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Understanding the impact of visual representation restrictiveness on experience sharing: An experimental assessment ☆

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ABSTRACT

This study investigates the effects of the restrictiveness of visuals on the communication process and outcome in small groups. Visual restrictiveness is conceived as the constraints imposed by a graphic template on the process of knowledge work. Through an experiment with ninety six experienced professionals we test the impact of a medium and a high level of visual restrictiveness compared to a control condition. As predicted, the results show that a medium level of visual restrictiveness, embodied in a grid layout, leads to higher experience sharing effectiveness. The impact is mediated by the structural pattern of appropriation of the interactive graphical template (assessed with content analysis). The implications of this study include extending the benefits and applications of visual representations to support group communication and the development (and testing) of the concept of visual restrictiveness.

1. Introduction: decomposition of space and visual restrictiveness

With the rapid proliferation of visual aids for knowledge work like mind mapping software, screen sharing applications, interactive whiteboards etc., visuality gains a new urgency [1]. Chang [2] emphasizes the importance of "visual reasoning" (p. 41) and Zhang [3] advocates the use of appropriate visualizations for rapid and effective communication in management. Although the academic community is beginning to achieve appreciation of the essential role of representational artifacts in cooperative work [4], research to date has not yet developed a rich understanding of the mechanics of image-enabled social interaction [5].

In a talk on "virtual spaces", Chang [6] pointed out that space can be seen in many different ways and that "decomposition of space leads us naturally to consider spatial relations and patterns" (p. 6). In a similar vein, Cheng [7] theorized that the "degree of spatial containment in diagrammatic systems" (p. 170) substantially impacts the perceptual accessibility of concepts. Analogously, Quispel and Maes [8] found that standard and abstract visualizations (like a grid layout) are superior to non-standard and pictorial visualizations (like a visual metaphor) in terms of their clarity (assessed through user response times).

As pointed out by Hundhausen [9], research into end user visualization environments has focused on human–computer interaction, leaving open the question of how such environments might support human–human interaction. As a consequence, the characteristics of visual templates for collaborative work have seldom been assessed. This study aims at addressing this gap by

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investigating the effect of the restrictiveness of visuals on the communication process and outcome in small groups.

In this context visual "restrictiveness", conceived as the constraints imposed by a graphic template on the process of knowledge work, is a highly relevant dimension. Some level of structure and restrictiveness of knowledge work is useful because it facilitates intercultural collaboration by providing common ground. It also reduces conflict by keeping the collaborators focused on the task (i.e., by limiting procedural ambiguity) [10]. Excessive restrictiveness, however, may be counterproductive. Wheeler and Valacich [11] described the restrictiveness of a collaboration system (CS) as the manner of limiting collaborative interaction to some certain types of "heuristic structures" (p. 433). Silver [12] conceptualized CS restrictiveness as the degree to which and the manner in which a CS limits its users' collaboration processes "to a particular subset of all possible processes" (p. 116). If restrictiveness is too high it may lead to excessive group cohesion and may channel conformity thoughts and groupthink, as Salisbury et al.'s [13] experimental study has shown.

The literature on CS restrictiveness is clustered around four main aspects: (a) *process* restrictiveness, denoting the degree to which and the manner in which a CS restricts its users' collaboration to a particular subset of all possible processes (i.e., all possible processes vs. processes supported by the system), (b) restrictiveness of the *script*, denoting the sequence of events and instructions (or prompts) given to the group (as they use a CS tool) to create the pattern of thinking, (c) *configuration* restrictiveness, denoting the specifics of how the collaboration system is configured to create a pattern of interaction and (d) *visual* restrictiveness, denoting the constraints imposed by the visual template or composition of templates used as a graphical user-interface in a CS environment.

The specific aspect of "interactive visual representations' restrictiveness" in an experience sharing context has, to the best of our knowledge, not yet been investigated. Furthermore, the Adaptive Structuration Theory (AST) [14] has, thus far, not been applied in a visualization context. AST explores how structures – technology-based or not – are appropriated by groups in organizational contexts. In particular, it explores the patterns of appropriation of structure and the structural outcomes during (the *process* of) social interaction, as well as the *outcomes* quality of the social interaction. Inspired by AST, this study is aimed at answering the following research questions: *Does the level of restrictiveness of an interactive visual representation affect the process and outcome of experience sharing in small groups? Is this relationship mediated by the structural pattern of appropriation of the visual representation?*

We investigated these questions through an experimental study in which we compared the effect on group knowledge work of two treatment conditions with a medium and high level of visual restrictiveness to a control condition with no visual restrictiveness (a blank layout). In particular the treatments consisted in a condition with a grid layout as background and a condition with a funnel-metaphor layout as background. Participants were asked to work in small groups to share their work experiences, using the provided visual representation to capture the discussion. A medium level of visual restrictiveness, embodied in the grid layout, was shown to lead to higher experience sharing effectiveness because of a more faithful (desired and intended) structural pattern of appropriation of the visual layout. In fact, the grid led to a logical decomposition of space [6] (i.e., structural pattern of appropriation) for capturing the participants experiences, which turned out to be beneficial for experience sharing effectiveness. The participants commented that, with the grid, it was easier for them to understand the meaning of the task, i.e., the grid proved to be an "appropriate visualization to maximize human's visual perceptual power" [3], p. 340 in the context of a knowledge sharing task. This finding corresponds to van Drie et al.'s [15] observations that matrix-like visual templates provide affordances [16] for users to direct their collective sense-making efforts toward deconstructing the collective activity into structural elements and sequential steps. Decomposition of space, observed in user behavior, is an important "cognitively-relevant aspect of (appropriation of) structure" [17], p. 131. The "choice of layout" [17], p. 131 as a "semiotic resource" [18], p. 2 turns out to be crucial for experience sharing effectiveness in small groups.

The originality of this work is to be found in extending Adaptive Structuration Theory [14] to visualization stimuli. Second, it extends to a "visualization" context the notion of the so called "form-filling phenomenon" [19,20]. We combine these two theoretical perspectives and provide evidence of the effect of visualization restrictiveness on experience sharing effectiveness mediated by the structural pattern of appropriation. Implications for management include suggestions to employ optimal visualizations for experience sharing in teams to enhance its process and outcome. Our contribution provides indications on the yet unexplored and unexploited power of visual representations for experience sharing in small groups.

2. Theoretical background: software-realized visualizations and Adaptive Structuration Theory

A conceptual cluster in literature relates to "visual restrictiveness" of collaboration systems. The term "visual" is used as an abbreviation denoting *the visual template or composition of templates used as graphical user-interface in a CS environment*. Metaphorically speaking, the "visual" is analogous to the background stage of a theatrical play and should be chosen to correspond well with the "atmosphere", the "spirit" and "the general ends and attitudes the technology aims to promote" [21], p. 151. According to Quintana et al. [22,23] the "visual" implicates various patterns of activity selection – for example, the "implied clockwise order in a wheel" [22], p. 85 results in blindly following the implied order in the representation. One influential concept developed to study (inter alia) software-embedded visual templates is "representational guidance" – i.e., the non-obtrusive property of the CS to make some of the knowledge more salient and hence a likely topic of group discussion [1,24,25]. Van Drie et al. [15] tested the concept of representational guidance in an experimental study. Their study resulted in observations showing that the visual template(s) applied in cognitive