CONTROVERSY ABOUT POWERPOINT SLIDE DESIGN

Particularly since the 2003 publication of Edward R. Tufte’s *The cognitive style of PowerPoint*, a critique of PowerPoint and similar presentation software, technical communicators have discussed the merits and pitfalls of conveying information via projected slides during presentations. Tufte argues that PowerPoint leads presenters to simplify their messages and to generate slides that hinder meaning, rather than support and enhance it. Specifically, in relation to PowerPoint slide design, Tufte claims that PowerPoint leads to “conspicuous decoration” and “a preoccupation with format not content” (4).

Even more specifically, in relation to slides that display graphs, he says that PowerPoint leads communicators to create graphs that convey little but are “smarmy” and “incoherent,” and that display “thin data-density, chartjunk, encoded legends,” and “meaningless color” (16). He goes on to say that designers who use PowerPoint’s default design settings generate graphs that cause an audience to conclude that the presenter does not “know much about data and evidence” (16).

Other experts, such as presentation experts and experts in presentation software, have made similar claims. For example, Munter and Russell (2002) echo Tufte in saying that “Chartjunk temptations are built into presentation software packages” (75). Also focusing on the inadequacies of default graph settings, Finkelstein (2003) says that “Rarely is the default version of the chart acceptable for a slide. Sometimes the labels aren’t readable. Perhaps the scale of the axes is not appropriate” (225).

In responding to Tufte, Doumont (2005) says that Tufte’s fault-finding is justified insofar as many people, when designing slides for their presentations, include unneeded information and use too many colors and decorations (68). However, Doumont argues that Tufte’s criticism lacks nuance. In regard to Tufte’s criticism of PowerPoint’s ability to display only simple graphs, Doumont points out that even a simple graph can foster communication, given the right situation: “graphs are a useful alternative to long text passages on slides” (66). Specifically, he says, “a truly visual graph is not processed sequentially, so it does not compete for the same intellectual resources as text” (66, see also Paivio 1986, 53). Here Doumont alludes to dual-coding theory, which posits that verbal and visual information can be cognitively processed simultaneously because they rely on two different cognitive resources (Clark and Paivio 1991; Paivio 1986). Thus, argues Doumont, Tufte does not acknowledge the benefit of using graphs to enhance an audience’s cognitive processing of the presenter’s message.

In light of recent debates about the use of PowerPoint during academic and business presentations (such as Keller 2003; Norvig 2004; Thompson 2003), particularly the discussions arising in regard to effective design of PowerPoint slides (for example, Doumont 2005; Manning and Amare 2006), studies that investigate people’s perceptions of slide design are needed. In addition, there is little but workplace anecdotes to back up Tufte’s assertion that PowerPoint slides convey minimal substantive information. Indeed, several studies of instructors’ use of PowerPoint during lectures showed that PowerPoint presentations improved...
students’ performance (Lowry 1999; Mantei 2000; Szabo and Hastings 2000). Interestingly, students stated that lectures accompanied by PowerPoint slides were more organized (Susskind 2005, 212).

This article reports findings of a study that examined PowerPoint graph slides in an effort to examine perceptions of design elements that they displayed. The study could not test all of the design elements that Tufte (2003) lists in his argument about the negative effects of PowerPoint on presenters and audiences, but it examined graph design elements that are interesting for theoretical and practical reasons. It examined people’s perceptions of the following:

1. The clarity of bar graphs displaying two-dimensional (2D) and three-dimensional (3D) bars
2. The attractiveness of bar graphs displaying default color combinations, particularly cool and warm colors

In addition, this study examines the role that cultural background—Eastern or Western—plays in ratings of color attractiveness. The aim of this study, then, is to help technical communicators make research-driven decisions about effective slide design. Such studies are needed, given recent research on students’ perceptions of PowerPoint presentations, which indicates several slide design elements that are appreciated by and that annoy students. Blokzijl and Naeff (2004) found that good layout/legibility and use of diagrams, pictures, and graphs were design elements that students appreciated most. In contrast, students rated poor layout/wrong color combination as the second-most annoying design characteristic, following effects (75). Blokzijl and Naeff’s study is one of few to examine viewers’ preferences for PowerPoint slide design, and it leads into this study of viewers’ perceptions of graph slide design.

PRIOR RESEARCH ON POWERPOINT AND ON GRAPHS

The following components were chosen for study in the research reported in this article:

1. The clarity of graphs containing 2D versus 3D bars
2. The attractiveness of color combinations

Clarity of 2D versus 3D bars

Anyone who has created a graph in PowerPoint has likely noticed that the default “chart” type that appears is a 3D bar graph. Besides displaying the two dimensions of length and width, 3D bars indicate volume, even though this extra dimension typically conveys no information. Compare 2D and 3D bar graphs in Figure 1 and Figure 2.

This “empty” dimension in PowerPoint’s default bars is a classic example of what Tufte calls “chartjunk,” and he declares that “the number of information carrying dimensions should not exceed the number of dimensions in the data” (Tufte 1983, 71). Schmid (1983) seems to agree. He says that “a three-dimensional chart should seldom, if ever, be selected if it does not carry information but instead exists only to generate “eye appeal” or “novelty” (154). Examining data displays in print documents, researchers have gauged the effects of this unnecessary though often-used empty third dimension in bar graphs. Several studies conclude that it impairs graph users’ accuracy in judging values (Cleveland 1985; Kosslyn 1994; Tufte 1983). Even PowerPoint experts advise presenters to break from PowerPoint’s 3D default. Finkelstein (2003) writes that, “3-D charts are notoriously hard to evaluate—it’s difficult to see exactly where the top of the column is” (232). Thus, researchers focused on audience claim that 2D graphs should be used rather than 3D graphs.

Recent research has shown that these claims may be too vehement. According to Zacks, Levy, Tversky, and Schiano (1998), the consequences of using empty dimensions in graphs “may be of little practical importance in the construction of effective figures” (135). They found only a small decrease in accuracy in judging values from graphs with empty third dimension, as opposed to 2D graphs. Other studies reveal similar findings (Carswell, Frankenberger, and Bernhard 1991; Fischer 2000; Spence 1990). In fact, Spence directly debates Tufte (1983) by saying that empirical studies “cast some doubt on the wisdom” of Tufte’s recommendation to avoid an empty third dimension (Spence, 1990, 691).
Also, researchers agree that people may actually prefer 3D graphs over 2D graphs because the extra dimension may make the graph more attractive: “Attractive displays often result when high dimensional elements with irrelevant extra dimensions are used, and undoubtedly, attractiveness plays a role in drawing the attention of the reader” (Spence 1990, 691). Indeed, when Levy, Zacks, Tversky, and Schiano (1996) tested people’s preference for 2D and 3D graphs under different scenarios of use, they found that participants preferred 3D graphs (line and bar) under the scenario of presenting to others and under the scenario of needing to foster colleagues’ recall (47). Levy and colleagues explain the finding this way: “people may feel that extra graphical flourishes will make the figure stand out, making the graph both more memorable and more impressive to others” (48). The empty extra dimension, then, may be perceived as adding visual interest to a graph slide.

Levy and colleagues (1996) provide another explanation for people’s potential preference for 3D graphs. The preference, they say, may stem from “the ecological and evolutionary situatedness of our visual systems.” More specifically, they say that 3D graphs convey a realistic environment more clearly and “may be more easily coded in terms of schemas we have for visual scenes” (48). Manning and Amare (2006) make a similar claim when discussing the ethical implications of empty third dimensions in graphs. Analyzing Tufte’s (2003) examples of 3D graph elements, such as bars and lines, they say that “the eye wants to interpret them as actual objects” (206). In short, to the extent that 3D bars reflect our expectations for perceiving the world around us, they may be perceived as more clear.

My study tested people’s perceptions of the clarity of 2D and 3D bar graphs to see whether potential preference for 3D bars, rising out of preference for normal perception, overcame a potential preference for bar graphs lacking the “graphical flourish” of an empty dimension.

Attractiveness of color combination

Another under-examined design element related to PowerPoint presentations is color. Analysis of color is particularly important, given a wealth of research that shows that different colors generate different psychological and physiological responses. In addition, cross-cultural analyses of color preferences and color meanings show that technical communicators should account for color in their slide designs.

That said, it is important to note that little research has explored color in the design of projected slides. An exception is the often stated guideline to use dark background color with light text in dark lighting conditions (e.g. Finkelstein 2003, 168; Jones 1997, 56). As Horton (1991) points out, describing color in terms of light and dark is indeed natural, but it is often more useful and has in fact long been a standard practice to discuss people’s perceptions of and preferences for different colors in terms of temperature, particularly “warm” and “cool” (Sutherland and Karg 2003). Warm colors are colors such as red, orange, and yellow. Cool colors are colors such as blue, green, and purple.

Categorizing colors into groups of warm and cool originated before 1813, when Charles Hayler distinguished between the two categories in his color wheel (Gage 1999, 22). Discussing colors in terms of temperature—warm and cool—harkens back to “archetypal human experiences” (Gage 1999, 22). As Wierzbicka (1990) points out, we think of yellow as warm because of the sun, and we think of red as warm because of fire. For example, in a cross-cultural study of color meanings, red was rated as “hot” by participants from diverse cultures (Madden, Hewett, and Roth 2000, 98).

It is important to consider color choice when designing PowerPoint slides because warm colors generate quite different psychological responses than cool colors. Warm colors are considered arousing (Bellizzi and Hite 1992; Cahoon 1969) and active (Madden, Hewett, and Roth 2000; Richards and David 2005), and lead to higher levels of anxiety (Jacobs and Suess 1975). This perceived response is likely related to warm colors’ greater ability to draw attention than cool colors’ ability to do the same (Danger 1969), which is the reason behind guidelines to use warm colors to emphasize and to make main points (Jones 1997; Murch 1987). Cool colors, on the other hand, are perceived to be peaceful and calm (Bellizzi and Hite 1992; Madden, Hewett, and Roth 2000; Sharpe 1974) and relaxing and pleasant (Bellizzi and Hite 1992). Such responses to cool colors are likely part of the reason that cool colors were found to be more attractive than warm colors in retail environments (Bellizzi and Hite 1992).

Physiological research correlates with people’s psychological perceptions of color. Measures of palmar conductance (Wilson 1966) as well as blood pressure, respiratory rate, eye blink frequency, and galvanic skin response (Gerard 1958) show that yellow and red, warm colors, generate a less relaxed state than blue. According to Clynes (1977), red may be inherently exciting to the human brain, and human evolution could be responsible for this universal response.

Understanding that cool colors lead to perceptions of relaxation as well as physiological relaxation can help technical communicators design on-screen documents that achieve their rhetorical purposes more effectively. Gorn, Chattopadhyay, Sengupta, and Tripathi (2004), for example, studied the effect of color on web users’ perceptions of download times. They found that screen hue (blue or red) had a significant effect on perception of download time; a blue hue correlated with perception of a quicker download time, as opposed to red screens (219).
In addition, cross-cultural research on color perceptions must be considered when examining preference for and meaning associated with warm and cool colors, and in turn, designing PowerPoint slides. In regard to color preferences, such research has shown that blue is well-liked universally (Guilford and Smith 1959; Karpowicz Lazreg and Mullet 2001), so much so that there exists what is called a “blue phenomenon” (Choungourian 1968; Madden, Hewett, and Roth 2000; Simon 1971). Adams and Osgood (1973), for example, asked high school students from 20 countries to evaluate seven colors. Blue was most highly evaluated. In their study of perceptions of 80 colors by participants from eight countries, Madden, Hewett, and Roth (2000) found that blue was rated “most liked” by participants from five of the eight countries, and green was rated second highest by participants from the other three countries.

Besides investigating cross-cultural preferences for color, researchers have also examined the meanings that diverse cultures assign to different colors. In a meta-analysis of cross-cultural color research, Aslam (2006) found that blue is associated with “high quality,” “corporate,” and “masculine” in Anglo-Saxon cultures, but in other cultures it conveys different meanings. For instance, in Germanic cultures it conveys “feminine,” and in Malaysia it conveys “evil.” Green means “good taste” and “envy” in Anglo-Saxon cultures, but it means “pure” in China and Korea, and “love” in Japan.

People also assign meanings to warm colors. In Anglo-Saxon cultures, yellow conveys “happy,” and in China it conveys “pure” and “royal.” In Germanic, Slavic, and Japanese cultures it conveys “envy” and “jealousy” (Aslam 2006, 19). Red means “lucky” in China, Denmark, and Argentina, but “unlucky” in Chad, Nigeria, and Germany (Neal, Quester, and Hawkins 2002; Schmitt 1995).

Thus, besides investigating perceptions of light and dark slide backgrounds, my study investigated people’s ratings of the attractiveness of color combinations displayed in bar graph slides, attending particularly to slides displaying warm colors versus cool colors. Figures 1 and 2 showed one of the color combinations (displayed in the 2D and the 3D versions). Figures 3, 4, 5, 6, 7, and 8 show the other three color combinations in 2D and 3D bar graph slides.

MATERIALS AND METHODS
Participants
The 37 participants were graduate and undergraduate students at a mid-size, private university in the Midwest of the United States. They were tested and found to have 20/20 corrected and normal color vision. Of the 37 participants, 23 were males and 14 were females. Their ages ranged from 18 to 42, with an average age of 24. Sixteen spoke English as a first language; the others spoke English as a second language. As Table 1 shows, 21 participants were from seven Southeast and East Asian countries. These participants were categorized as being from “Eastern” cultures. Table 1 also shows that 16 participants were from three countries typically categorized as “Western” cultures.

Participants’ cultural background was of interest for its possible relationship to perceptions of color attractiveness. Participants’ experience in viewing and creating PowerPoint presentations was gauged through a questionnaire of demographic information. Over two-thirds of the participants had viewed at least six PowerPoint presentations within the prior month, and 16 of the participants had created at least six presentations within the past year. The
participants' brought a range of experience with both viewing and creating PowerPoint presentations to the study.

**Procedure and instruments**

In groups of two to six participants, the 37 participants viewed graph slides that were unaccompanied by oral presentation. Although gauging perceptions of the visual component of a presentation (slide design) divorced from a verbal component (a presenter's words) created an unnatural situation, isolating the visual component allowed valid measures of clarity and attractiveness of design elements.

Of the eight bar slides, four displayed 2D bars and four displayed 3D bars (see Figures 1–8). Also, four color combinations were displayed:

- White background/warm bar colors (red, orange, yellow)
- Blue background/cool bar colors (light blue, green, blue)
- Black background/cool bar colors (light blue, sage green, blue)
- White background/cool bar colors (light blue, teal, blue)

These colors were chosen for the following reasons:

- They allowed cool *versus* warm color comparison (white background/cool bars *versus* white background/warm bars).
- They allowed evaluation of a “blue phenomenon” (white background/cool bars and blue background/cool bars *versus* other color combinations).
- They were default color schemes in PowerPoint.

The design variables compared in the 8 bar graph slides are delineated in Table 2.

Participants received a paper-clipped packet containing the following items: a consent form to participate in the study, a demographics sheet, stapled booklets for rating the slides, and a follow-up questionnaire. Before viewing the slides, participants viewed an example slide that was labeled with terms that they would encounter in scales of the rating booklet. They were told and shown what was meant by *overall slide, words and numbers, and graph area* (the area between the *x* and *y* axes).

Figure 9 shows a slide that was used to clarify referents of these terms and thus to create and strengthen internal validity.

The participants were told that the slides conveyed information about three countries in western Africa: Angola, Benin, and Liberia. They were told that the study was intended to get their feedback about the PowerPoint slides, not to test their knowledge of the three countries. Participants were given an opportunity to ask questions and rated a practice slide.

Participants used 1–7 Likert scales to rate the slides on rating scales. They rated the clarity of the graph area, allowing comparison of their perceptions of 2D *versus* 3D bars. *Clarity* was consistently defined as “how easy or difficult it is to make out or distinguish the information in the graph area.” Figure 10 shows the rating scale they used.

Participants also rated the attractiveness of the color combination in the bar graph slides. *Attractiveness* was consistently defined as “how visually appealing or not appealing the graph area appears.” The scale used for this rating is shown in Figure 11.

Participants also rated other slides on other rating scales (see Mackiewicz forthcoming) and filled out a questionnaire about their preferences for PowerPoint presentations. The entire study session lasted about one hour. Participants were either paid $10 or were given extra credit in a university course.
Participants were seated in desks that were 15–20 feet (4.5–6.1 meters) from the screen, like students in a class or audience members in a breakout conference session. The projected image was 6 feet by 4.5 feet (1.8 × 1.4 meters). The projected image was focused prior to each session of

### TABLE 1: PARTICIPANT CULTURE AND HOME COUNTRY

<table>
<thead>
<tr>
<th>Eastern Country</th>
<th>Number of Participants</th>
<th>Western Country</th>
<th>Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>7</td>
<td>United States</td>
<td>14</td>
</tr>
<tr>
<td>China</td>
<td>4</td>
<td>Canada</td>
<td>1</td>
</tr>
<tr>
<td>South Korea</td>
<td>4</td>
<td>Germany</td>
<td>1</td>
</tr>
<tr>
<td>Thailand</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vietnam</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21</strong></td>
<td></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

### TABLE 2: SLIDE DESIGN VARIABLES

<table>
<thead>
<tr>
<th>2D/3D</th>
<th>Background Color</th>
<th>Bar Colors</th>
<th>Warm/ Cool</th>
</tr>
</thead>
<tbody>
<tr>
<td>2D</td>
<td>white blue</td>
<td>blue teal</td>
<td>cool</td>
</tr>
<tr>
<td>3D</td>
<td>white blue</td>
<td>blue teal</td>
<td>cool</td>
</tr>
<tr>
<td>2D</td>
<td>white red</td>
<td>orange yellow</td>
<td>warm</td>
</tr>
<tr>
<td>3D</td>
<td>light white red</td>
<td>orange yellow</td>
<td>warm</td>
</tr>
<tr>
<td>2D</td>
<td>blue light blue</td>
<td>blue sage green</td>
<td>cool</td>
</tr>
<tr>
<td>3D</td>
<td>blue light blue</td>
<td>blue sage green</td>
<td>cool</td>
</tr>
<tr>
<td>2D</td>
<td>black light blue</td>
<td>blue sage green</td>
<td>cool</td>
</tr>
<tr>
<td>3D</td>
<td>dark black light blue</td>
<td>blue sage green</td>
<td>cool</td>
</tr>
</tbody>
</table>
the study. An Epson PowerLite S1 Plus projector was used to project the slides. Light in the room was measured prior to each session and light was modulated for glare. In each session, light was measured between 125–150 lux. This amount of light approximates the light in most classrooms and conference rooms when the lights have been dimmed somewhat but there is still enough light to take notes and see the speaker easily and clearly. This lighting situation was used so that the findings could be applied to academic and business settings.

RESULTS AND DISCUSSION
This section delineates the findings for perceived clarity of 2D versus 3D bars and attractiveness of color combination. It also discusses how these results are relevant to technical communicators.

Clarity of 2D versus 3D bars
Differences in participants’ ratings of 2D and 3D bar graphs were examined first by comparing all 2D to all 3D bar graph slides. Mean ratings and standard deviations for these groupings are shown in Table 3.

A one-way ANOVA test reveals a significant difference between participants’ ratings of 2D and 3D graphs \((F(1, 36) = 6.09, p < .05)\). Participants in this study rated the graph areas of 2D bar graphs significantly higher for conveying information clearly than 3D bar graphs.

This finding is in keeping with graph and presentation designers’ claims about the hazards of unnecessary data ink, such as that created by an empty third dimension (for example, Munter and Russell 2002; Schmid 1983; Tufte 1983; Tufte 2003). This finding also weakens the argument that 3D bars are preferable because they conjure people’s visual schemas for viewing the world around them (Levy and colleagues 1996). Even if 3D bars better reflect people’s visual expectations, they are not perceived as conveying information—their primary purpose—as clearly as graphs with 2D bars.

Thus, this empirical research supports recent claims by Manning and Amare (2006) about the importance of differentiating among decorative, indicative, and informative visuals. They note that 3D graph elements such as the empty third dimensions in the bars of the graphs of this study are decorative, conveying a feeling, rather than informative, conveying “statements or ideas that can be validated (judged as true or false) by means of logical reasoning or experiment” (201). In other words, decorative elements may play to the presenter’s need to evoke feelings by adding “graphical flourish” (Levy and colleagues 1996, 48), but decorative elements decrease the clarity of the visual information.

Manning and Amare (2006) argue that a breach of ethics occurs when technical communicators prioritize decoration over information, saying that communicators must “exercise due diligence to make sure a visual is actually informative for a given audience (201). Their argument makes sense theoretically; however, in relating their claim to this research, it is important to point out that although 3D graphs were perceived as significantly less clear than 2D graphs, this difference in perceived clarity may not relate to a difference in accuracy of reporting graphed information (see, for example, Spence 1990; Zacks and colleagues 1998). That is, people may perceive 2D bar graphs to convey information more clearly than 3D bar graphs, but people may still make accurate judgments when viewing 3D bar graphs. Even so, it is safe to say that the perceived clarity of 2D bars makes them preferable to 3D bars. In this case, less is more.

Therefore, because an empty third dimension in bar graphs is the default setting in PowerPoint, technical communicators who want to maximize benefits from their design work should prioritize changing from the default 3D setting to the 2D graph setting. Of course, changing one’s own work is not difficult, but initiating changes within an organization is not always a simple matter, as Doumont (2005) points out. He says that certain design elements, particularly those generated by default settings, can become the norm, creating situations in which people maintain bad design rather than initiate change:

> Young professionals, trying their best to fit in, learn by imitation; those who deviate from the norm, for example by designing their slides markedly differently, . . . may be frowned upon by middle or even upper management, who implicitly set expectations for poor slides even if they suffer the consequences. (Dumont 2005, 68)

Citing research that shows the benefits of deviating from PowerPoint’s defaults will likely aid technical communicators in moving an organization’s culture from default set-
Attractiveness of color combination

When all four color combinations were compared, color combination was found to have a significant effect on participants' ratings of attractiveness ($F(3, 73) = 8.13, p < .05$). The color combinations that were rated highest were the slides with white background/cool bars and those with black background/cool bars. The blue background/cool bar slides received the lowest ratings. These results are shown in Table 4.

These findings suggest that participants perceived slides with cool colors to be most attractive, but that ratings for attractiveness also depended on sufficient contrast between background color and bar colors. The slides displaying all cool colors, the blue background/cool bar slides, were also the slides that displayed the least background-to-bar color contrast, and these slides by far were rated as the least attractive.

This finding contrasts with prior research that has shown that a strong “blue phenomenon,” a cross-cultural preference for blue, persists. It seems then, that there is an exception to the blue phenomenon rule: technical communicators designing PowerPoint slides should use blue, but they must also allow for contrast and the easier access to information that it imparts. Participants' questionnaire responses support this idea. One wrote that colors can make a presentation clearer, but that clarity requires “contrast between background and foreground colors.” These findings suggest that technical communicators should choose color schemes with salient differences in color between background and graphical elements like bars.

Interestingly, the white background/cool bars slides and the black background/cool bars slides received especially high ratings from participants from Eastern cultures. Their ratings for attractiveness of the combination white background/cool bars (2D and 3D combined) was significantly higher than the ratings of the participants from Western cultures ($F(1, 72) = 6.79, p < .05$). The same was found for their ratings of the combined 2D and 3D slides displaying black background/cool bars ($F(1, 72) = 6.12, p < .05$).

Prior research on color meaning offers few clues as to why participants from Eastern cultures would rate these slides significantly higher than the participants from West-
ern cultures did. The colors used in the slides—hues of blue as well as sage green and black—tend to be associated with either positive or neutral meanings cross culturally. However, in the United States, black is associated with grief and fear. Black either lacks such negative associations in Eastern cultures, or those meanings are not as strong as they are in the United States (Aslam 2006, 19). It could be that black’s meanings suppressed Western participants’ ratings of the black background/cool bar slides.

This study also tested the effect of cool and warm bar colors on slides with white backgrounds. One-way ANOVA tests revealed no significant difference in the ratings of 2D, 3D, or combined 2D and 3D graphs for cool and warm colors. In addition, when ratings of participants from Eastern cultures were compared with ratings of participants from Western cultures, no significant differences were found.

Participants rated slides with warm colors as less attractive than slides with cool colors, except when background and bars failed to contrast, as in the blue background/cool bars slides. This finding accords with findings of prior research on color preferences. The warm colors yellow and orange—particularly orange—ranked low in Madden, Hewett, and Roth’s (2000) study of color preferences in eight countries (95). In contrast, the warm color red ranked in the middle of the 10 colors that were rated for preference.

It may also be that the warm colors were considered too “intense” by the participants to be rated as attractive as the cool colors. Indeed, two participants explicitly mentioned their dislike of yellow and four other participants stated that “bright” colors negatively affect design. Although the differences between the ratings of the cool and warm bars were not significantly different, participants’ ratings and their questionnaire responses suggest that technical communicators should favor cool colors over warm colors and use warm colors to highlight specific items, rather than using them over large expanses of slide area (such as bars in bar graphs).

One other finding to note is that the lightness or darkness of background color had little effect on participants’ ratings of the attractiveness of slides’ color combinations: black background/cool color bars and white background/cool color bars received approximately the same mean ratings for attractiveness, both in the 2D and 3D bar graph slides. (In addition, there was no significant difference between the ratings of participants from Eastern and Western cultures for attractiveness of slides displaying light versus dark backgrounds.)

This finding likely stems from the fact that the lighting in the room was dimmed, but the room was not completely dark. Dark backgrounds, such as the black background slides in this study, are more easily seen in dark rooms versus normal lighting, dark backgrounds (and dark colors in general) can appear faded and unclear. The black background slides in this study could be seen in the 125–150 lux lighting of the testing situation but probably not as well as if the slides had been viewed in a dark (25–50 lux) room.

Of course, the problem with advising people to use slides with dark backgrounds is that PowerPoint designers often do not know the lighting conditions of the rooms in which they will be delivering their presentations. One solution is to make two versions of a presentation: one for a dark room and one for normal lighting. Technical communicators can follow this advice by creating and saving one version of the presentation, then selecting and applying a new color scheme in a second copy of the presentation for the other lighting condition. PowerPoint allows a new color scheme to be applied at one time to all slides. Another solution is to choose a color scheme with a light background, which will generate slide content that is visible in most lighting conditions.

CONCLUSION
This study set out to test some design elements of graphs displayed on projected PowerPoint slides. The main comparisons were clarity of 2D versus 3D bars and attractiveness of color combination. Table 5 lists the main recommendations for technical communicators based on the results.

Unexamined use of PowerPoint can generate graph slides that are not perceived as clear or attractive. Technical communicators can help others to move beyond the default settings of PowerPoint, to consider the implications of their audience’s cultural background, and to apply research-supported design in their graph slides.

Further research needs to examine not only perceptions of graph slides, but also slides that combine text and image, perhaps slides displaying Alley and Neeley’s (2005)

### TABLE 5: RECOMMENDATIONS FOR DESIGNING POWERPOINT GRAPH SLIDES

<table>
<thead>
<tr>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saliently contrast background and graph colors (for example, white background/cool colors for bars).</td>
</tr>
<tr>
<td>Use 2D rather than 3D graphs; that is, change PowerPoint’s default setting.</td>
</tr>
<tr>
<td>Favor cool colors (for example, blue, green) over warm colors (for example, orange, yellow) for graph slides.</td>
</tr>
</tbody>
</table>
suggestions for sentence headlines and visuals. Indeed, Alley, Schreiber, Ramsdell, and Muffo (2006) recently found that PowerPoint slides displaying key assertions in sentence headlines, as opposed to phrasal headings, significantly improved students’ recall. Besides testing other slide content, researchers could further examine the effects of different design elements on accuracy of recall as well as the comprehension of information.

Debates about the extent to which slide design can obscure or enhance the intended message of a presentation will no doubt continue, but empirical research can inform the debate. This study begins to supply some answers, especially in relation to graphs displayed on projected PowerPoint slides. This and other empirical research on PowerPoint slide design can facilitate a more balanced approach to PowerPoint. Certainly, myriad poorly designed PowerPoint slides have been created, but with careful analysis of people’s perceptions of slide design, technical communicators can offer solutions to people who create presentations.

REFERENCES


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