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THE NEURAL BASES OF FOSSILIZATION

The article aims at presenting a few neuroanatomical models and neuroanatomically based theories (the Maturational State Hypothesis, the Aging Hypothesis, the Fragile Rote Hypothesis and the Entrenchment Hypothesis, among other things,) inherent in the concept of fossilization. The models will be considered from the point of view of the advanced users of language, an emphasis being put on an interplay of factors responsible for the fossilized language competence.

1. Introduction

The individual factor underlying the concept of fossilization is the age. This paper is focused on neural changes that occur during adulthood – a period that roughly spans the age range of 20–80 years. Obviously there are finer than age differences across adults as some people exhibit extensive decline in cognitive efficiency as their age, whereas others show only modest losses, and a few maintain cognitive functioning at a near constant level throughout their life. That is why we focus on adulthood without differentiating between its early and late stages.

2. Fossilization

Most frequently described as a process in which inappropriate language features become a permanent part of the way the person speaks or writes the language (Richards et al. 1999:145), fossilization has taken on many other shapes and forms. To name a few, it may be coterminous with:

- 'Stopping short' (Selinker 1974: 36),
- 'Ultimate attainment' (Selinker 1974: 36),

- 'Language incompleteness' (Schachter 1990: 99),
- '(…) non-progression of learning (…)' (Selinker 1992: 257),
- '(...) non-learning' (Selinker 1992: 257),
- '(…) an early halt to further progress in the new language (…)' (Paul 1993:93),
- 'The point at which development towards the target language norm stops' (Norrish 1995:53),
- '(...) cessation of further systematic development in the interlanguage'. (Selinker &Han 1996), or
- 'Permanent failure of L2 learners to develop complete mastery of TL norms' (Bartelt 1993:127).

What they have in common is the emphasis of a temporary and regressive nature of fossilization resulting in language blockage and impediment. And whether it be two--word definitions or longer descriptions of the phenomenon in focus, they all fall into the category of inaccuracies and shortcomings in the target language, their common denominator being lack of interlanguage development. This "stagnation" in learning, however, results in far-reaching consequences which do not only add much "flavour" to the very interpretations of fossilization alone, but also allow for its thorough investigation, and, thus, a multitude of more specific views on the fossilized language.

These more specific judgements are encapsulated in the following statements portraying fossilization as:

- 'Regular reappearance or re-emergence in IL productive performance of linguistic structures which were thought to have disappeared' (Selinker 1974: 36),
- 'Appearance of certain structures despite continuous exposure to natural and pedagogical L2 data' (Selinker & Han 1996)
- 'Persistent non-target-like structures' (Selinker &Lamendella 1978: 187), or, to put it in a bit lengthy fashion,
- 'The long term persistence of plateaus of non-target-like structures in the interlanguage of non-native speakers (even those who are very fluent speakers of the L2)' (Selinker & Lakshmanan 1993: 197).

Following from the above, the opinions on fossilization, be it general in nature or specific in character, are two-fold, i.e. derive from two different approaches to the subject-matter. The first one identifies fossilization with incorrect language forms exclusively. The other, however, places fossilization under the heading of both an erroneous and non-erroneous phenomenon.

The former standpoint is, among others, fully shared by Hyltenstam (1988: 68 or Preston (1989: 245), who conceive of fossilization as 'features of the second language learner's inter-language that deviate from the native-speaker norm', and 'persistence of an incorrect form in the emerging inter-language' respectively. Brown (1987: 186), in his detailed description of fossilization, shows the same attitude to the phenomenon under investigation, recapitulating with a definition of a construct of 'the relatively permanent incorporation of incorrect linguistic forms into a person's second language

competence'. This way or another, fossilization is explicitated as a phenomenon pertaining to the language shape(s) far from the language norm(s).

Much as has been said on the erroneous character of fossilization, the latter point of view, mirrors the opinions expressed by Vigil and Oller (1976) or Ellis (1994) who all perceive fossilization as consisting in both correct and incorrect forms. To provide evidence for the existence of erroneous and non-erroneous representations of fossilization, Ellis (1994: 48) demonstrates the exact mechanism responsible for the processes under discussion:

> If, when fossilization occurs, the learner has reached a stage of development in which feature x in his interlanguage has assumed the same form as in the target language, then fossilization of the correct form will occur. If, however, the learner has reached a stage in which feature y still does not have the same form as the target language, the fossilization will manifest itself as error.

The mechanism, as can readily be seen from the above quotation, stands for the learner's stage of language development and internalization of language rules. These, unsurprisingly, determine the quality of the language and, at the same time, indicate the extent to which the language has fossilized.

2.1. Learning

Analysing the concept of fossilization it is important to depart from an appropriate definition of learning. Definition which would assume learning to be an active process, and according to Centre for Educational Research and Innovation (2007: 139) learning can be described as a series of mediated socio-cultural adaptations of brain structure with functional consequences. Then from a neuroscientific perspective, learning occurs as a cascade of molecular events resulting in structural modification with significance for subsequent learning (Centre for Educational Research and Innovation 2007: 139). As a result, the following sources of fossilization may be distinguished.

2.2. Sources of fossilization

The sources of fossilization are numerous and slightly differ according to a given approach and/or classification. Selinker (1974), for example, speaks of five central processes, namely language transfer, transfer of training, strategies of SL training, strategies of SL communication, and overgeneralization of TL linguistic material. Ellis (1995) makes a distinction into external (e.g. communicative pressure, lack of learning opportunity, the nature of the feedback on learner's use of L2) and internal (e.g. age and the lack of desire to acculturate) causes of fossilization. And most recently, Han (2004) alarms on cognitive, socio-affective, environmental, and neuro-biological factors contributing to the phenomenon in question. The exact influences are illustrated in the table below (Table 1), however, the onus will fall on the neuro-biological aspect, it being the main focus of the paper.

Table 1. Sources of fossilization (adapted from Han 2004: 29)

EXTERNAL	Environmental		Absence of corrective feedback Lack of input Reinforcement from linguistic environment Lack of instruction Lack of communicative relevance Lack of written input Language complexity Quality of input Instruction
INTERNAL	Cognitive	Knowledge representation	L1 influence conspiring with other factors L1 influence Lack of access to UG Failure of parameter-resetting Possession of a mature cognitive system Non-operation of UG learning principles Learning inhibiting learning Representational deficits of the language faculty
		Knowledge processing (receptive/productive)	Lack of attention Inability to notice input-output discrepancies False automatization Automatization of the first language system Using top-down processes in comprehension Lack of understanding Use of domain general problem-solving strategies End of sensitivity to language data Lack of opportunity to use the target language The speed with which, and extent to which, automatization has taken place Processing constraints Failure to detect errors Failure to resolve the inherent variation in the inter-language Reduction in the computational capacity of the language faculty Lack of verbal analytical skills Lack of sensitivity to input
		Psychological	Inappropriate learning strategy Change in the emotional state Reluctance to take the risk of restructuring Simplification Natural tendency to focus on content, not on form Avoidance Transfer of training

	Neuro-biological	Changes in the neural structure of the brain Maturational constraints Age Decrease of cerebral plasticity for implicit acquisition Neural entrenchment Lack of talent
	Socio-affective	Satisfaction of communicative needs Lack of acculturation Will to maintain identity Socio-psychological barriers

2.2.1. Neuro-biological bases of fossilization

Taking into consideration neuro-biological constraints triggering fossilization (Table 1.), much attention is paid to *age* and *maturational constraints*. What is at issue is Critical Period Hypothesis (CPH), which, in its second version under the name of the Maturational State Hypothesis, holds that

> (…) early in life, humans have a superior language capacity. The capacity disappears or declines with maturation, i.e. even when it is used normally for L1 acquisition.
>
> (Long 2003: 497)

The implications for SLA indicate that the lower the age at which the learners are exposed to a language, the higher the chances of long-term success in that particular language. Learning difficulties the adult learners are believed to experience are specifically determined by the Aging Hypothesis (Barkow et al. 1992), the Fragile Rote Hypothesis (Birdsong 2005), and the Starting Small Hypothesis (Newport 1990) respectively.

The Aging Hypothesis postulates a marked slowdown in activity, energy and flexibility people face with age. A serious decline is likely to be observed with respect to the storage of new memories and the retrieval of the old ones, which, in learning conditions, readily translates into hardships in storing and retrieving vocabulary. However, Gutchess et al., (2005) research shows that adults have greater activation of medial PFC (pre-frontal cortex) than the young while encoding pictures in a memory task, whereas the young show more hippocampal activation and in the area of lexicon new learning continues to occur in L1 in any case (MacWhinney, 2006). This suggests that adults compensate for hippocampal processing deficits by recruiting additional resources from the frontal areas, which is in line with phylogentic development of the brain as the frontal areas get myelinesed as the last ones with other areas in the brain.

Secondly, to build on the Fragile Rote Hypothesis, with increasing age, learners may have problems with irregular language forms, including irregular inflections, use of particles and prepositions, due to the neuroanatomical changes in the parts of the

brain subserving the declarative memory system. Declining memory, as the third assumption has it, may be responsible for difficulties with abstract syntactic patterns. It is so because the adult learners, according to MacWhinney's (2006: 145) Starting Small Hypothesis, 'learn each new noun as a separate analysed unit, rather than as a part of a richer phrase', thus being incapable of picking up large unanalysed chunks.

As it follows from the above, the recommendable age of onset, as Lenneberg (1967) suggests, is the pre-puberty period. Others, like Geschwind (1970) or Krashen (1973), assumed a much earlier age. Everything boils down to the time of lateralization and effects its completion has on the process of language development. To name a few, the consequences in question range from *changes in the neural structure of the brain,* predicted by the Neural Commitment Hypothesis (Lenneberg 1967), and *the neural entrenchment* in line with *decrease of cerebral plasticity for implicit acquisition*, encompassed in MacWhinney's (2006) Neural Entrenchment Hypothesis, and Lenneberg's (Lenneberg 1967) Lateralization Hypothesis respectively. According to these accounts, language functions responsible for language acquisition, which are controlled mainly in the left hemisphere, are no longer operating and cannot be reactivated once lateralization has been accomplished. The neural entrenchment, as has already been hinted at, due to the resistance of the L1 neural system to that of L2, often when the L1 form is already well consolidated by the time the learner tries to add the TL form to the language system, is responsible for failures to acquire certain TL features. This makes it difficult for people to be able ever again to easily acquire the language. Conversely, the learning process becomes explicit, and does not take place without a great deal of effort invested on the part of the learners. In addition, lack of brain plasticity, which reduces its capacity for new forms of learning, comes down to a non-fluent and non--native language construct. However, Cabeza's (2002) findings reflect that adults show bilateral activation during tasks which in the young are left-hemisphere lateralized and McCandliss (2002) conducted research in which the speech inputs of /r/ and /l/ were modified to such an extent that Japanese natives were able to perceive them as distinct inputs. With short-term training, subjects were able to transfer this ability when listening to unmodified speech. Complementary neuroimaging results provided initial evidence that such training impacts the same general cortical regions implicated in native language speech production, which suggests that adults may compensate for decline in processing capacity by recruiting different and/or additional neural areas; it implies plasticity which continues into late adulthood.

3. Conclusions

It is premature to base conclusions on the above presented findings, which were to support the above listed hypotheses as they need further investigation. We also would not like to fall into the trap of naive 'neurologising' and suggest implications for educational practices but the following conclusions might be put forward.

As experiments using imaging techniques (Tudela, 2002) indicate different neural circuitry supports implicit as opposed to explicit learning, explicit instruction should

be focalised. As new phonological words are initially learned as combinations (Gupta & MacWhinney, 1997) of old L1 segments and syllables, resonance strategy employing the keyword mnemotechnique could be recommended.

Adults will do better at the extraction of lexical forms and rules if they are not overloaded with too much input (Cochran et al., 1999; Kersten & Earles, 2001)

Simultaneous bilingual acquisition tends to minimize the misleading effects of transfer and parasitism of L2 on consolidated L1 (MacWhinney, 2006).

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