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An Empirical Comparison of Accounting Information Representations (Research-in-Progress)

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ABSTRACT

Information is often multidimensional, dynamic, and difficult to communicate using traditional representations such as verbal descriptions or even graphics. Taking a distributed cognition perspective and integrating several theories of visualization, this study formulates a theoretical model to examine the effects of information representation on a classic business decision-making task: bankruptcy prediction. The preliminary results from a laboratory experiment show that animated representations lead more accurate decisions than static graphs. The findings indicate that animation facilitates identification of the flows and problems in operating and financing processes, thereby improving subjects' assessment of firm health.

KEYWORDS

Animation, visualization, information representation, decision making, accounting information systems.

INTRODUCTION

Little has changed in the graphics we use to represent key management data since William Playfair published his *Commercial and Political Atlas* in 1786. Meanwhile many areas of science and engineering have seen interactive computer graphics transform the way they explore and present data. Whether it is a weather pattern or a molecule, a tsunami or an as yet unbuilt building, computer graphics are being used both to explore and to explain complex systems. Because accounting information is multidimensional and dynamic, and because decision makers often find it difficult to discover relationships hidden in this complex information, we particularly investigate whether animated visualizations can enhance the understanding of multidimensional accounting information to predict bankruptcy when compared with traditional financial statements or graphs in this paper.

THEORETICAL BACKGROUND AND PROPOSITIONS

A basic principle of distributed cognition is that a cognitive task includes both internal and external representations, which together contain the abstract structure of the task (Zhang and Norman 1994). To perform a cognitive task such as making a business judgment or decision, people need to process information distributed across both the internal mind and the external environment.

Dual coding theory suggests that memory consists of two separate and distinct internal representation systems—verbal and nonverbal (Pavio 1986). Information is much easier to retain and retrieve because of the availability of two representation systems, and recalling information in the visual system is faster than recalling information in the verbal system because the visual system accesses information through synchronously, as opposed to the sequential access of the verbal system. Further, people process and recall pictures more fully than words and sentences.

External representations include the knowledge and structures in the environment. Although external representations exist in many forms, one important class of external representations that make us smart is graphical inventions of all sorts (Card 1999). Tables and graphs are both used to represent large data sets. Many studies have explored the features of these two representations and the conditions under which each is superior in business decision making tasks (Benbasat 1986; Chan 2001; Vessey and Galletta 1991).

Whatever external representations we create have to link to the internal representations that people produce, and computer offloading is one of three characteristics that can be used to explain this connection (Scaife and Rogers 1996). Visualization can substitute preconscious visual competencies and machine computation for conscious thinking (Friedhoff and Peercy 2000). Such processing is fast, automatic, and indefatigable, so it carries less cognitive load than conscious processing. Color, size, contrast, and movement are properties that invoke preconscious visual processing. Similarly, a long history dual-processing theory proposes the similar structure of human reasoning system (Evans 2008).

In a word, the prior literature provides a basis for optimism that an animated graphic representation will be useful given our objective of developing an understanding of the dynamics of an organization through time. Therefore, we propose that decision making accuracy will be higher when animations are used than when static graphs are used.

RESEARCH DESIGN

Research in visualization-based decision making often uses a comparative approach to study the differences among representations. The design of this study followed that tradition. We employed a holistic task—bankruptcy prediction. To succeed at this task, people need to process many ratios and temporal factors as a whole to assess the financial situation of a company (Vessey and Galletta 1991). Seven critical financial indicators (capital, total assets, current ratio, receivables turnover, inventory turnover, self-financing, and debt service) of thirteen firms adapted from previous research (Vessey and Galletta 1991) were evaluated by subjects over five time periods. In order to show a more complete structure of the organization's operational flows and shareholder equity and liabilities, an additional four indicators (debt, paid-in capital, retained earnings, and payables turnover) were also included. The dependent variable was judgmental accuracy. The independent variable was the type of representation (static graphs vs. animations). Static graphical representations were based on conventional financial market practice (NYSE: Daily Graphics) with financial statement balances as column graphs and financial ratios as line graphs. The animated representation was also adapted from previous research (Boland et al. 2008). All of the eleven financial indicators were represented by the animated change of color, movement speed and size of the graphic elements over five years as Figure 1 illustrates. On the left of the interface was a vertical list of buttons (ranging from "A" to "M") that allowed the user to choose which firm to view. Pressing on one of these allowed the user to view the changes (trends) of that particular firm from the first year to the fifth year. The two textboxes to the right showed the user which year and which firm was being viewed. The example in Figure 1 is showing Firm K in the second year. Since both the dynamic and static representations were fed with the same source data, they were considered as informationally equivalent, one of the most important criteria to compare different representations effectively (Larkin and Simon 1986; Tversky et al. 2000).

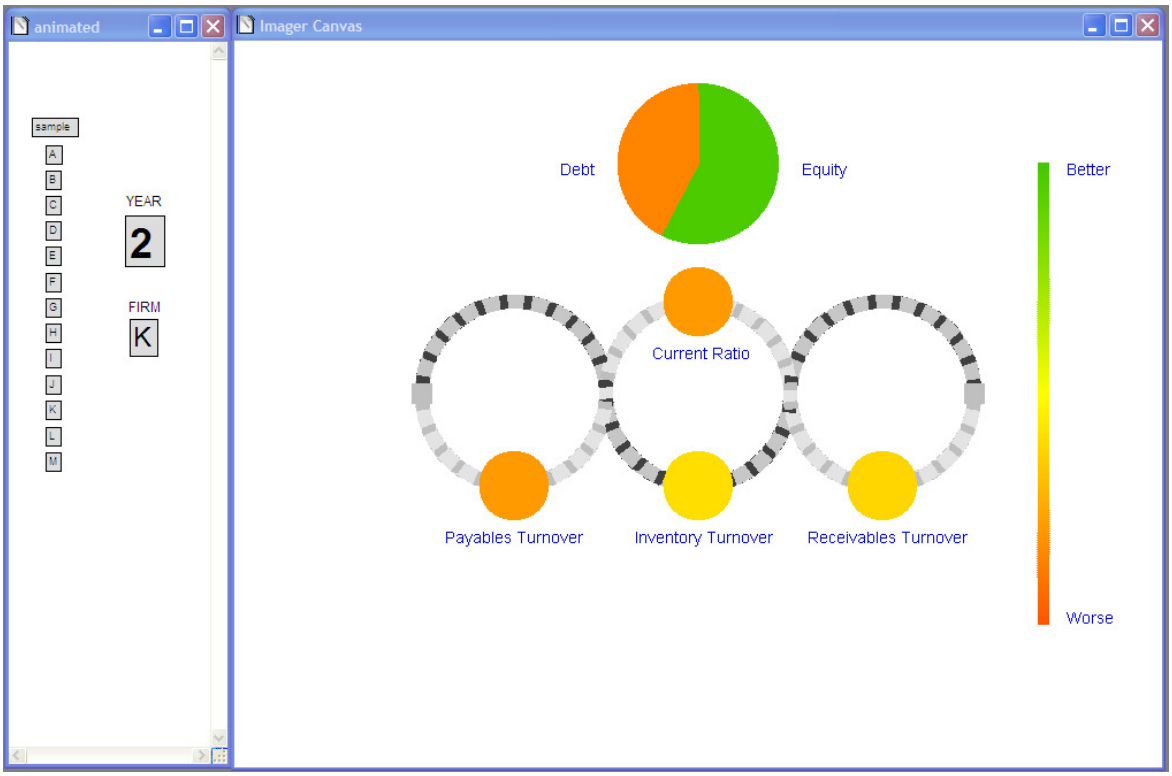

Figure 1. The interface of Business Animator

PRELIMINARY RESULTS

The experiment was conducted in three rounds at two universities following the same procedure. Of the 57 subjects who participated in the experiment, six did not complete the tasks successfully, so their inputs with missing values were deleted. As each subject performed the same tasks twice using different representations, a total 102 cases/observations were kept for further analysis. The ANOVA test showed there were significant differences across groups viewing different representations in accuracy ($F(3,98)=2.743$, $p=0.047$). An independent sample t-test shows that subjects using business animator made significantly more accurate judgment ($t=-3.568$,$df=45$, $p<0.01$) than graphs.

IMPLICATIONS

The use of animations resulted in significant improvement in accuracy in bankruptcy prediction performance. Given a holistic decision-making task, subjects made more correct judgments when viewing an animated representation than when using static graphs. In information systems research, cognitive fit theory (Vessey 1991) has been widely used to explain why graphs are sometimes better than tables for supporting decision making, but it does not systematically describe the link between external representation and internal representation. In another word, "fit" is not well defined. This research took distributed cognition theory as the foundation to consider cognition as a process distributed between individuals and artifacts rather than as a pure internal process. We also integrated dual coding theory to explain the internal representation and visual perception theories and to analyze the connections between internal and external representations. The conclusion was that one external representation outperforms others because it better invoked the preconscious connection with internal representations. The features in

animations such as movement and color change increased the magnitude of the preconscious processing to facilitate the task performance, which was supported by preliminary empirical findings.

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