind). Though with time, controlled observation carried out in laboratory conditions or in various research contexts, and described in terms of strictly controlled variables, has become a scientific method capable of offering "indisputable evidence" (Ericsson & Simon 1984). The pioneers of introspective methods emerged at the turn of the 20th century. Most of them used the method to investigate the contents of consciousness (James, Wundt, Doners), reducing it to sensory and imaginal components reported by the subjects. The number of studies undertaken was relatively small. The first *thinking aloud protocols* (TAPs) produced in psychological experiments were simple descriptions of what had been said by the subjects and not their actual verbalized thoughts. As a consequence, they were very selective, biased and interpretative. The first protocols were used by Watson (1920) to illustrate thinking processes involved in a problem-solving situation. They were very unsystematic and full of interpretative remarks (Gabryś 1995).

2 – Introspective methods in second language acquisition research

As noted in Gabryś (1995), research in SLA dealing with error analsis over the past decade reflects a shift of emphasis from the product (i.e., an incorrect language form) to the process which underlies generation of the latter, as well as of correct forms. **Introspective reports,** described as an empirical tool of measurement of human behaviour long employed in psychology, have gained recognition as a mode of research in SLA only recently. Cognitivism in L2 /FL teaching and learning allowed the introduction of introspection as a valid and reliable method of research. It offers a variety of procedures for data

collection that can be classified according to certain pre-established criteria (Faerch & Kasper 1987).

2.1 - The criteria for classification of data collection

Faerch & Kasper (1987), the most ardent advocates of introspective methods in SLA research, propose the following criteria:

1. Object of introspection (according to the type of information gathered):

    a. cognitive, affective or social aspects

    b. declarative versus procedural knowledge

    c. modality of language use (spoken vs. written, receptive vs. productive, combination of the above, e.g. in translation)

    d. continuity of the process vs. a concrete aspect.

2. Related or unrelated to a concrete action.

3. Temporal relation to action (simultaneous, immediately conse-cutive, delayed consecutive).

4. Informant training.

5. Elicitation procedure selected:

    a. degree of structure

    b. media support

    c. self-initiated v. other-initiated

    d. degree (presence or absence) of interaction between the in-formant and experimenter or between informants themsel-ves

    e. integration with action (e.g. recorded discussions).

6. Combination of methods.

2.2 – Characteristics of data and focus of research

The object of introspection may refer to various aspects of lan-guage production the experimenter wishes to investigate. His/her in-terest may lie in a cognitive structure of the IL (interlanguage) of the informants. In other cases, when for example L2 achievement is to

be measured, an affective aspect of a language performance may be in focus. In the case of measuring affective aspects involved in L2 learning such as motivation and attitudes, introspection becomes a complementary tool to all kinds of interviews and questionnaires administered.

When performing certain language tasks *two types of knowledge* are being activated by the subjects, that is, *declarative knowledge,* referring to the knowledge of L2 rules (competence), and *procedural knowledge*, referring to the actual production (performance). Introspective methods and especially TAPs make it possible to follow the processes which are being activated, be they either in language learning and the development of receptive or productive skills. However, it is important to note that only *conscious thinking processes* can be stored and verbalized in STM (LTM in the long run). It is obvious that some of the cognitive processes (automatic ones) are lost in TAPs. But in most language tasks, subjects are faced with certain linguistic problems to be solved, so the thinking processes operate on a conscious level, i.e., the solutions do not come automatically but require all sorts of strategies (for example, recall strategies) to be used by the subjects.

The first studies in SLA carried by means of introspection in the early 70's referred to investigating the *competence of native speakers* (i.e. their declarative knowledge) concerning their intuitions about L1 (their mother tongue). They consisted of judgement tests and interviews recorded and transcribed. At the beginning of the 80's, TAPs found their way into L2 research of reception and production (Raabe 1982; 1986; Faerch & Kasper 1986; Schneider & Zimmermann 1986; 1987).

Introspective thinking aloud may focus on either the *overall approach* of the subjects towards the task, in which the whole process of task fulfillment is verbalized - or on *a specific aspect* of the task under consideration, which involves question-asking and interference on the part of the experimenter. The latter is often used in the cases of lexical search performed by the subjects. A part of SLA research, namely that dealing with motivation and establishing profiles of learners, focuses on the description of a certain action or behaviour the subject is involved in when performing the task.

Temporal relationship to action in thinking aloud can either be:

a. simultaneous - subjects verbalize at the moment of performance;

b. consecutive - verbalization comes immediately after the fulfilment of the task;

c. delayed consecutive - there is a time span between the performance and verbalization.

The first type – *simultaneous verbalization* – is used in such tasks as listening and reading comprehension, writing or translation. The phenomenon of speech (communication strategies) can best be investigated by means of immediately *consecutive reporting* (STM is activated here), while *delayed introspection (retrospection)* makes use of diary studies or direct retrospective interviews and discussions.

Another important aspect of the methodology of introspective methods is the subjects' *training in verbalizing* cognitive processes. Although it was claimed by Ericsson & Simon (1984) that lack of training does not influence the reports, it nevertheless influences their completeness. Subjects that have been exposed to the recordings of thinking aloud become more conscious of what verbalization means and what aspects of cognitive processes and which emotional stages are taken into consideration. In addition, such exposure definitely reduces the stress and inhibition caused by the novelty of the method of data elicitation, which for some subjects may seem daunting.

The elicitation procedures utilized differ according to *the degree of structure* imposed on the informants (subjects) by the experimenter. They vary from multiple choice questions (e.g. judgment tests), open – ended questions (eg. in interviews and questionnaires) to "free" verbalization (e.g. in translation or cloze tasks), in the case of which subjects themselves make choices or often are straightforwardly being told to verbalize continuously everything that comes into their mind.

In the case of introspection, informants are often exposed again to the stimulus with which they had performed their task for the first time, that is, an original text or a picture story they had been previously asked to reflect on – with the purpose of activating their LTM. However, some retrospective studies do without recall support.

The data elicitation sometimes involves *interaction between the experimenter and the subjects or between the subjects themselves.* In such cases, interpretation of the data collected becomes much more complex as extra variables such as group structure and its dynamics, personal characteristics and other social and psychological factors influence it (Gabryś 1995).

2.3 – Introspection in translation tasks

One of the SL teaching and learning areas most open to introspective methods of investigation is *translation*, since it is a process which for the most part takes place on the level of consciousness which means it is accessible to verbalization.

Krings (1986) argues that the objections raised against concurrent introspective verbal reports are valuable sources of data, such as:
- the inaccessibility of certain cognitive processes for verbalization,
- the inconsistency of the actual behaviour and verbalization,
- the interfering character of verbalization, i.e., influence on the performance of an informant,
- the incompleteness of reports become irrelevant and inapplicable in the case of translation.

Compared with retrospective methods, *introspection* utilizes information stored by informants in their STM, i.e., information which is still accessible at the time of verbalization. Besides, processes verbalized do not require on the part of the informant any kind of "selection' or "interference' or speculation on the language sample, but straightforward information on what he or she is actually doing at the very moment and whatever thoughts pass through his or her mind.

The process of translation embraces *two aspects of language performance:* automated processes on the unconscious level and non-automated processes on the conscious level of processing. Verbal reports make it possible to distinguish between the two aspects. When verbalizing on the conscious level no distortion or change of the structure of language form received takes place, while translation, unlike non-verbal tasks, involves the use of a verbal code, so no extra

encoding is necessary. It is a natural process, and so Ericsson & Simon (1984) call it "level 1 verbalization" (see above).

It is often argued by those who criticize verbal reporting that verbal reports present *incomplete data.* It is obvious that a full report of all the mental (cognitive) processes is indeed not possible, taking into consideration the fact that a part of them is automated, i.e. unconscious. But accompanied by other experimental data, verbal reports come closer to a direct presentation (interpretation) of cognitive models than any other method.

Krings (1986) and other researchers who used translation tasks in collecting verbal report data all stress a low degree of structure of the reports, and Krings (1986) argues that "it is necessary to develop analytical categories step by step and to refine them gradually". In the case of a translation task, *the basic categories* are those of *translation problems* (the first category) encountered by the informants and *strategies* (the second category) that are used to solve them. Translation problems can be caused either by comprehension problems at one end and production ones at the other.

For *the first category* (translation problems), further differentiation at the level of features can be made for both translation problems and strategies employed by the informants. It may include:

1. a number of problems encountered (for the purposes of comparison of the informants)

2. identification of difficulty areas (often very individual, showing idiosyncratic use of both L1 and l2)

3. successful (correct) solutions of translation difficulties versus unsuccessful (incorrect) ones.

The second category focuses on retrieval strategies, i.e. ways in which informants perform lexical search. Retrieval diagrams have been drawn up to demonstrate step by step strategies verbalized in TAPs. It is especially in this category that thinking aloud gives a lot of information, compared with pure performance data (product) analysis of a translation handed in.

These categories refer to structuring data received in TAPs that can be identified in verbal protocols. Apart from the two mentioned

above, other types of information can be gathered, for example, the informant's attitude towards the solutions of the problems he or she has arrived at - ranging from full acceptability to full dissatisfaction, or justification for certain choices made. Krings emphasizes the importance of *minimal interference* by the experimenter, i.e. no pressure to verbalize should be put on the informant since it could cause certain distortions of the naturalness of the translation process. Data received in TAPs can easily be *complemented* and *validated* by means of other methods, such as word-association tests and judgement tasks.

The results received in verbal reports that are based on translation can obviously be used for *a description of translation processes*, but at the same time they give a valuable insight into retrieval strategies, production problems and make it possible to identify areas of difficulty encountered by the subjects at various level of language advancement (Gabryś 1995).

3 - Introspective methods in second language learning research (examples)

Table 1 presents examples of studies of various aspects of foreign/ second language performance when the whole variety of introspective methods and their combinations was deployed.

TABLE 1. Introspective methods in SLA studies (based on Gabryś-Barker 2005)

Research focus:	Studies:
Learning strategies	Naiman 1975, Stevick 1981, Wenden 1982, Cohen 1984
Reading in a foreign language	Cavalcanti 1982, Serrano 1984
Translation	Gerloff 1986, Krings 1986, Schneider & Zimmermann 1986, Schneider & Zimmermann 1987
Lexical search	Schneider & Zimmermann 1986, Haastrup 1987, Williams & Hammarberg 1998, Herwig 2001
Spoken language	Schwartz & Flower 1980, Dechert, Mohle & Raupach 1980/1984,Cohen & Aphek 1981, Faerch & Kasper 1987
Writing in a foreign language	Hayes 1983, Raimes 1985
Language transfer	Dewaele 2001, Jessner 2003

The whole variety of learners' behaviours can be observed on the basis of introspective verbal reports:

a. the way learners attend to language input

b. the way they arrive at spoken utterances (speech production)

c. the way the text is being processed (reading comprehension, the reading process in L2 itself)

d. the way the text is being generated (the writing process)

e. the way lexical items are learnt at the stage of input

f. the way lexical items are retrieved from memory.

The presentation in Table 1 is by no means exhaustive. The studies quoted above are the earliest, the most recent and the best-known ones in SLA research. It is worth mentioning that research in SLA by means of introspective methods has become more and more influential, especially as it gained the status of a scientific research tool not so long ago.

To exemplify the use of the theoretical framework of introspective methods in research, both in psychology and SLA, I would like to describe the way in which I incorporated **concurrent introspection** to advance my studies on multilinguality, or more precisely on the mental lexicon of multilingual language users (Gabryś-Barker 2005).

4 – Multilinguality researched by introspection

I would like to present here several projects I conducted with the aid of simultaneous introspection, in which the complexity of multilingual language interaction in the mental lexicon was observed from various perspectives (Table 2)

TABLE 2. Simultaneous introspection in SLA studies (Gabryś/Gabryś-Barker 1993-2005)

Study:	Type of language tasks used:	Research focus:	Year:
1.	Cloze task (in L2 English) Translation from L1 (Polish) into L2 (English)	* retrieval strategies of restricted collocations * metaphoric interpretations * psychotypology * learner profiles	1993
2.	Translation from L2 (English) into L3 (Italian) (English/Italian)	* language transfer at the level of lexis and syntax * transfer of training * language competence in language transfer	1999a
3.	Translation from L1 (Polish/Portuguese) into L2 (English) Translation from L2 (English) into L3 (German)	* lexical search processes * acquisition versus learning * transfer of training	1999b
4.	Translation (as above)	* the influence of the language of input (L1 versus L2) on the TL output * implicit versus explicit processing * lexical transfer	2005
5.	Translation (as above)	* inner/private speech * activation of individual languages * levels of metalinguistic awareness	2005

The transcripts of the verbalizations in the form of TAPs demonstrate the ways multilingual language users access their mental lexicon(s) and what processing mechanisms can be observed. The data stressing the importance of individual factors in multilingual processing, such as for example learning history or transfer of training, are re-examined in studies 1, 2 and 3 (Table 2).

In study 4, different approaches to the language task are presented, depending on the language of input (L1 or L2). The data exemplify different types of retrieval strategy used by the subjects in their verbalizations. The incorrect lexical solutions are observed, classified and discussed. Study 5, on the other hand, focuses mainly on the

language of thought and language activation/inhibition in different types of comments produced by the subjects when performing thinking aloud during a multi-language translation tasks. (Table 2)

Having analysed the results of the above studies, it became apparent that the phenomenon of multilinguality and in this case multilingual lexical competence, is very much determined by the language awareness of the subjects - in general, and by lexical awareness in particular. Additional survey studies were carried out to determine the subjects' perceptions of the phenomenon and their ability to use their linguistic knowledge in the practice of multilingual lexical development. It was assumed by me that this form of data collection (questionnaires) would exhaustively and explicitly show the subjects' language awareness.

As I say in the concluding chapter of my book (Gabryś-Barker 2005), these studies investigated the enormous complexity of multilinguality, and specifically lexical multilinguality – not only how words and phrases are stored but also how they are accessed and retrieved from memory. The observations on processes involved in the tasks of lexical retrieval (search) were recorded and discussed on the basis of thinking aloud protocols (simultaneous introspection) and retrospective comments by the subjects. They demonstrated that lexical search processes are not only lexical in nature; they also involve syntactic and phonological processing as important elements in lexical competence. TAP data also allowed me to formulate possible explanations for types of relations between languages that were observed in language processing recorded and retrieved from ST memory. They are:

- an L3 acquisition mechanism is different from that of L1 – learning L3 involves a similar mechanism to be activated as is the case with L2 (learning and not acquisition),
- activation of the mechanisms leads to activation of the language itself,
- suppression of L1 as *" non-foreign"* and recourse to another *foreign language* i.e. L2 as a learning/processing strategy.

5 – Sample data: A learner profile

The following examples come from the study conducted in 1995 (Gabryś 1995), which aimed as demonstrating the type of data accessible by means of simultaneous introspection.

TAP 1:

 - ah - I'll read it first - *przeczytam (czyta)* When Albert ..... I've won the big prize - *kurcze nie wiem - hm hm - czasy - (czyta)* When Albert entered the office- *(pisze)*Quando Alberto - *enter -entrare- entered - entre - o - r - a - entrato in - past definite - czyli simple past - czyli - passato prosimo - entered - (pisze)entrare* - entrato in - *l'oficio - l'uficio - nel'oficio - (pisze)* nel'oficio - *double f - (powtarza) officio-officio-officio.......*

Observations on language processing:

- · attendance to input: holistic versus fragmentary
- · the use of metalanguage and consciously acquired rules
- · automatic recall of nominal phrases
- · importance of accuracy in grammar and spelling

TAP 2:

(reads) Nobody was working - *to będzie czas ciągly -(powtarza) nobody was working- czas ciągly czyli imperfetto czyli a -work - lavoro- (pisze)* nessun - *tylko czy to będzie tak jak po angielsku - was working - working - liczba pojedyncza - nikt nie pracowal - (pisze)* nessun - - *nie wiem czy to bedzie podwojna negation - bo jak w polskim - (pisze)* nessun lavorava - *napiszę-* a tutti impiegati.

Observations on language processing:

- · examples of transfer between L1, L2 and L3
- · focus on grammatical accuracy
- · verbalisation exclusively in L1

 TAP 3:

(czyta) ... were still talking about the lottery - *and - znowu będzie imperfetto- to zreszta podają poniżej - parlare di - parlavano - (pisze)*

impiegati parlavano - *vamo - di lottery - lotterija - to bedzie po hiszpańsku - no to ja muszę sprawdzić w slowniku -* loteria - *parlavano di lotteria - czyli będzie (pisze)* della lotteria - *della lotteria.*

Observations on language processing:
- · grammar focus (again)
- · use of grammatical rules
- · references to Spanish (L4): perceived language distance

TAP 4:
(czyta) Jules - *jak to się będzie wymawiało - po włosku -* Jules - *nie - (czyta)* his best friend - *I - il - migliore - miglior - (pisze)* miglior amico - il suo miglior amico - *a jeszcze zapomnialam - (czyta)* impiegati parlavano - *still still - to jest - nie - ancora - nie pamietam - musze sprawdzić - still ancora - nie wiem czemu mi sie skojarzyło z już - yet - still - impiegati ancora parlavano - nie wiem czy będzie przed parlavano ...*

Observations on language processing:
- · focus on word order (L2/L3 language transfer)
- · need of assistance (dictionary) in lexical search

To sum up, this data can lead to establishing a learner's profile on the level of:
1. language competence in:
   * attendance to input
   * crosslinguistic consultations (L1, L2, L3)
   * memory and cognitive strategies of recall
   * perceptual styles
   * sources of language interference and typology of errors
   * strong and weak points of a learner
   * degree of internalization of rules and automatization of recall
   * transfer of learning and transfer of training
2. on the affective level:
   * attitude to the language task
   * motivation to perform
   * autonomy in language production

6 – The final comment

The success of verbalization processes, and as a consequence the type of data retrieved, is very much determined by the initial training of the subjects. It entails exposure to the introspective methods and thinking aloud materials. In many cases warm-up exercises are used to attune the subjects to the experiment or to give them some initial practice. Such exercises allow the researcher to intervene to help the subjects in their verbalizations by stopping them from lapsing into silence or by monitoring them initially. However, the extent to which pre-training is given should depend on the informants and their personal characteristics and on the nature of the task to be performed.

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