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The Cognitive Functions of Inner Speech

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Abstract

This paper compares Peirce's and Wittgenstein's view of "thinking in words" and "talking to oneself" and relates their positions to contemporary debates on the *cognitive conception of language*. For further clarifications of functions and functioning of inner speech recourse is taken to mechanisms operating verbal working-memory. Main arguments concern the preparatory role of inner speech with respect to a wide spectrum of possible demands of future communication and as a continual adjustment of programming devices to implicit linguistic/statistical knowledge.

1. Introductory notes

In a first step, statements of Peirce and Wittgenstein will be related to contemporary interpretations of language as a vehicle of conscious propositional thinking (Section 2). Could this interpretation mean that the temporal structure of language also shapes the temporal structure of reasoning? (Later Wittgenstein would disagree.) And is even *language-based* reasoning "genuinely computational", as considered in Frankish (2010)? I shall pick up such questions later in the paper. But the computational view will be rather on verbal working memory (Section 3), and main arguments will flow into questions concerning *preparatory functions* of inner speech: "Preparatory" not only with respect to forthcoming utterances and as a superior inner try-out and rearrangement of evidence in the witness box or of arguments in more or less foreseeable debates. I shall suggest (in Section 4) a much more general "side-effect" of this ongoing activity: *It provides continual updating and increased readiness of our highly developed symbol-manipulating system, thus preparing it for a wide spectrum of possible demands of future communication.* It provides repartee, so to say.

2. "Minds who think in words"?

"Language and all abstracted thinking, such as belongs to minds who think in words, [are] of the symbolic nature", says Peirce (1976: 243) at the beginning of a paragraph explaining that words, "though strictly symbols", may realize additional semiotic functions as well: Many of them "are so far iconic that they are apt to determine iconic interpretants /.../; that are *onomatopoetic*, as they say." And there are also words acting "very much like indices. Such are personal demonstrative, and relative pronouns". Language provides, so to say, all the tools necessary for communication and abstracted thinking. But note that Peirce admits the possibility of forms of thinking that are not of the symbolic nature.

Early Wittgenstein takes on a more radical position: "*Die Grenzen meiner Sprache* bedeuten die Grenzen meiner Welt" (5.6 in the *Tractatus*). In the *Philosophical Investigations* he is distancing himself from this position: "'Talking' (whether out loud or silently) and 'thinking' are not concepts of the same kind; even though they are in closest connexion." (Wittgenstein 2006: 185) Especially talking to oneself remains inextricably linked with thought and *Verstand:* "When I think in language, there aren't 'meanings' going through my mind in addition to the verbal expressions: the language is itself the vehicle of thought" (§329). And "... couldn't we imagine God's suddenly giving a parrot understanding [*Verstand*], and its now saying things to itself?" (§346).

But do we really think "in words" (Peirce) and "in language" (Wittgenstein)? Contemporary authors also propose a *linguistic mind* (Frankish) or *cognitive conception of language* as opposed to a purely communicative conception (Carruthers). They emphasize that a linguistically operating mind is supported by introspection (Frankish 2010: 657) and a "bit of folk-wisdom" (Carruthers 2002: 657). The strong version of the cognitive conception claims that "*all* thought requires language", says Carruthers (p. 661) and places Wittgenstein among the proponents of this "anti-realist" position. Weak versions view language as a conduit of concepts and beliefs, as a cognitive scaffold for the build-up of more complex thoughts, and as sculpting cognition in the course of language acquisition. Carruthers places his own hypothesis somewhere between strong and weak versions: Language is the medium of *conscious* propositional thinking and, moreover, of "*all* non-domain-specific reasoning of a non-practical sort (whether conscious or non-conscious)" (p. 666).

Wittgenstein's dictum on the boundaries of his language as the boundaries of his world (in 5.6 of the Tractatus) is in line with what is known – and criticized (Holenstein 1980) – as the doctrine of the *Nichthintergehbarkeit* of language. This indeed strongest possible version of a *cognitive conception of language* avoids well-known problems with the empirical basis of linguistic representation. And in Peirce, Wittgenstein's "closest precursor" (Moyal-Sharrock 2003: 126), the "object of a representation can be nothing but a representation of which the first representation is the interpretant" (CP 1.339). In contemporary philosophy, Mitterer's (1992: 56, §13) non-dualistic description of *description* as a continuation of an already given description is reminiscent of Peirce's (CP 1.339) characterization of *representation* as a representation of the representation behind it in a series of representations.

Frankish (2010) characterizes the *linguistic mind* as a *level of mentality* "which operates by accessing and manipulating representations of natural language sentences". After some critical comments on Carruthers' (2002) "central-process modularism" and on Bickerton's (1995) model which assumes that language and central cognition share the very same neural basis, Frankish argues in favor of "the view that the linguistic mind is a virtual system (a 'supermind'), which arose when early humans learned to engage in private speech and to regulate it using metacognitive skills originally developed for use in public argumentation." (p. 206) "Language-based reasoning will thus be genuinely computational, though the computation in question will be carried out at an explicit, personal level." (p. 213)

Guerrero (2005) summarizes the main assumptions of the famous Russian school associated with the names Vygotsky, Luria, and Sokolov. One of these assumptions says: "In planning the spoken or written utterance, inner speech has an essential rehearsal or speech preparatory role." (p. 50) Before taking up again this line of argument and Frankish's hint at computational levels, let us have a "computational" (cf. Tenenbaum et al. 2011) look on perceptual/cognitive mechanisms required for (inner) speech.

3. How to grow a linguistic mind[1]

(i) The oldest mechanism required is pattern-detecting, inferential machinery. Its inferences go far beyond the data available. It is not purely data-driven but incessantly generating top-down processes, i.e. "hypothesis-testing". This picture connects with neurobiological descriptions (Buzsáki 2006) of a continual adjustment of the brain's *self-generated patterns* by outside influences.

Powerful statistical learning and pattern recognition show in infants' "co-occurrence statistics between words and referents" (Vouloumanos and Werker 2009), in their acquisition of rudimentary phrase structure (Saffran 2001), and, already in the age of eight months, in the separation of words (Saffran et al. 1996). Saffran et al. characterize this "as resulting from innately biased statistical learning mechanisms". A functionalist interpretation of Chomsky's innate *Language Acquisition Device*?

(ii) Experiments using transcranial magnetic stimulation (TMS) indicate "a direct link between the language and the manual/facial action system" (Rogalewski et al. 2004). But a predominantly auditory-articulatory communication is, other than predominantly visual-gestural communication, functional even without inter-visibility (Wilson 1975). And the hands, the eyes, and thus also the "eye-hand dyad" remain, where necessary, free for other (visually guided) activities such as the flight through the branches or the use and making of tools.

The detection of patterns in the sound stream requires, however, a selective "echoic memory". Such a sensory memory retaining vocal utterances seems to be quite common in a wide range of species – recall the parrot in Wittgenstein's example above – but was most probably augmented in the course of language evolution, and, moreover, specialized for verbal utterances of increasing complexity and duration.[2]

(iii) *Rehearsal* of utterances, as well as their planning, inner try-out and monitoring, needs a feedback-loop that allows "self-generated patterns" of articulatory circuits to interact with auditory circuits.[3] Descriptions of neural circuits (Hickok & Poeppel 2004: 89) rendering such "motor-to auditory mappings" suggest that the respective *auditory-articulatory interface connects to an auditory-conceptual interface*. Such integration is a prerequisite of *verbal working-memory* in the sense of a relatively autonomous, actively "self-feeding" processor, apt to keep self-generated patterns resonating and circulating within a symbol-manipulating system. Recent experiments by Geva et al. (2011: 3081) indicate, moreover, that the neural processes operating inner speech are initiated in frontal regions before they involve posterior regions that "link speech production to speech comprehension."

4. Inner speech as continual training of the linguistic mind

Frankish's approach provides interesting starting points for further considerations:

(a) He assumes that language at first developed as a tool for interpersonal communication and only then as a cognitive tool. Provided that the latter happened in the very first stages of language evolution, Frankish's suggestion seems to be compatible with the idea (Fenk-Oczlon and Fenk 2002) of a co-evolution of language and (other subsystems of) cognition that could explain the fast evolution of an apparatus capable for the acquisition of an extremely complex language very early in individual life.

(b) According to Frankish (p. 212), humans internalized their skills in interpersonal argument; on the level of mentality, where linguistic reasoning happens, they experience themselves as intentionally acting (p. 211f). And linguistic clauses or intonation units can be viewed as special cases of action units (Fenk-Oczlon and Fenk 2002). Should we, therefore, assume that the clausal structure of speech shapes inner speech – and thus even thought? Later Wittgenstein would deny at least this last step from linguistic structure to the structure of thought: "Thought and intention are neither 'articulated' nor 'non-articulated'" (Wittgenstein 2006: 185). In Wittgenstein "a thought lacks duration" and hence can neither accompany a sentence nor occur in an accelerated form (Budd 1989: 144). But Wittgenstein could neither know empirical evidence for motor theories of speech perception (Liberman and Mattingly 1985) and cognition nor for a temporal segmentation (Schleidt and Kien 1997) of cognitive activities. Should we thus rather assume that cognition shapes the clausal structure of language? Or again consider co-evolutionary models?

(c) Frankish considers that even language-based reasoning will be genuinely computational. Post-Tractarian Wittgenstein also considers something beyond, prior and fundamental to language and thought. "This something is *grammar*", asserts Moyal-Sharrock (2003: 131), referring to Wittgenstein's *On Certainty*. Many of her explications of *grammar* fit with what is often addressed as "computational" – an indeed appropriate label for Wittgenstein's definition of *meaning* in the *Investigations* (§43): "the meaning of a word is its use in the language." Under this conception, say Manning and Schütze (1999: 17), much of Statistical NLP (Natural Language Processing)-research "directly tackles questions of meaning." And *Google Translate* is, so far, superior: It relies, like the native speakers of one or more than one language, rather on statistical than explicitly rule-based analysis.

The detection of regularities in a given language is a demanding cognitive task. Even more demanding is the integration of this enormous body of "computational" – non-personal, non-conscious, and in the essence statistical – knowledge of language into the production system, i.e., its ongoing transformation into "procedural knowl-

1 Section 3 includes fragments of a talk at the *International Colloquium "From Grooming to Speaking"*, Centre for Philosophy of Science of the University of Lisbon, 10-12 September 2012: Fenk and Fenk-Oczlon, "Language Evolution Requires and Reinforces Inferential Machinery".

2 Echoic memory is assumed to contribute to the recency-effect in the serial position curve, and cumulative rehearsal to the primacy-effect. In the recall of sentences the recency-effect goes even further back than in series of unconnected words (Fenk & Fenk-Oczlon 2006).

3 *Rehearsal* is also required for *musical minds*, e.g. for the "recall" of a melody, for whistling or singing it, for playing it on the piano or writing it down in notes. That this process of "inner singing" involves neural circuits also involved in speech-related rehearsal (Hickok et al. 2003) may, to my (linguistic) mind, explain some of the parallels found (Fenk-Oczlon and Fenk 2009-2010) between language and music.

edge". This is the place to recall an already indicated, very general preparatory function of inner speech: It helps improving linguistic/rhetoric skills and keeping them on a personally high level. This preparation for fast and accurate interpretation and action in future situations comes by

(i) a facilitation of the access to, or retrieval from, implicitly learned, predictive statistical dependencies allowing for instance a fast and automatic check of an expression's possible meaning(s) in a given context,

(ii) a more or less habitual training of those complex interactions between an auditory-motor interface and an auditory-conceptual interface operating our verbal working memory, and

(iii) a continual adjustment of programming devices to a huge and ever growing body of tacit or implicit, statistical/linguistic knowledge.

In point (i) the focus is on the role of the hearer and in (iii) on that of the speaker. But this is anyhow a rather artificial distinction: Not only is the *speaker* always also listener of her own utterances, but also is the *hearer* a tentative and anticipative, though subvocal "co-speaker" of the utterances she is listening to.

This view might well be extended to the special kind of inner speech that accompanies reading. Here its main function is the transformation of a visual code into the auditive-articulatory code of our verbal working memory; but the long-term training- and programming-effects mentioned above will be realized as well.

To summarize: Preparatory functions of inner speech are intuitively plausible. And what else but its preparatory effects would have stimulated the development of linguistic minds "debating with themselves", as Frankish dubs it? In this paper I wanted to draw attention to less obvious benefits, i.e., the priming and fitness of highly developed, "genuinely computational" mechanisms operating language as a cognitive and communicative tool.

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