

META REPRESENTATIONAL KNOWLEDGE, TRANSFER, AND MULTIPLE EMBODIMENTS IN LINEAR ALGEBRA

Lance Burger, Ph.D.
California State University, Fresno
Department of Mathematics

A common theme in educational research on linear algebra concerns cognitive inflexibility associated with the appropriation of different linear algebra problem settings to similar matrix representations and methods, a consequence of the multiple embodiments of linear algebra concepts (Harel, 1989; Hillel & Mueller, 2006; DeVries & Arnon, 2004; Hillel & Sierpiska, 1994; Dias & Artique, 1995; Dorier, 2000). The study of multiple embodiments in linear algebra is important since students require an ability to establish meaningful links between representational forms in order to “understand the necessity for representing these situations by a general concept,” a competence known as representational fluency (Harel, 1987, p.30-31). Informed by methods from experimental psychology, this mixed-methods study reconceived cognitive inflexibility and the role of meta-mathematical information in terms of the transfer of knowledge from familiar to unfamiliar problems settings sharing common abstract problem solving schemas.

Previous research in experimental psychology suggests spontaneous transfer between non-isomorphic problem settings to be rare in the absence of hints concerning the relationships between those settings (Holyoak & Koh, 1987). Two factorial experiments reinforce previous findings that transfer does not significantly occur between dissimilar settings, even when problems share abstract problem solving schemas and representations. A third experiment supports the *Indirect Representational Transfer Hypothesis*: meta-representational reflection on the meaning of a common abstract representation in relation to diverse mathematical settings induces schema transfer. Over the past several decades, a debate has ensued concerning the theoretical foundations of transfer theory. Rather than judging transfer according to normative, i.e., expert functionalist views, according to Lobato (2003), “actor-oriented transfer is defined as the personal construction of relations of similarity between the activities.” In conclusion of this mixed-methods study, qualitative interviews uncover evidence of the role of meta-representational thought as part of a larger developmental process of actor-oriented transfer.