Chapter 3

The Use of Gesturing to Facilitate Older Adults' Learning from Computer–Based Dynamic Visualizations

Kim Ouwehand
Erasmus University Rotterdam, The Netherlands

Tamara van Gog
Erasmus University Rotterdam, The Netherlands

Fred Paas
Erasmus University Rotterdam, The Netherlands & University of Wollongong, Australia

ABSTRACT

The present chapter describes the role of gestures in instructional design from a cognitive load theory perspective, addressing in particular how this might benefit aging adults. Healthy older adults have to cope with several cognitive changes related to their working memory, such as a decline in: 1) the ability to deal with interference, 2) cognitive speed in response to unimodal stimuli (e.g. visual information), and 3) the ability to associate and integrate information elements. Cognitive load theory, with its focus on adapting learning formats to the limitations of working memory, provides a promising framework to address learning in older adults. Research inspired by cognitive load theory has shown that attentional cueing can reduce interference during learning, presenting instructions in a multimodal format can make more efficient use of WM stores (both auditory and visual), and the manner of presentation of information can aid integrative learning. Interestingly, studies using gestures in instruction show that gestures accompanying verbal information improve learning in similar ways. However, not much research has been done in applying the instructional guidelines of cognitive load theory and the use of gestures to older adults' learning. In the present chapter, the authors will discuss possibilities of gestures to improve multimedia learning in older adults using some important guidelines proposed by cognitive load theory.

INTRODUCTION

In the present chapter, Cognitive Load Theory (CLT) (Paas, Renkl, & Sweller, 2003; Sweller, 1988, 2010; Sweller, Van Merriënboer, & Paas, 1998) and the cognitive architecture it describes is used as a framework to discuss the possibility of improving learning in older adults by using gestures in instructional design.

Normal aging has been associated with age-related changes in cognitive functioning, such as a decline in; WM functioning (Celnik, et al., 2005; Park, et al., 2002), the speed with which information is processed (Salthouse, 1996), and associative memory (for a review, see Old & Naveh-Benjamin, 2008). As will be discussed, a multimodal format of instruction (a format in which the information is simultaneously presented to two or more modalities, e.g. visual and auditory), has been found to speed up information processing in older adults (Laurenti, Burdette, Maldjian, & Wallace, 2006) and when the visual information contains a manual action, it can enhance associative memory in older adults (Kormi-Nouri & Nilsson, 2001). Because gestures are a form of manual actions, and provide an additional modality when combined with speech and/or pictorial information, we suggest that adding gestures to computer-based instructional dynamic visualizations can improve learning in older adults. Two types of gestures are of specific interest for this chapter: 1) deictic gestures, which are used to refer to something that is physically present in the environment (e.g., a pointing gesture; Iverson & Goldin-Meadow, 2005) and, 2) representational gestures, used to depict visual information, i.e. about an object or action.

First, we will discuss some main points of CLT with specific relevance for the present chapter. Within the context of this theory, age-related declines and changes in Working Memory (WM) of healthy older adults in relation to learning will be extensively discussed. We will then introduce research that has shown beneficial effects of producing or observing gestures on comprehension, learning, and cognitive load. We will then relate these findings to CLT-inspired instructional formats and guidelines for the design of computer-based dynamic visualizations that have proven successful. For example, instructional formats such as observational learning from modeling examples and worked examples (for reviews, see Atkinson, Derry, Renkl, & Wortham, 2000; Sweller, et al., 1998; Van Gog & Rummel, 2010), guidelines to use multiple modalities in instructional materials (Ginns, 2005; Tindall-Ford, Chandler, & Sweller, 1997; Van Gerven, Paas, Van Merriënboer, Hendriks, & Schmidt, 2003), and using cues to guide learners' attention to relevant elements of materials (for a review, see De Koning, Tabbers, Rikers, & Paas, 2009) have been found to reduce cognitive load and foster learning. However, the existing literature on the effects of gestures on learning has mainly focused on children or young adults, and to the best of our knowledge, it has not yet addressed learning in older adults. We will relate the beneficial effect of gestures on learning to the age-related declines and changes in WM and CLT-inspired guidelines for instructional design, and discuss how gestures might help optimize learning in older adults. Important shared features between CLT-inspired instructional designs and gesture-speech instructions discussed here, are: 1) gestures can function as attentional cues, guiding learners efficiently through dynamic visualizations such as animations and video-based examples, 2) gesture-speech instructions are a form of multi-modal instruction, and 3) observational learning and gesture-speech instructions both make use of (human) models, which may provide a rich embodied representation of the study material. Based on this integration of research on gestures and CLT-inspired instructional formats and guidelines we will generate some hypotheses about how gestures can be implemented for multimedia learning in older adults, for example in the design of computer-based dynamic visualizations.

Related Content

Early Identification of Transformation in the Proficiency Level of Critical Thinking: In the Associate Degree Nursing Student
Velmarie King Swing (2017). *Handbook of Research on Individualism and Identity in the Globalized Digital Age (pp. 190-211).*
www.irma-international.org/chapter/early-identification-of-transformation-in-the-proficiency-level-of-critical-thinking/162952

The Efficiency of India's Cities: Is There a Case to Finance Them?
Kala Seetharam Sridhar (2014). *International Journal of Applied Behavioral Economics (pp. 51-65).*
www.irma-international.org/article/the-efficiency-of-indias-cities/106910

An Exploration of Thinking About Complex Global Issues and Then Taking Action
Ian Roderick (2018). *Systems Research for Real-World Challenges (pp. 102-146).*
www.irma-international.org/chapter/an-exploration-of-thinking-about-complex-global-issues-and-then-taking-action/205047

New Evidence on the Role of Size Effect in Determining the Pricing of Risk, Volatility Dynamics, and Economic Exposure of Firm Returns
Faisal Khanand Sharif Ullah Jan (2020). *International Journal of Applied Behavioral Economics (pp. 1-25).*
www.irma-international.org/article/new-evidence-on-the-role-of-size-effect-in-determining-the-pricing-of-risk-volatility-dynamics-and-economic-exposure-of-firm-returns/258854

Experimenting Through Mobile 'Apps' and 'App Stores'
Paul Coultonand Will Bamford (2011). *International Journal of Mobile Human Computer Interaction (pp. 55-70).*
www.irma-international.org/article/experimenting-through-mobile-apps-app/58925