The role of the interoceptive system in grounding Abstract Concepts: a cross-cultural study on conceptual knowledge, bodily sensitivity and prosocial behaviors

Fabio Marson, Patrizio Paoletti, Joseph Glicksohn, Revital Naor-Ziv, Filippo Carducci, Tal Dotan Ben-Soussan

First author address: Patrizio Paoletti Foundation , Assisi, Italy.
First author email: f.marson@fondazionepatriziopaoletti.org

Introduction*: According to Embodied Cognition theories, sensorimotor experiences determine the semantic content of concepts [1]. This framework explains the sensorimotor grounding of Concrete Concepts (CC), while it's still unclear how Abstract Concepts (AC) could be embodied. Some recent studies suggested that interoception, namely the sensing of physiological and visceral states arising from inside the body, could be the sensorial system underlying AC's embodiment [2,3]. Interoception has also been linked to emotional responses in social interaction, suggesting that social experiences could also be involved in the embodiment of ACs. To test the interoceptive embodiment hypothesis of ACs, perceptual ratings of concepts, measurements of empathy and sensitivity of bodily functions were collected.*

Methods*: Data from a total of 200 Italian and 195 Hebrew native speakers were collected. Sensorial features of concepts were examined focusing on Perceptual Strength ratings on the five senses and interoception for 40 ACs and 40 CCs. Empathy Quotient (EQ) and Body Perception Questionnaire (BPQ) were adopted to assess empathy and sensitivity to bodily functions. All data were analyzed in R. Perceptual ratings were analyzed to examine whether ACs would be associated with greater interoception than CC. Then, correlations of interoceptive ratings with EQ and BPQ scores were computed. Finally, we trained a classifier using the perceptual ratings in one language to see if it could correctly categorize AC and CC in the other language. Indices of accuracy were used to rank modalities for their importance.*

Results*: Greater interoceptive ratings were observed for AC compared to CC in both languages ($p < .001$). Comparing languages, CCs were rated with higher interoception by Italians compared to Hebrews ($p < .001$).*
EQ and BPQ scores correlated with interoceptive ratings of ACs ($p < .01$) but not with CCs. Looking at the languages separately, EQ scores correlated with ACs in the Italian sample only, while BPQ scores were correlated with interoceptive ratings of ACs in both languages.
Finally, the classifier trained on the perceptual ratings in one language categorized the concepts in the other language with high accuracy (Hebrew-to-Italian: 79% for CCs, 77% for ACs; Italian-to-Hebrew: 78% for CCs, 83% for ACs). Interoception played a particularly relevant role in determining a correct classification.

Discussion*:Our results advocate for the pivotal role of interoception in the embodiment of ACs. Differences between ACs and CCs in perceptual strength ratings and the correlation of their respective interoception ratings with EQ and BPQ suggest that ACs and CCs are characterized by different sensorimotor grounding mechanisms. As showed by the classifier results, good performances in the categorization of ACs and CCs could be achieved using perceptual ratings alone, with Interoception playing a privileged role.*
In general, our results support the interoceptive embodiment hypothesis of ACs. However, some language related differences were observed, suggesting that features not considered in this context (e.g., sociocultural habits or linguistic co-occurrences) could influence the way ACs are embodied.

References*: 1. Barsalou L BehavBrainSci (1999) 22, 637– 660 2. Connell L et al PhilTraRSocLond (2018) 373, 20170143 3. Villani C et al JMemLang (2021) 116, 104173*

Keywords: Body & Sensorimotor Integration; normal population; not relevant; behavioural, computational - meta-analytical.