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**A CORPUS- AND PSYCHOLINGUISTIC TESTING OF THE
STRONG VERSION OF THE EMBODIMENT HYPOTHESIS IN
COGNITIVE LINGUISTICS**

PhD thesis booklet

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ABSTRACT

Do people think in terms of concrete representations when they use abstract language? According to the strong version of the Embodiment Hypothesis, our abstract knowledge and higher cognitive processes are *directly* grounded in sensory-motor representations rather than in amodal symbols. Crucially, according to this view, sensory-motor states, which are claimed to be *conceptual features*, are *partially* and *automatically* re-activated during both concrete and abstract language use. However, this conception is highly debated on theoretical and empirical grounds and other approaches have emerged.

In a test of this radical hypothesis, we carried out corpus- and psycholinguistic experiments. The thesis first reviews theoretical claims with empirical evidence for and against the strong version of the Embodiment Hypothesis, then five studies are presented, four of which provide novel empirical data and one reviews theoretical positions. It is argued that effects revealed by psycholinguistic measures do not clearly support the strong version of the Embodiment Hypothesis but rather an amodal view of language processing, according to which linguistic-propositional representations underlie language understanding.

The results of a series of experiments with environmental sounds and language provided support for the conclusion that sound representations are not conceptual features because they are not necessarily and automatically activated during normal language use. All in all, the findings support the weak version of the Embodiment Hypothesis, according to which abstract concepts are represented separately from concrete concepts.

GENERAL BACKGROUND AND AIM OF THE THESIS

An extreme suggestion in cognitive linguistics is that abstract domains (such as, time, love, truth, etc.) are understood in terms of more concrete, experience-based domains (Lakoff & Johnson, 1980, 1999). This is also known as the Embodiment Hypothesis. The general aim of this thesis is to shed light on the following questions relating to this statement: Does the strong version of the Embodiment Hypothesis hold? Are sensori-motor representations/experiences *necessarily* and *automatically* activated for concrete and abstract language processing? These questions were investigated by applying corpus-linguistic (Thesis 2) and psycholinguistic techniques in various domains of investigation (Theses 3 and 4). The psycholinguistic techniques that were employed in the present thesis aimed to investigate visual sentence processing using the self-paced reading paradigm. Throughout the Thesis points, both concrete and abstract conceptual language were investigated and compared to each other because the weak and the strong version of the Embodiment Hypothesis generates different predictions in this respect.

I included four theses that embody the main scope of this work. In Thesis 1, theories are presented within and outside the Embodiment Hypothesis. The article attached to Thesis 1 reviews the problem of conceptual and lexical representation in cognitive science and critiques of the strong version of the Embodiment Hypothesis. Based on the principles above, the studies investigate aspects of the research question in three different domains: a study tied to Thesis 2 aims to examine the question from a corpus-linguistic point of view, and studies in Theses 3 and 4 aim to investigate the research question using psycholinguistic techniques.

The Thesis points, especially the two articles tied to Thesis 4 speak against the strong version of the Embodiment Hypothesis because it is demonstrated that sound representations are not necessarily and automatically activated. The thesis argues both on theoretical (Thesis 1) and empirical grounds (Theses 2, 3, and 4) that amodal representations should not be dismissed.

THESIS POINTS

Thesis 1: The Strong Version of the Embodiment Hypothesis (Radical Embodiment) versus Amodal Theories of Cognition

The amodal account of conceptual processing cannot be dismissed because there are articulated arguments on the amodal side. There are different kinds of amodalism, such as the theory of Newell and Simon (1972), Fodor's LOT theory (1975), Minsky's Frame-conception (1975), or conceptual atomism (Fodor, 1998). There are accounts which also use amodal representations, such as Damasio's convergence zone theory (1989), or the metamodal organization theory (Pascual-Leone and Hamilton, 2001). These newer amodal theories, but not propositional theories, can predict embodiment effects and can be integrated well into embodiment theories. Amodal symbols may reside near modality-specific areas of the brain. Embodiment effects in empirical investigations can also be explained in terms of propositional/amodal theories in cognition (e.g., Machery, 2006; Pylyshyn, 2003). Embodiment effects supporting the strong version of the hypothesis may be epiphenomenal (Mahon and Caramazza, 2008). There are neuro-scientific investigations, which demonstrate that there are specific brain regions (e.g., LOTv, POT) that implement amodal (modality-independent) mechanisms (Amedi et al., 2002; Wilkins and Wakefield, 1995). There are various accounts of Radical Embodiment; one of these is the Cognitive Metaphor Theory (Lakoff and Johnson, 1980, 1999) which claims that sensorimotor representations underlie the processing of concrete and abstract language. Embodiment effects can be interpreted in frameworks other than the Cognitive Metaphor Theory, for example, in the Perceptual Symbol Systems Theory (Barsalou, 1999), or other modality-specific theories (e.g., Bergen, 2007; Damasio, 1989; Pecher and Zwaan, 2005; Glenberg and Robertson, 1999). A radical constructivist account of linguistic semantics is presented.

- **Fekete, I.** (2010). A nyelvi szemantika a kognitív tudomány perspektívájából [Linguistic semantics from a cognitive science perspective], *Magyar Pszichológiai Szemle* [Hungarian Journal of Psychology], Vol. 65. (2), 355–388.

Thesis 2: A Corpus-Linguistic Investigation of the Strong Version of the Embodiment Hypothesis

The strong version of the Embodiment Hypothesis, specifically the source-target theory was not confirmed by corpus-linguistic data because results show that a metaphor does not necessarily need to contain source domain words. This finding speaks against the necessary aspect of the strong version of the Embodiment Hypothesis, which claims that source-domain activation is necessary when processing metaphors. However, this finding is regarded as a weak falsification of the strong version of the Embodiment Hypothesis because it may be the case that metaphors do not group together along source and target domains.

- Babarczy, A., Bencze, I., **Fekete, I.**, Simon, E. (2010): The Automatic Identification of Conceptual Metaphors in Hungarian Texts: A Corpus-Based Analysis. In *Proceedings of LREC 2010 Workshop on Methods for the Automatic Acquisition of Language Resources*, Malta. 31–36.
- This article is available in Hungarian: Babarczy, A., Bencze, I., **Fekete, I.**, Simon, E. (2010). A metaforikus nyelvhasználat korpuszalapú elemzése [A corpus-based analysis of metaphoric language use]. In VII. Magyar Számítógépes Nyelvészeti Konferencia [Hungarian Computational Linguistics Conference], Szeged. 145–156.

István Fekete's contribution: theoretical background, contribution in annotation of metaphorical expressions, word association experiment, contribution in compilation of the corpus-based list.

Thesis 3: A Psycholinguistic Investigation of the Strong Version of the Embodiment Hypothesis at the Interface of Argument Structure and Semantics

This study explores how bidirectional and unidirectional comitative constructions are processed. Bidirectional comitative constructions describe events where the two actors undergo the same effect described by the predicate (e.g., John was kissing with Mary), whereas unidirectional comitative constructions describe events in which

one of the actors is the Agent, and the other one is the Patient (e.g., John was messing with Mary). In particular, we used the self-paced reading paradigm to determine if the two constructions access distinct mental representations. The findings suggest that distinct mental representations are activated automatically by bidirectional and unidirectional verbs during online language comprehension.

However, the processing of bidirectional and unidirectional comitative constructions can be explained by propositional/linguistic rather than embodied representations (cf. Thesis 1). The results of this study should not necessarily be interpreted in the framework of strong Embodiment theories, Simulation theories (Bergen, 2007; Zwaan and Madden, 2005), Situation models (Zwaan and Radvansky, 1998), or the CMT framework. Second, the finding, according to which the two constructions are read differently, is consistent with both a procedural and a representational account. On the procedural account, thematic roles are organized in a higher-order amodal representation and different thematic roles are processed differently as a function of cognitive load. For example, computing an AGENT - PATIENT representation is more difficult because of its asymmetry than computing an AGENT - CO-AGENT thematic representation. Thus, the strong version of the Embodiment Hypothesis is not confirmed because the result profile obtained in the experiments can be well explained by alternative conceptions (linguistic/propositional or amodal theories).

- **Fekete, I., Pléh, Cs.** (2011). Bidirectional and Unidirectional Comitative Constructions in Hungarian: a Psycholinguistic Investigation at the Interface of Argument Structure and Semantics, *Acta Linguistica Hungarica*, Vol. 58. (1–2), 3–23.
- **Fekete, I., Pléh, Cs.** (2011). „Ne viccelődj a rendőrökkel”: egy- és kétirányú társas viszonyok a nyelvben [Don't Fool around with the Cops”: Unidirectional and Bidirectional Comitative Relations in Language], *Magyar Pszichológiai Szemle* [Hungarian Journal of Psychology], Vol. 66. (4), 559-586.

(This article, which is the Hungarian translation of the English article, contains additional statistics for the experiments. The experiments, the dataset, and the conclusions are unchanged. The additional statistics are reported in Chapter 3.3.. before the paper)

Thesis 4: A Psycholinguistic Investigation of the Strong Version of the Embodiment Hypothesis in the Domain of Environmental Sounds and Language

Both fictive (abstract, metaphoric) and concrete sound events are processed in a shallow manner (Barsalou, 1999; Louwerse and Jeuniaux, 2008) without access to embodied sound representations. Congruency-effects, counter-intuitively, do not emerge at a short SOA, while at the same time category-external items exert an inhibitory effect under the same condition. Congruency-effects cannot be explored in the shallow control question condition. A congruency-effect was yielded only in the sensibility judgement task under a long SOA condition. Congruency-effects cannot be observed on the region following the critical verb either, or at the end of the sentence (no carry-over effects), while the effect of inhibition is still present at the end of sentence. Taken together, four experiments with four different settings unanimously demonstrate that specific sound representations are not accessed routinely during normal reading of sound-related language.

Thus, these results do not confirm the psychological reality of the strong version of the Embodiment Hypothesis at the interface of concrete/abstract sounds and language but rather support the Good-Enough processing approach of language processing, as proposed by Ferreira et al. (2002, 2009) and the shallow processing account (Barsalou, 1999; Louwerse and Jeuniaux, 2008). The findings in this Thesis point are suggestive for an independent storage of abstract concepts from modality-specific representations.

- **Fekete, I., Babarczy, A.** (accepted, 2012): *Mi van akkor, ha a macska ugat? Kognitív templátok és a valóság illesztése a nyelvi megértés során [What if the cat is barking? Cognitive templates and the matching of reality during real-time language understanding], *Általános Nyelvészeti Tanulmányok XXV* [General Linguistic Studies].*
- **Fekete, I., Babarczy, A.** (submitted, 2012): *A psycholinguistic analysis of 'fictive' sound events.*

CONCLUSIONS AND FUTURE DIRECTIONS

Taken together the findings of Theses 1–4, beginning with a review article presenting theoretical arguments through a corpus-study to a series of psycholinguistic experiments, it can be concluded that both the theoretical arguments and the experimental data converge on the *negation* of the strong version of the Embodiment Hypothesis. It has been emphasized at the outset of the dissertation that if any one of the three aspects of the strong version (*automaticity*, *necessity*, and *direct activation*) gets disconfirmed, then the strong version is not tenable. I have opted for confirming or disconfirming the strong version, rather than testing the weak version (cf. Meteyard and Vigliocco, 2008). The reason for this choice is that a direct testing of the weak version requires a comparison of performance as a function of task-demand. I claim that the strong version needs to be refined by taking into consideration a couple of theoretical arguments as reviewed in Thesis 1 and experimental results about real-time processing, for example, as outlined in those studies tied to Theses 3–4.

LIST OF PUBLICATIONS RELATED TO THESES

Fekete, I., Babarczy, A. (accepted). Mi van akkor, ha a macska ugat? Kognitív templátok és a valóság illesztése a nyelvi megértés során [What if the cat is barking? Cognitive templates and the matching of reality during real-time language understanding], *Általános Nyelvészeti Tanulmányok XXV* [General Linguistic Studies].

Fekete, I., Babarczy, A. (submitted). A psycholinguistic analysis of 'fictive' sound events.

Fekete, I., Pléh, Cs. (2011). Bidirectional and Unidirectional Comitative Constructions in Hungarian: a Psycholinguistic Investigation at the Interface of Argument Structure and Semantics, *Acta Linguistica Hungarica*, Vol. 58. (1–2), 3–23.

Fekete, I., Pléh, Cs. (2011). „Ne viccelődj a rendőrökkel”: egy- és kétirányú társas viszonyok a nyelvben [Don't Fool around with the Cops”: Unidirectional and Bidirectional Comitative Relations in Language], *Magyar Pszichológiai Szemle* [Hungarian Journal of Psychology], Vol. 66. (4), 559–586.

Babarczy, A., Bencze, I., Fekete, I., Simon, E. (2010): The Automatic Identification of Conceptual Metaphors in Hungarian Texts: A Corpus-Based Analysis. In Proceedings of LREC 2010 Workshop on Methods for the Automatic Acquisition of Language Resources, Malta. 30–37.

Babarczy, A., Bencze, I., Fekete, I., Simon, E. (2010). A metaforikus nyelvhasználat korpuszalapú elemzése [A corpus-based analysis of metaphoric language use]. In VII. Magyar Számítógépes Nyelvészeti Konferencia [Conference on Hungarian Computational Linguistics], Szeged. 145–156.

Fekete, I. (2010). A nyelvi szemantika a kognitív tudomány perspektívájából [Linguistic semantics from a cognitive science perspective], *Magyar Pszichológiai Szemle* [Hungarian Journal of Psychology], Vol. 65. (2), 355–388.

Fekete, I. (2010). “The Psycholinguistics of Fictive Sound Events”, COST Action A31 meeting (“People classifying people”), The Hebrew University of Jerusalem, 2010, 6–7 March, Jerusalem, Israel

Fekete, I. (2010). “Konkrét és absztrakt hangot kódoló mondatok által kiváltott mentális modellek” [Mental models elicited by concrete and abstract sound-related sentences], MAKOG, 2010, 25–26 January, Budapest, Hungary

Fekete, I. (2010). “BME Presentation of Abstract”, Presentation at the ABSTRACT Project meeting, University College London (UCL), 2010, 10–11 January, London, England

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Fekete, I. (2009). “‘Fictive’ sounds in language: the processing of abstract sentences encoding fictive sounds evokes sound representations”, MeiCogSci conference, 2009, 19–20 June, Vienna, Austria

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Fekete, I., Pléh, Cs. (2008). "Bidirectional and unidirectional comitative verbs in Hungarian", International Conference on Language, Communication and Cognition, 2008, 4–7 August, Brighton, England

Fekete, I. (2008). "BME Presentation of Abstract", Presentation at the ABSTRACT Project meeting, University College London (UCL), 2008, 2–3 June, London, England

Fekete, I., Pléh, Cs. (2008). "A psycholinguistic analysis of the instrumental-comitative syncretism in Hungarian", 13th International Morphology Meeting, 2008, 3–6 February, Vienna, Austria

Fekete, I. (2007). "Főnévi fogalmak konkrétsági, elképzelhetőségi és definiálhatósági értékeinek összefüggései" [Concreteness, imageability, and definability values of noun concepts], Nyelvészdoktoranduszok 11. Országos Konferenciája, 2007, 6–7 December, Szeged, Hungary

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