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Imagic and Textual Components of Web

Page Design: The role of Gender

in Subjective Ratings

Richard H. Hall

University of Missouri - Rolla

Lewis L. Hickman

Hughes Aircraft

Abstract

Undergraduate students viewed a series of web pages which displayed information about the neuron from a general psychology text. The information was presented in text only, picture-only, and text-picture formats. In addition, the text presentation was displayed on three different backgrounds: gray, texture, and a background that included text. Students rated the displays based on how effective they were for conveying the information they contained. All students rated the text-picture formats as most effective. However, the men and women differed dramatically in their rating of the three different types of background, with the males rating the text background as the most effective, and women rating this background as the least effective. The results also indicated that this gender effect was not due to perceived experience with computers or the World Wide Web.

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The World Wide Web is, at the most basic level, a graphic-textual interface, and, in fact, the major advantage of this internet medium, when compared with its predecessors, is its ability to display imagic-graphic and textual information in combination. Due to the imagic/textual nature of web page displays, a group of educational theories, which were developed before the World Wide Web came into being, are applicable to learning from web pages. We will refer to this related group of models as spatial-verbal processing theories, i.e., contiguity theory (Mayer, 1997; Mayer & Anderson, 1992); spatial-verbal processing model (Dansereau, 1989; Lambiotte, Dansereau, Cross & Reynolds, 1989); and conjoint retention (Kulhavy, Lee, & Caterino, 1985).

All of these theories borrow heavily from Paivio's dual-coding model (Paivio, 1971). Paivio suggests that some types of information are learned much more quickly and readily since they lend themselves to a dual verbal/abstract and imagic/concrete code, so that the information is stored diffusely/redundantly. A host of research has, since that time, supported Paivio's theory (e.g., Clark & Paivio, 1991; Mayer, Bove, Bryman, Mars & Tapangco, 1996; Paivio, 1986; Schwartz & Kulhavy, 1981).

The spatial-verbal processing theories extend dual-coding, in that they apply not just to verbal information that lends itself to verbal and imagic storage, but to pictorial/spatial and verbal (i.e., multi-media) displays. Research based on these models has supported the idea that spatial-verbal presentations can indeed greatly enhance retention, and subsequent application (Abel & Kulhavy, 1986; Hall, Dansereau, & Skaggs, 1992; Mayer & Anderson, 1992; Mayer, 1997; Rewey, Dansereau, Skaggs, Hall, & Pitre, 1989). The first goal of the present experiment was to extend research on spatial-verbal displays to web page design. We predicted that information presented on web pages that utilized a combination of imagic and textual information would result in a richer dual (verbal - spatial) code, as the theories above would suggest, and consequently students will rate these pages as more effective for learning.

The second purpose of this experiment was to examine the mediational role of gender in the rating of web pages. There are a number of reasons why we expected ratings to be influenced by gender. There is evidence that gender differences in attitudes toward computers begin developing as early as preschool (Beenson & Williams 1993; DiAmico, Baron, & Sissons, 1995). This pattern persists throughout life. Some researchers suggest that women have a learned pattern of helplessness when it comes to the field of computing (Nastasi & Clements 1992). With this in mind, it is no wonder that men outnumber women six to one on the web, and in the computer field there is a two men to one woman

ratio (Shea 1995). This may be the result of socialization, as women and men develop self-efficacy and learning motivation differently in the world of technology (DiAmico et al. 1995).

Gender differences in attitudes towards computers may also be partly explained by more fundamental differences in the way that men and women process visual displays (Halpern 1995; Hellige 1993). Recent magnetic imaging research indicates that men and women differ substantially in the way their brains represent basic types of verbal processes (Shaywitz et al. 1995). For this reason, we were particularly interested in examining gender differences in the rating of pages that were displayed on backgrounds that varied in the amount of verbal information they contained. More specifically, in addition to varying the imagic-textual nature of foreground information, we also varied the backgrounds.

When varying the backgrounds we used only one, textual, information display in the foreground, in order to parcel out the background effect. We presented this text-foreground on one of three backgrounds: gray, texture, or text. The text backgrounds, however, were not expected to enhance the foreground information, in that the background text information was a school logo that was unrelated to the to-be-learned information. Therefore, to whatever extent the learner processed the background, it should act to interfere with, rather than support, the to-be-learned information. Thus, in the case of background, we

predicted that the information presented on the textual background would be rated lower in its effectiveness.

Method

Subjects

Twenty-seven students from a medium sized midwestern technologically-oriented university participated in this experiment. The participants were students in an undergraduate general psychology or physiological psychology class, and received extra class credit for participating. There were ten females and seventeen males, and they ranged in age from 19 to 45 with a median age of twenty-two.

Materials and Procedure

A computer program written in HTML and displayed via the world wide web served to display the stimulus materials for this experiment. When students began the experiment, an explanation page was presented, which explained the subject's task. On this page subjects read the following before beginning the experiment.

We have developed the following sample web page displays as part of a research project that is aimed at examining basic properties of web pages that are important for learning. As a participant in this experiment, your task is to rate the effectiveness of each of these page displays for conveying the information

contained in the display. There are no right or wrong answers, we are simply interested in your opinion as to how effective the displays are for conveying the information they contain. Please answer as honestly and thoughtfully as possible.

The students then viewed five pages with the order counterbalanced, to avoid order effects. Each page contained a paragraph of text material describing a neuron and/or the picture of a neuron with a short description. These materials were excerpted from a general psychology text book (Myers, 1995). Three of the pages consisted of just the text excerpt. These three pages differed only in their background. One background was the default gray, one was a gray texture, and one contained the school letters "UMR" repeating. A fourth page consisted of the picture of the neuron only and the fifth page included both the text and the neuron. Both of these pages were on a standard gray background.

Students were allowed to view each page for as long as they chose, after which they rated the page on a scale of 1-10, based on how effective they believed the displays to be for conveying information, by using a pull down menu on each page. After these five pages, a final page was included in the program which asked students to answer questions about their age and gender, and they were asked to rate, on a scale of 1-10 their experience with both the world wide web and computers in general.

Results

The analyses began with two, two-way mixed analyses of variance. In the first analysis of variance "foreground" (text vs picture vs text and picture) served as a within subjects independent variable, and, in the second, "background" (gray vs texture vs text) served as a within subjects independent variable. In both analyses, gender was a between subject independent variable. Student's ratings of the pages served as the dependent variable in both analyses of variance.

In the first analysis, a main effect was found for foreground $F(2,50) = 21.56, p < .001$. The mean ratings and standard deviations for the text, picture, and picture plus text pages, respectively, were: $M = 4.88, SD = 2.35$; $M = 5.93; SD = 2.55$; $M = 8.46; SD = 1.36$. Tukey post hoc tests (Schweigert, 1994) indicated that ratings of the page with the picture and text together were significantly higher than the ratings of both of the other pages, which were not significantly different from one another. No other effects were significant.

In the second, background, analysis of variance, a significant gender X background interaction was found $F(2,50) = 6.21, p < .01$, and no other effects were significant. This interaction is displayed in Figure 1. Men and women were compared at each level of background using Tukey's post hoc tests, and, while the ratings of the gray and texture pages did not differ significantly, the males rated the text background significantly higher than the females.

Students ratings of their experience with the world wide web and computers in general were found to be strongly correlated, $r = .81, p < .001$, so

the two measures were combined, by taking the mean of the two scores, and creating a single "experience" variable. Men and women were significantly different on experience ratings as indicated by a between subjects' analysis of variance in which experience was the dependent variable and gender was the independent variable $F(1,26) = 4.77, p < .05$. Men ($M = 7.41, SD = 1.52$) rated themselves as significantly more experienced than women ($M = 5.80, SD = 2.32$).

In order to assess the relationship between experience ratings and web page ratings a series of zero-order Pearson correlations were performed between ratings of each of the web pages, and experience ratings. In no case were these correlations statistically significant.

Lastly, in order to further examine the role of experience in accounting for the gender effect with the background ratings, an analysis of covariance was performed using the same variables as with the analysis of variance described above, except that experience served as a covariate. The results were almost identical, in terms of the gender X background effect $F(2,46) = 6.59, p < .01$, and, in terms of the adjusted means compared to the original means, thus indicating that experience ratings did not play a role in this effect.

Discussion

As expected, students rated the pages that included both textual and image information as more effective than the pages that included only one of the

two. This finding is consistent with the spatial-verbal processing theories described in the introduction. Background ratings, on the other hand, were strongly mediated by gender. Females' ratings were consistent with our predictions that the text background would act to interfere with the to-be-learned information, in that they rated the web pages with text backgrounds as the least effective. Males ratings, however, were the opposite, in that they rated these backgrounds as the most effective. It is important to note, that students' ratings of their experience with computers and the web did not influence their ratings of the pages. This indicates that gender differences in rating were not due to differences between males and females in their experience with computers and the web.

A number of possible interpretations can be offered for this striking difference between females and males in their ratings of backgrounds. First, the women may have more readily/automatically processed the verbal background, thus increasing its interference, while the men may have been better able to focus on the to-be-learned information, and easily ignore the background. However, the fact that the men rated this background as higher than the non-verbal background indicates that this verbal information had some sort of facilitative effective. It may be that the school letters were associated with sports teams/events, and this, then, created positive affective, more conducive to learning. Although it is difficult to determine which of these factors account for the male/female differences, the results do strongly suggest that it is important for the educational

web page designer to consider gender when designing pages to be optimally effective.

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Figure Caption

Figure 1. Rating as a function of gender and background.

