

# Students' preferences and beliefs regarding visual displays as a component of graphicacy

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**Abstract.** The literature on how students process graphics in domains in which they are not knowledgeable suggests that they possess some general knowledge and skills on how to interpret, generate and evaluate graphics over a large variety of types and domains, what we call here graphicacy. Few studies investigated the subjective component of graphicacy, in the sense of preference and perception of self-efficacy with different types of graphics. An experimental study was conducted to investigate whether subjective evaluation of preference and effectiveness of enhanced graphics was related to performance in tasks involving the mental rotation of a 3D object. Participants studied an animated or a static version of a 3D realistic visualization displaying an anatomical structure in different orientations. The results showed that students preferred animated and realistic displays. They also reported being more effective with them. There were positive correlations between the rating of animated displays and performance to one task involving mental rotation, but no effect of conditions was found on subjective rating. These findings suggest that students' preference and beliefs of effectiveness are somehow related to performance, but more research is needed to understand this link.

## Introduction

Graphics are ubiquitous in instructional materials across all educational levels as well as in many areas of adult life, for example cooking recipes, trouble-shooting instructions or financial charts. Despite this extensive use, the knowledge and skills required to interpret, generate and evaluate graphics over a large variety of types and knowledge domains (what we call here *graphicacy*) is usually not addressed formally in education, or only in strong relation to a specific content (Bétrancourt et al., 2012). As a consequence, students develop “spontaneous” knowledge about graphics and how to process them, as well as correlatively, beliefs about their own capabilities to understand and process graphics (diSessa, 2004). Hegarty et al. (2009) investigated how undergraduate students and meteorologists evaluated the desirability and effectiveness of different types of graphics. They found that naïve students and meteorologists, who use complex graphic displays everyday, shared the same preferences and beliefs of higher effectiveness for enhanced visualizations (animation, realism, 3D graphics). However, adding realism to visualizations was detrimental to performance in an interpretation task for both expert and student meteorologists. This research demonstrates that spontaneous beliefs and preferences for enhanced visualizations is not necessarily linked to actual processing and performance. In the present study, we investigated this issue for animated compared to static display in the case of realistic 3D visualizations. The objective was twofold: First, to examine with students in sport education what their preferences and effectiveness beliefs are for different types of graphics. Second to assess whether these preferences and beliefs were related to actual performance.

## Method

Participants were forty-nine undergraduate students in their first or second year of physical and sport education in University of Lyon. They were 9 women and 40 men between 18 and 22 years old ( $M = 18.98$ ,  $SD = 0.98$ ). They were randomly allocated to one of two learning conditions depending on the format of the instructional material, static ( $N = 27$ ) or animated ( $N = 22$ ).

*Instructional material.* - The learning material consisted of a 3D realistic visualization developed by Icap (University of Lyon) depicting the structure of the scapula in different orientations. The Visual Display Questionnaire used in Hegarty et al. (2009) to evaluate students' preferences for different characteristics of graphic displays and their beliefs about display effectiveness, was adapted and

translated in French. The questionnaire was composed of 17 items (measured using 7-point Likert scales) about the use of three types of visual display (diagram, animation, map), combined with the presence or absence of enhancement features (details, realism, 3D and animation), and related to the preference or belief of effectiveness.

*Procedure.* – Participants studied the instructional material twice then completed one task involving the identification of features of the scapula (feature identification task) and two tasks involving the recognition of the degree of rotation of the structure (rotation task) or its orientation compared to those of a reference character (orientation reference task). Then the participants completed the visual display questionnaire and additional cognitive measures assessing mental rotation abilities (MRT; Vandenberg & Kuse, 1978), field dependence (GEFT; Oltman, Raskin, & Witkin, 1971) and subjective workload.

## **Results**

In both learning conditions: (1) the strongest preference was for animation (Animated visualization condition:  $M = 6.05$ ,  $SD = 0.92$ ; Static visualization condition:  $M = 5.97$ ,  $SD = 1.24$ ) followed by realism (Animated:  $M = 5.39$ ,  $SD = 1.22$ ; Static:  $M = 5.08$ ,  $SD = 1.32$ ), and (2) animation (Animated:  $M = 5.98$ ,  $SD = 1.05$ ; Static:  $M = 5.89$ ,  $SD = 1.23$ ) and realism (Animated:  $M = 5.39$ ,  $SD = 1.38$ ; Static:  $M = 5.04$ ,  $SD = 1.39$ ) were also ranked as the most effective displays. These results are similar to what Hegarty et al (2009) found in their studies for both preference and effectiveness beliefs. Two ANOVAs were conducted to examine whether there were significant differences between the two learning conditions in terms of display preference and beliefs about display effectiveness. No effect of the format of the instructional material has been found on students' preference ( $F < 1$ ), or on their effectiveness beliefs ( $F < 1$ ). A correlation analysis was performed to explore the relation between students' subjective evaluation about visual displays and their performance on learning tasks (feature identification and rotation tasks). Students' performances on the scapula rotation task were positively correlated with both their preference ( $\rho = .29$ ,  $p < .05$ ) and effectiveness belief for animation ( $\rho = .28$ ,  $p = .06$ , marginally significant relation). Students who preferred animation and believed in the effectiveness of this display enhancement had better accuracy scores on the rotation task.

## **Discussion and conclusion**

Regarding display preferences and beliefs of display effectiveness, we replicated Hegarty's et al (2009) findings, revealing that students find animation and realism more desirable and more effective, over 3D and details. However, contrary to Hegarty et al., we found a positive correlation between students' subjective evaluations (preference and effectiveness beliefs) for animation and performance to their scores on recognition of the degree of scapula rotation. Further analyses are in progress to investigate the possible relation between students' visuo-spatial abilities and their subjective ratings of visual displays, which could explain this correlation. This study reinforces the claim that people have beliefs on what makes graphics effective and on the way they process graphics independently of the knowledge domain, which are partly related to their actual processing. More research is thus needed in the field of graphicacy to understand this relation.

## **References**

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