Learning anatomy by pointing and tracing: A review

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Paas and Sweller (2012, p.27) propose working memory limitations may only be critical when dealing with culturally constructed knowledge or biologically secondary knowledge. They speculate, "if biologically primary knowledge is less affected by working memory limitations, it may be advantageous to use primary information to assist in the acquisition of secondary information" (Paas & Sweller, 2012, p. 27). One of the forms of biologically primary knowledge proposed by Paas and Sweller (2012) that might support learning biologically secondary knowledge is gesture. While a range of gestures are typically produced in mid-air as part of speech-based communication, tracing gestures typically involve moving the pointed index finger against a surface (Ginns et al., 2016), and may support understanding and learning across a range of contexts. Such gestures may act as visual cues that guide attention, reduce search and extraneous cognitive load, and enhance learning (cf. de Koning et al., 2009).

Gestures using the index finger to point and trace while learning from worked examples have been found to benefit learning across a number of studies (e.g., Agostinho et al., 2015; Ginns et al., 2016; Hu et al., 2014, 2015). The presentation will review studies investigating effects of tracing and pointing involving an alternative but common form of instruction, expository text with diagrams. Macken and Ginns (2014) found tracing enhanced performance on tests of terminology and comprehension following study of expository text and diagrams about the human heart, but process hypotheses concerning different sources of cognitive load were not supported. The three experiments presented here tested alternative methods for measuring cognitive load using self-report measures.

In Study 1, 30 university students were instructed to gesture or not gesture while learning from materials about the structure and function of the human heart. Difficulty ratings were made after each page of instruction, following van Gog et al.'s (2011) finding that measuring cognitive load during a learning phase provided more valid indications of cognitive load than a single post-learning phase rating. Participants in the gesture group performed significantly better than the non-gesture group on terminology and comprehension tests, but there was no significant difference in the average difficulty rating between the two groups. In Study 2 (n = 30), using the same materials, participants rated cognitive load both after each page, as well as following the instructional phase using a new multi-item instrument developed by Leppink et al. (2013), measuring both intrinsic and extraneous cognitive load. The experimental conditions did not differ in average post-page difficulty ratings or in test performance, but a reliable difference favouring the tracing condition was found on post-instruction ratings of extraneous cognitive load. Study 3, currently being performed, will replicate and extend Study 2 by investigating cognitive load and learning hypotheses with the same experimental materials, translated into Chinese. Together, this series of studies aims to develop our understanding of the effects of pointing and tracing while studying expository text with associated diagrams, while comparing and contrasting the sensitivity of alternative cognitive load self-report measures.