GovStat Statistical Interactive Glossary: Two studies of effectiveness and control

Ron T. Brown
School of Information and Library Science, University of North Carolina, Chapel Hill, NC 27599-3360.
ront@email.unc.edu

Stephanie W. Haas
School of Information and Library Science, University of North Carolina, Chapel Hill, NC 27599-3360.
jdwilbur@email.unc.edu

Stephanie W. Haas
School of Information and Library Science, University of North Carolina, Chapel Hill, NC 27599-3360.
stephani@ils.unc.edu

Leo Cao
School of Information and Library Science, University of North Carolina, Chapel Hill, NC 27599-3360.
lcao@email.unc.edu

The GovStat Statistical Interactive Glossary (SIG) is designed to allow users of government statistical websites to consult definitions of statistical terms while continuing their current task of browsing statistical websites. In this paper, we present results from two studies of the SIG that evaluated the effectiveness of the SIG presentations. We specifically

focus on two areas: the effects of three presentation formats (text only, graphics + text, animation + text) on user performance and preferences, and the effects of three levels of controls for animations on user performance and preferences. Our findings have implications for designers of just-in-time help, as well as raising questions for future research.

Introduction

The web is changing the policy and practice in government statistical agencies. Previously, the primary audiences for statistics published by government agencies were statisticians, policy makers, journalists and researchers who had the domain knowledge necessary to manipulate, compare, and interpret the data they desired. However, with the increased deployment of federal statistical information on the web, information access has expanded to the general public. This expansion broadens the previous audience to include secondary and postsecondary students, and "just plain folks". These new populations have different information needs than the specialized needs of experts; in particular, this expanded population has lower levels of statistical literacy. For statistical information to be used properly, additional information is necessary to supplement the statistical material available. The goal of the GovStat (http://ils.unc.edu/govstat) project is to create an integrated model of user access to and use of US government statistical information. This is summed up in the project motto: *find what you need, understand what you find.*

The GovStat Statistical Interactive Glossary (SIG) was developed as part of a larger resolution by the GovStat Project to deliver help in an online environment (Marchionini *et al*., 2003). The SIG was designed to provide useful explanations to users as they browsed a statistical report or table. Inevitably, the general public has questions about the information they encounter on statistical agencies' websites. Basic questions such as, "what does this word mean" or "what is the difference between age adjusted and unadjusted data?" are common. The glossary helps answer these questions; it also includes terms that are frequently misinterpreted or that define crucial concepts (Pattuelli *et al*., 2003; Haas *et al*., 2003). Each glossary explanation is a presentation that can be launched from links embedded in a web page. Placing attachment points for links in close proximity to statistical information defined in the presentation facilitates the delivery of appropriate online help (Wilbur, 2004). Term explanations are currently available in three formats: text only, graphic + text, and animation + text. The various presentation formats are intended to meet the different learning styles and preferences of the general public (Brown *et al*., 2003; Felder 2002; Boulter 1994). Each explanation was designed to be

informative, attractive, and integrated with the user's current task.

We conducted two evaluations of the SIG to determine the effectiveness of the presentations in helping people understand statistical terms and concepts. The first study evaluated the overall effectiveness of the presentations in helping people understand statistical terms, whether format made a difference in effectiveness, and user preferences for the various formats. The second study focused on the animated presentations, and evaluated user preference for control of the animations, time-to-completion for different types of controls, and user satisfaction.

1. The Context for SIG Help

Online help is generally concerned with procedural help – getting from point A to point B, or how to use a particular tool. The SIG is concerned with helping people understand concepts. The system is not intended to replace a learning curriculum; instead, we have focused on delivering very small nuggets of information that are necessary to aid users while they are deep within their task. This type of help is different than learning, but learning-related research is still helpful in working out the design and delivery of SIG presentations. In particular, the SIG development draws from several research areas: cognitive learning styles, multimedia instruction, and tutorials for declarative knowledge.

The concept of learning styles is fundamental to the design of the SIG. Learning styles research highlights the optimal conditions for learning and suggests that a variety of formats combining different visual and textual information will best meet the needs of the broadest range of users. We considered the visual/verbal learning style pair to be the most pertinent to our study. Learning style studies show that visual learners consider concepts as objects, and use objects as reference when solving visual-spatial problems, while verbal learners tend to use words or formulas to work through the same kinds of problems (Boulter 1994). The learning style literature also indicates that we can expect users to have a clear preference for a particular format (text, graphic, or animation) based on how they learn.

The second area that defines the context of SIG help is multimedia instruction. However, multimedia instruction literature tends to focus primarily on hypermedia and multimedia computer materials, courses, and tutorials; whereas the SIG is focused on simple,

linear presentations. Chuang (1999) examined ways to combine text, voice, and computer animation, and found that users in the animation + text + voice condition performed significantly better on post-test questions than those in the text only, animation only or text + animation conditions. Many studies (e.g., Narayanan, 2002; Tabbers, 2004; Chuang, 1999) use interactive courseware lessons that lasted approximately 30 minutes. In contrast, SIG presentations last approximately 30-45 seconds. The hypermedia and multimedia instruction studies expose users to conditions that are similar to a classroom setting, whereas the SIG study focuses on just-in-time help.

The third area that defines the context of SIG help studies methods for teaching *procedural vs. declarative knowledge*. Previous studies focus more on procedural knowledge, or teaching people the process of how something works. Mayer and Anderson (1991, 1992) used animations that depicted the operation of a bicycle tire pump or an automobile braking system. Mayer and Anderson's research focused more on procedural knowledge, and their studies evaluated problem solving related to the process of how a bicycle tire pump works. In contrast, the SIG focuses on declarative knowledge, and describes what a statistical term means, rather than how to gather the data or calculate the results. With the declarative knowledge the SIG provides, people should be able to do tasks such as choosing which statistic to use, or identifying the units of a statistic.

Although previous research on learning topics provides some guidance as to the design of SIG explanations, we also needed to consider the needs and limitations of the federal statistical agencies that would be deploying them. One concern is the need to comply with the Section 508 Disability Act, ensuring information access for all users. Another concern is to lower the requirements for hardware, software, and bandwidth so that users with access to minimal computing power can still benefit from the presentations. Text or still graphics have advantages over animations with regard to both concerns. Sound files, such as narration tracks that accompany the presentations, were considered too much of a burden for both production and dissemination, despite evidence that suggests significant benefits (Mayer, 2001). Thus we settled on the three formats of text only, graphics + text, and animation + text.

2. Methodology

Each study used a pre-test/post-test design. For the pre-test, users were shown a screen shot from one of the various government

statistical agency websites and asked two questions related to the table or graph shown. After answering each question, they rated their confidence that were their answer was correct. Next, the users were shown a SIG presentation that explained a statistical term used in the table or graph. For the post-test, users reviewed the same two questions they answered in the pre-test condition and were given the option of changing their answers. Users were also asked to give new confidence ratings for their answers. The users were mostly students from the university community, and had minimal exposure to statistics. For Study 1, posters were placed around campus to recruit users. Study 2 used mass email to recruit users.

Study 1 Design and Instrument

The first study was intended to test the effectiveness of the presentations in assisting users to understand statistical information. The research questions were:

- does seeing an explanation help people understand statistical terms,
- does viewing an explanation increase people's confidence in their understanding of the terms, and
- does the format in which the explanation is presented affect whether the explanation helps people understand statistical terms?

Index

Question 1:
Which statement best describes what a statistical index is?

Answer:
A ○ An index is a measure of central tendency such as an average or mean.
B ○ An index combines measures of several different things into a single number.
C ○ An index compares a measure of something with the current inflation rate.
D ○ An index tells you how much allowance for error there is in the measure.

How confident are you that your answer is correct?

○ 1 Not confident
○ 2
○ 3
○ 4
○ 5 Very confident

Next Question

U.S. Department of Labor
Bureau of Labor Statistics
Bureau of Labor Statistics Data

www.bls.gov

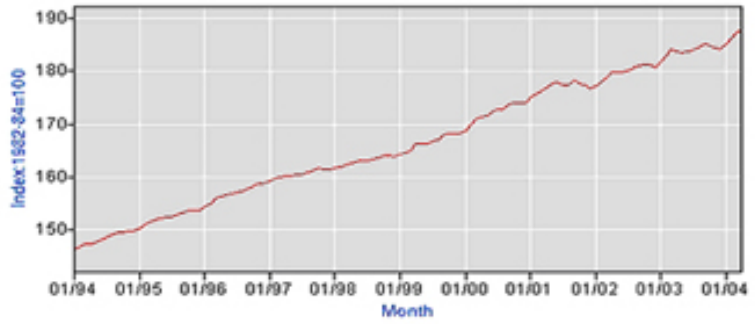
BLS Home | Programs & Surveys | Get Detailed Statistics | Glossary | What's New | Find It! In DOL

Change Output Options: From: 1994 To: 2004 GO
☑ include graphs NEW!
More Formatting Options

Data extracted on: May 19, 2004 (10:22:40 AM)

Consumer Price Index - All Urban Consumers

Series Id: CUUR0000SA0
Not Seasonally Adjusted
Area: U.S. city average
Item: All items
Base Period: 1982-84=100



Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	HALF1	HALF2
1994	146.2	146.7	147.2	147.4	147.5	148.0	148.4	149.0	149.4	149.5	149.7	149.7	148.2	147.2	149.3
1995	150.3	150.9	151.4	151.9	152.2	152.5	152.5	152.9	153.2	153.7	153.6	153.5	152.4	151.5	153.2
1996	154.4	154.9	155.7	156.3	156.6	156.7	157.0	157.3	157.8	158.3	158.6	158.6	156.9	155.8	157.9
1997	159.1	159.6	160.0	160.2	160.1	160.3	160.5	160.8	161.2	161.6	161.5	161.3	160.5	159.9	161.2
1998	161.6	161.9	162.2	162.5	162.8	163.0	163.2	163.4	163.6	164.0	164.0	163.9	163.0	162.3	163.7
1999	164.3	164.5	165.0	166.2	166.2	166.2	166.7	167.1	167.9	168.2	168.3	168.3	166.6	165.4	167.8
2000	168.8	169.8	171.2	171.3	171.5	172.4	172.8	172.8	173.7	174.0	174.1	174.0	172.2	170.8	173.6
2001	175.1	175.8	176.2	176.9	177.7	178.0	177.5	177.5	178.3	177.7	177.4	176.7	177.1	176.6	177.5
2002	177.1	177.8	178.8	179.8	179.8	179.9	180.1	180.7	181.0	181.3	181.3	180.9	179.9	178.9	180.9
2003	181.7	183.1	184.2	183.8	183.5	183.7	183.9	184.6	185.2	185.0	184.5	184.3	184.0	183.3	184.6
2004	185.2	186.2	187.4	188.0											

U.S. Bureau of Labor Statistics
Postal Square Building
2 Massachusetts Ave., NE
Washington, DC 20212-0001

Done

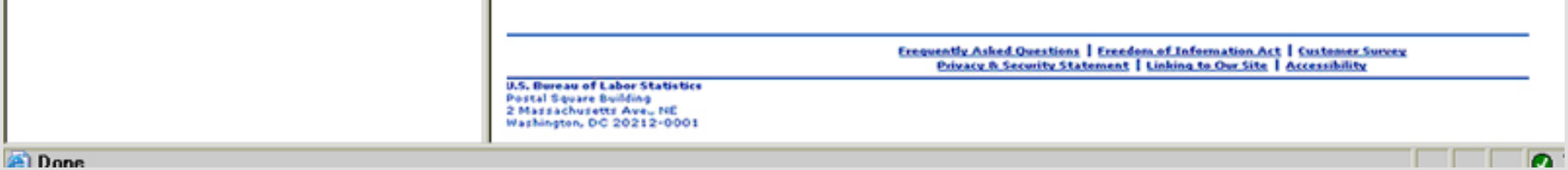


Figure 1. Screenshot of Consumer Price Index question 1

Study 1 consisted of six test items and one practice item. Each item focused on a single term: mean and median household income, mean and median age of mother at birth of first child, age adjustment, seasonal adjustment, consumer price index, and antiknock index. The practice item term was average height and weight. Each item consisted of 4 multiple-choice questions about the term, along with a 5-point scale for rating confidence for each question (1 = not confident and 5 = very confident). Figure 1 shows an example question. Presentations for each term were prepared in three formats: text only, graphics + text, animation + text.

The text presentations were typically less than 3 sentences long in explaining the statistical terms; most were derived from the materials used on the agency websites. We attempted to create each definition to an eight grade reading level, but were not able to achieve that for every definition. The graphics were static graphics with some text, presented in MS Power-Point ®. The animations were short Macromedia Flash ® presentations with moving graphics and text. To the greatest extent possible, we sought to make the content equivalent in each format.

For Study 1, each user viewed presentations for 6 items, 2 in each of the 3 formats. Three sets of item/format pairs were prepared, to minimize format/item, and order effects. Users were assigned sequentially to one of the sets in the order in which they began their session. A member of the research team administered the study sessions to users individually. All materials were presented online, and responses were collected in a database. At the beginning of the session, users provided demographic information and information about their statistical experience (e.g., number of statistics courses taken and frequency of statistical tables used). After completing the study, users were interviewed briefly and were asked for preference of format and other opinions about the presentations. We pilot tested the instrument to remove bugs. Aside from a technical incident where we had to restart the experiment for one user, the overall setup worked well.

Effectiveness was measured in two ways. First, we compared the number of correct answers on multiple choice questions before viewing the presentations (pre-test) to the number of correct answers after viewing them and having the opportunity to change

answers (post-test). Second, we compared users' pre- and post-test confidence ratings. Both correctness and confidence contribute to the effectiveness of SIG presentations. If people can choose the correct answer after viewing a presentation where they chose the wrong one before, the presentation may have helped them understand the term (although they could still just be guessing). But even if they chose the correct answer before viewing the presentation, if their confidence that they understand the term increases, then the SIG presentation has helped them.

Study 2 Design and Instrument

Study 2 examined the use of controls for the animation format of the SIG, and whether different levels of control affect the learning rate, the quality of learning, and user satisfaction. Because the design of the SIG animations was limited by agency preferences and delivery requirements (i.e., no narration), we wanted to introduce controls that would allow a user to manage the pace of a presentation and potentially reduce the cognitive load so that users could learn more effectively. By testing levels of control we hoped to find the point at which user control intersected with the highest learning score and highest user satisfaction. We provided three levels of control and included a progress indicator to let users know how far along in a presentation they were. The control levels measured were:

- Level 0, no control: only a progress indicator and the ability to replay the entire animation;
- Level 1, next: pauses the animation at the end of a segment until the user advances;
- Level 2, next & back: allows the user to review the previous segment.

This study was very similar to the first study, sharing many of the materials, including the demographic questionnaire, and a comparable, but truncated design. This study used a subset of terms and selected questions: Index, Consumer Price Index, Octane Index, Adjustment, Seasonal Adjustment, and Death Rate. The main differences were in the post-test interview, and in the user satisfaction measures that were collected for each animation. User satisfaction measures were collected quantitatively as self-reported feelings of control and perceived speed after each presentation, and qualitatively gathered in the post-test interview responses. Users rated control on a 3-point scale (1 = too little and 3 = too much). The perceived speed of the animation was rated on a 3-point scale (1 = too slow and 3 = too fast). Quality of learning was measured by the number of correct answers and the

confidence rating (or change in confidence). The learning rate was measured by the length of time a user spent on an individual animation. Timing was accomplished by automatically starting the timing clock when the user clicked the button to begin the animation. The timing clock was stopped when the user clicked on the button that advanced them to the repeat questions.

3. Results

Study 1 Results

Nineteen people completed the study; only two were identified as having high statistical knowledge. The full results of the study are presented in (Haas, *et al*. in preparation). In this paper, we present findings related to format.

Overall, viewing presentations increased users' ability to choose the correct answer, and increased their confidence that their answers were correct (Tables 1 & 2).

Table 1. Number of correct answers, Number of questions = 456

Pre-test	Post-test
333	392

Table 2. Average confidence value, Number of ratings = 456

Pre-test	Post-test
3.38	4.36

The next research question asked whether format makes a difference in effectiveness.

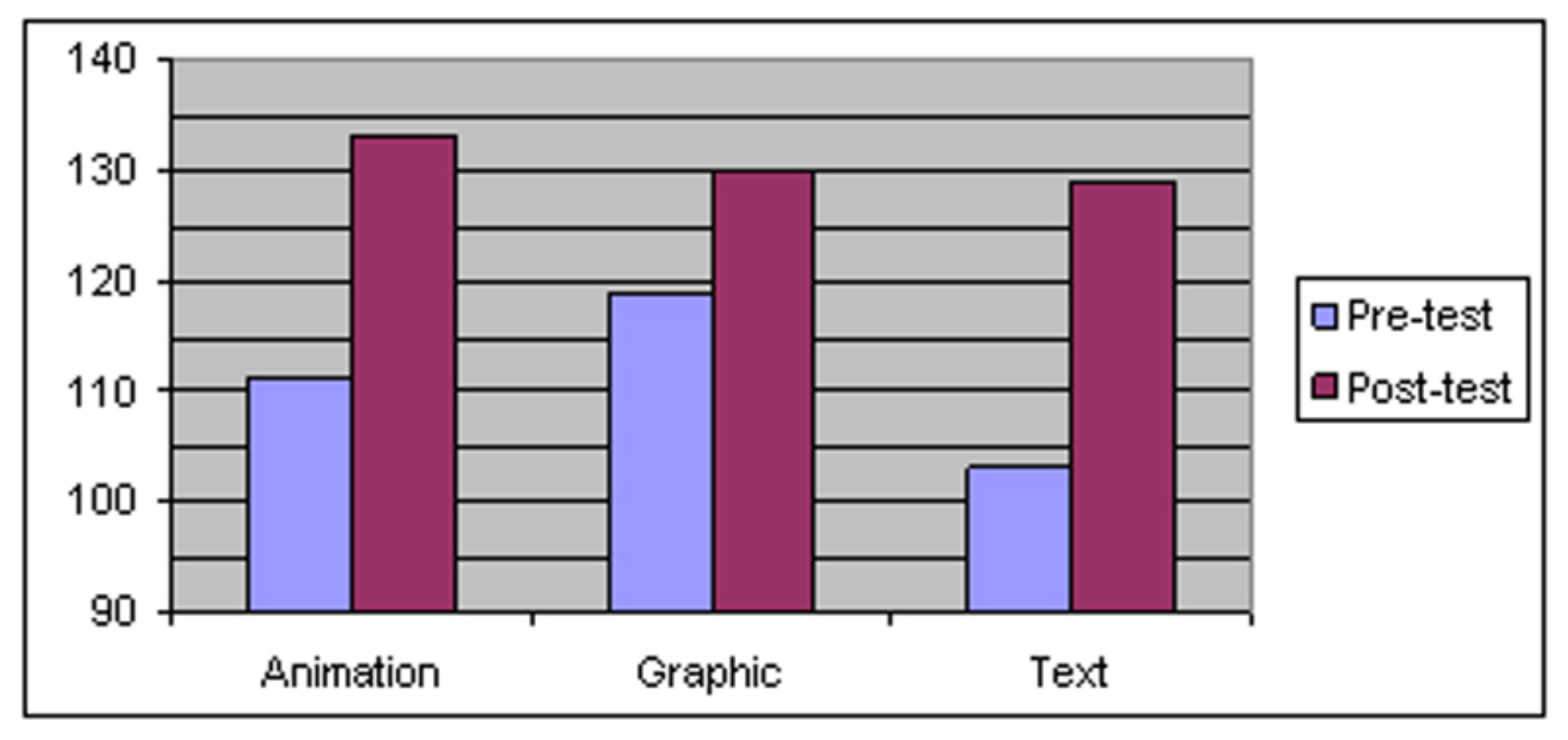


Figure 2. Number of correct answers pre- and post-test by format, N/format = 152

As Figure 2 illustrates, format made little difference in the number of correct answers chosen after viewing the presentation. In the pre-test, two users had particular difficulty with one of the terms, and both happened to be in the group that would see text presentations for those items. But even in this case, the presentations were able to help them choose correct answers. Figure 3 shows that there was also little difference in post-test confidence ratings among formats.

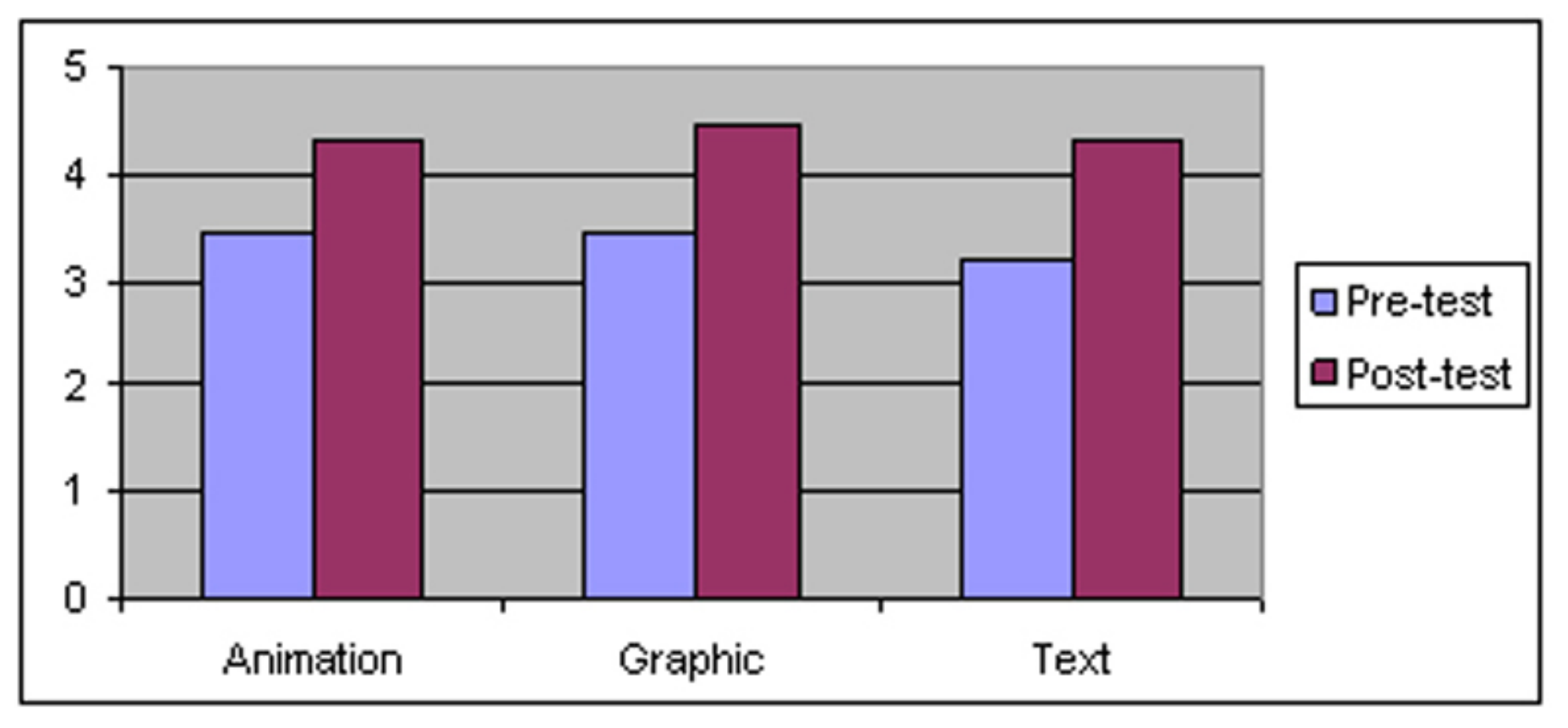


Figure 3. Average confidence rating pre- and post-test by format, N/format = 152

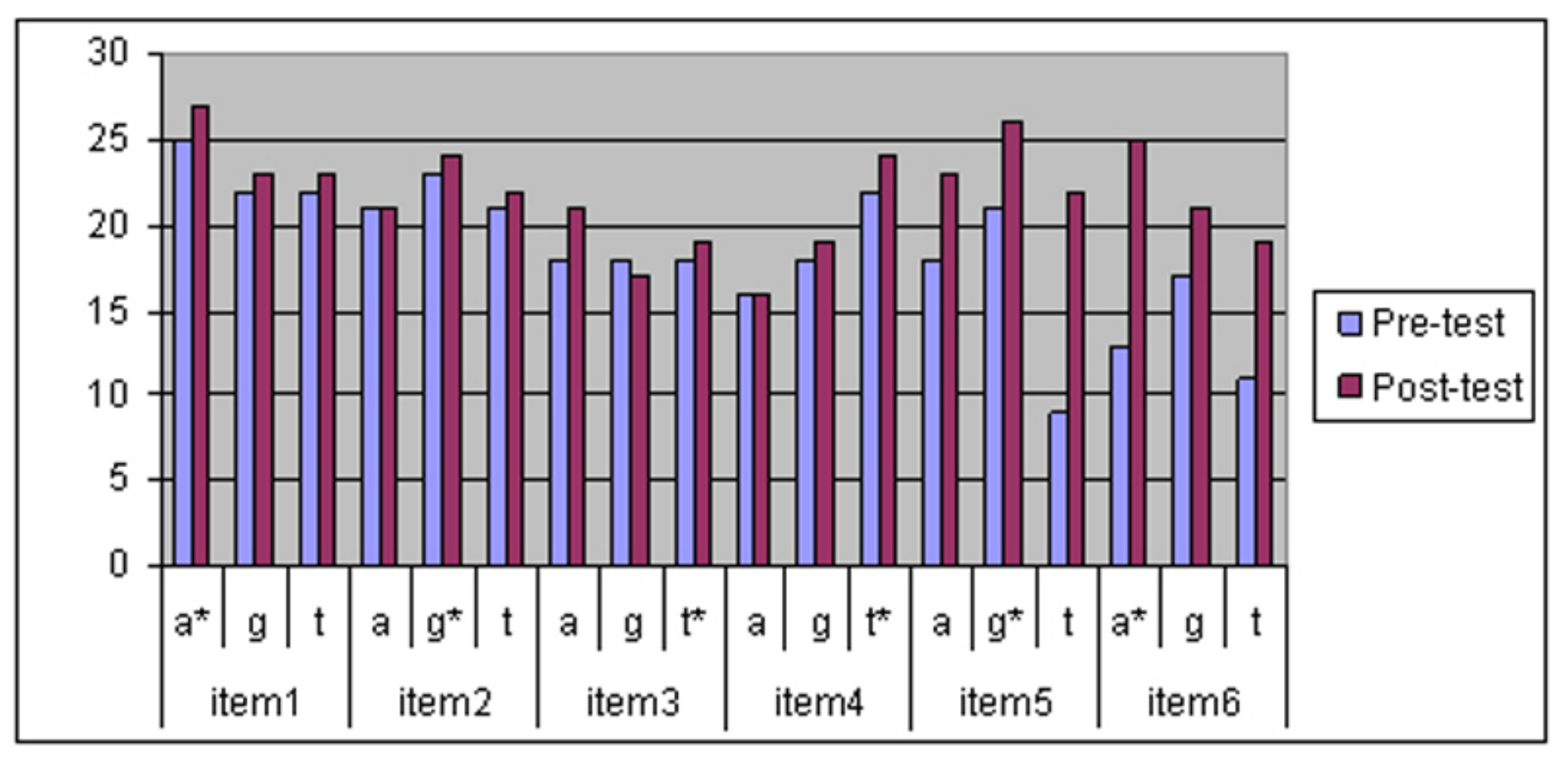


Figure 4. Number of correct answers pre- and post-test N/format/item = 24 or 28* a = animation, g = graphic, t = text

Figures 4 show the number of correct answers by format and item. (Note that because there were an odd number of subjects, some item/format combinations were used 24 times, and some 28 times: combinations marked with * were used 28 times). Users apparently had more trouble with items 3 and 4 than with other items. Possible reasons include that the terms or questions about the terms were harder, or they did not find the explanation as helpful; further investigation is needed. Confidence increased for all item/format combinations.

There was also little difference in the number of correct answers users chose after viewing presentations in the 3 formats. Table 3 shows the average number of post-test correct answers per user by format. Note that each user viewed 2 items in each format, thus answering 8 post-test questions for each. The 2 participants judged as having high statistical knowledge were assigned to different item/format groups and their results did not differ from those of other participants.

Table 3. Average number of post-test correct answers per user by format, N/user = 8

	Animation + text	Graphic + text	Text only
Number correct	7	6.84	6.78

Study 2 Results

The second study had a total of 24 users. The analysis found no significant relationships between the control level and the tendency for users to choose the correct answer after viewing the animation, nor did it find a significant relationship between confidence ratings, time values, or prior knowledge (high or low statistical experience). However, the relationship between the control level and the level of perceived control was significant, X^2 (2, N = 144) = 19.38, p < .0001), as was the relationship between the control level and perceived speed of the presentation, X^2 (2, N = 144) = 19.52, p < .0001).

4. Discussion

Overall, users liked the presentations and found them helpful. One user thought that the mean and median presentations would help in their statistics class. Users remarked that they liked explanations that used things in the table or graph best. Users often remarked how helpful presentations were for concepts they had not previously encountered and said they would use such help if it were readily available in the table or graph. Users' confidence often increased, even in cases when users chose the correct answer before viewing the presentation. One user commented that she thought she had the right answer, but after the presentation, she was sure.

Increasing users' confidence is an important aspect of the effectiveness of this type of help.

Study 1

No format stood out as being more effective than the others in terms of helping users choose correct answers or their confidence in doing so. Similarly, users did not express clear cut preferences for any of the formats; each had their advantages. Text was cited mainly for its efficiency while animations and graphics were cited for their pictures, and visual stimulation. The users often discussed animations and graphics collectively.

Based on evidence from the learning styles literature, one might expect users to have performed better and/or with more confidence with one format depending on their specific learning style or expressed preference. Our results did not show any difference based on format. One possible explanation for not seeing a clear distinction between the numbers of correct items after presentation is due to the short exposure users had to the definitions. The duration of animations were 30 to 45 seconds, and the time to read through text or view graphics in general took the same amount or less time. Short exposures to information may reduce and remove the effect of learning styles or preferences because other factors may take precedence.

Another reason why we may not have seen this effect involves the possibility of an interaction between item and format. That is, characteristics of the term itself may outweigh individuals' learning styles or preferences in this situation. Some users remarked the animation did not "add" to the explanation of some terms, while others said that the animations were especially helpful in "showing how something worked". This suggests that some definitions make good animations and other do not. There is some evidence from literature that animations are most effective with concepts that involve action. However, SIG definitions focus on declarative, not procedural, knowledge. Action is implied in some terms, such as the idea that a statistical index is a combination of different measures; the animated explanation emphasized this component of the meaning. For other terms, perhaps the animation did not illustrate such a key component.

Study 2

The data analysis for Study 2 did not reveal significant differences between the control levels and quality of learning or time spent viewing an animation. However, the control levels were significant when measuring the user satisfaction measures (Level 0 = no control, Levels 1 = next, Level 2 = next & back). This conclusion is supported by the post-test interview data: over 95% of the users favored some form of control (that is, preferring Levels 1 or 2 over Level 0). This is not a surprising result; previous research has indicated that user control increases motivation and satisfaction (Mayer 2001; Narayanan 2002; Tabbers 2004).

Users overwhelmingly preferred to have the option of controlling the pace of the animated presentations. We did not anticipate the way the users split on the choice of Level 1 or Level 2. Our assumption was that users would prefer the most control (Level 2). Instead, the post-test comments suggest that the test conditions supported the use of the Level 1 equally. Informal observation during the test reveal that most users did not use the Back button when given the opportunity, but stated in the post test-interview that they would like to have it there "just in case."

Users noted that the duration of the SIG Animations was short enough that the ability to immediately review a segment did not hold a competitive advantage compared to restarting the animation. One user said:

I don't think I ever used the back button because I knew I could always just use the replay animation button and keep going through [with the next button], and do it all again if I needed to.

The longest animation lasted 45 seconds; the average length of an animation is only 22.5 seconds. The average length of time spent watching a presentation was 28.875 seconds. We conclude that a few seconds difference was not a large enough burden to make an instant review option more attractive.

Limitations

Both studies share a sampling limitation: the samples we used were drawn from the university community, and do not reflect the

demographics of the entire population of potential users. There would likely be greater variation in the results if the sample pool included users from the general public, especially considering differences in reading ability and comfort with learning new ideas from text and other formats.

Another concern is the quality and appeal of the design and implementation of the presentations, especially the animations. We did not specifically ask users about this, but it is possible that they perceived some as being of higher quality, and therefore as more authoritative.

Conclusions

The SIG presentations, especially the animations, represent a compromise between recommendations from graphic and instructional design and learning theory, the need to deliver quick, just-in-time explanations of statistical terms, and practical considerations in delivering online help. Two studies were conducted to investigate effectiveness of the presentations. One study investigated the differences between formats and user preference for format, while the other investigated if differing levels of control in the animations would affect quality of learning, viewing time, or user satisfaction. Study one found that overall, the presentations were effective, users were more confident and users provided more correct answers after viewing presentations. While results from the second study show that there are no statistically significant relationships between the level of control and the quality of learning, or the viewing time, we found that the control levels did relate significantly to user satisfaction measures.

The SIG presentations operate in a complex dynamic between learning style, semantic components of the term, and presentation format. Given the necessary brevity of the presentations, expected influences from learning styles or formats may not be as crucial as they would be in longer, tutorial-style materials. For example, learning style preference may have less influence on format due to the very brief exposure users had to each presentation. Similarly, term characteristics such as presence or absence of an action component may have more impact on the perceived necessity of animation when the influence of learning style decreases. These are all topics for further research. If future research determines that very short animated or graphical presentations are not affected by learning styles, then development work can be focused on creating cost-effective presentations designed according to user preference, rather than presentation tailored to learning styles. Future research must also investigate the dynamic between duration

and learning styles, term, and format. At this point, however, we suggest that agencies and others concentrate their efforts on the text and graphic + text formats. The cost and effort of creating animated explanations should be reserved for terms that have a strong action component, and if developed, should include the ability to control progress through the animation. Overall, more research is needed so that developers of SIG-style just-in-time help will have more information on which to base their design decisions.

Acknowledgements

This research was supported by NSF Grant EIA 0131824. We would also like to thank the GovStat team for helpful comments and discussions.

References

Blank, G. D., Roy, S., Sahasrabudhe, S., Pottenger, W. M., Kessler, G. D. (2003). Adapting Multimedia for diverse student learning styles. *Journal of computing sciences in colleges, 18*(3), 45-58.

Brown, R.T., Wilbur, J., Haas, S.W., & Pattuelli, M.C. (2003). The GovStat Statistical Interactive Glossary (SIG). In *Proceedings of the dg.o2003, The National Conference on Digital Government Research*, Boston. Retrieved November 15, 2004, from http://www.diggov.org/dgrc/dgo2003/cdrom/DEMOS/demos2/brown.pdf

Boulter, D. R. (1994). Identification of strategies used in solving transformational geometry problems. *Journal of Educational Research, 87*(5), p. 298.

Chuang, Yea-Ru (1999) Teaching in a multimedia computer environment: A study of the effects of learning style, gender and math achievement. *Interactive Multimedia Electronic Journal of Computer Enhanced Learning 1*(1). Available at http://imej.wfu.edu/articles/1999/1/10/index.asp

Felder, R. M. (2002). Learning and Teaching Styles in Engineering Education. *Engineering Education, 78*(7), 674–681. Originally

published in 1988. Revised in 2002. Retrieved November 7, 2004, from http://www.ncsu.edu/felder-public/Papers/LS-1988.pdf

Haas, S. W., Brown, R. T., Cao, L. & Wilbur, J. *Evaluation of the effectiveness of the Statistical Interactive Glossary*. Unpublished manuscript.

Haas, S. W., Pattuelli, M. C. & Brown, R. T. (2003). Understanding statistical concepts and terms in context: The GovStat Ontology ad the Statistical Interactive Glossary. *Proceedings of the Annual Meeting of the American Society for Information Science and Technology, 40*, 193-199.

Hert, C.A. and Haas, S.W. (2003). Supporting End-users of Statistical Information: The Role of Statistical Metadata in the Statistical Knowledge Network. In *Proceedings of the dg.o2003, The National Conference on Digital Government Research*, Boston. Retreived January, 10, 2005, from http://www.dgrc.org/dgo2003/

Marchionini, G., Haas, S.W., Plaisant, C., Shneiderman, B., and Hert, C. (2003). Toward a Statistical Knowledge Network. In *Proceedings of the dg.o2003, The National Conference on Digital Government Research*, Boston. Retrieved November 6, 2004, from http://www.digitalgovernment.org/dgrc/dgo2003/cdrom/PAPERS/datastats/marchionini.pdf

Mayer, R.E. (2001). *Multimedia Learning*. New York: Cambridge University Press.

Mayer, R. E. and Anderson, R. B. (1991). Animations need narrations: An experimental test of a dual-coding hypothesis. *Journal of Educational Psychology, 83*(4), 484-490.

Mayer, R. E. and Anderson, R. B. (1992). The instructive animation: Helping students build connections between words and pictures in multimedia learning. *Journal of Educational Psychology, 84*(4), 444-452.

Narayanan, N. H. & Hegarty, M. (2002). Multimedia design for communication of dynamic information. *International Journal of Human-Computer Studies, 57*, 279-315.

Pattuelli, M.C., Haas, S.W., Brown, R.T., and Wilbur, J. (2003). The GovStat Ontology. In *Proceedings of the dg.o2003, The National Conference on Digital Government Research*, Boston. Retrieved November 15, 2004, from http://www.diggov.org/dgrc/dgo2003/cdrom/POSTERS/pattuelli.pdf

Tabbers, H.K., Martens, R.L. & van Merriënboer, J.J.G. (2004) Multimedia instructions and cognitive load theory: Effects of modality and cueing. *British Journal of Educational Psychology, 74*, 71–81.

Wilbur, J. D. (2004). *The GovStat Glossary Animations: An Evaluation of Control, Learning, Time, and Satisfaction*. Unpublished manuscript, School of Information and Library Science, University of North Carolina at Chapel Hill. Available at http://jdwilbur.org/sils/govstatglossaryanimations.pdf