Assessing the Utility of Computer-Generated Graphics in Problem Solving

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ABSTRACT

From a technological standpoint, we are on the brink of a revolution in the potential capabilities of computer graphics. Software packages of unknown graphic possibilities are likely to continue at an accelerated rate of development. Because of this increasing capability, now is the time to refocus on the human link. What graphics capabilities are most likely to be useful to end users?

The purpose of this study was to test whether dynamic (moving) computer-generated graphics are more useful than static (still) graphics in problem-solving situations. Results show that individuals using dynamic graphics have higher problem-solving accuracy than individuals using static graphics.

Additionally, the concept of "computerthink" is introduced and discussed.

INTRODUCTION

Until the beginning of the 20th century, the use of graphics in business settings was limited to presentations of aggregate statistical data [22]. However, as American managers began to realize that graphs could present information "quickly, effectively and persuasively," in addition to helping them analyze large amounts of data, the use of graphics rapidly became widespread [22, p. 7].

Graphics, a somewhat generic term includes a number of applications. The major distinction is between graphs that represent symbolic relations (diagrams and flow charts) and graphs that represent numerical data [6].

With the advent of the technological revolution, interest in graphics resurfaced. Promises offered by computer-generated graphics are debatable however, because accessibility of powerful graphics packages to end users untrained in graphic design may result in the declining quality of information presentations [11].

Research on the usefulness of computer graphics in presenting information, and particularly the facilitative effects of graphics on decision making, has been mixed [5, 8, 18, 20]. DeSanctis [7] maintained that a major problem in graphics research has been inadequate attention given to the dependent variables and an absence of common agreement concerning reasons for studying particular outcomes. She suggested eight major dependent variables for graphic research and provided a rationale for each. The variables included interpretation accuracy, problem comprehension, task performance, decision quality, speed of comprehension, decision speed, memory for information (recognition and recall), and viewer preference [7, p. 468].

Other problems that have hindered graphics research include the variation of tasks from one study to another and the quality of the information presentation. Some graphics may be of high quality whereas others may actually interfere with information to be presented.

Some research has indicated that the use of graphics reduces the time variable in decision making [3, 20], and certainly managers seem to agree that a graph is preferable to several pages of text [9, 19]. Research on the influence of graphics on learning and recall has been inconclusive. Watson and Driver [21] found that three-dimensional graphics did not result in greater recall of information than did a tabular presentation. Lucas and Nielson [15] found little support for their hypothesis that graphics would result in greater learning. They suggested that the situation, the type of graphics display, the task, and the personal background of the user were important considerations for learning.

Cognitive or decision style and its relation to graphics has been considered. Chervaney and Dickson [5] compared the performance of quantitatively oriented subjects with verbally oriented subjects and found that the quantitative aptitude of the subject was associated with better performance.

Lucas [14] found limited support for the use of graphics in decision making. He maintained that cognitive or decision style was an important consideration. Lucas hypothesized that heuristic decision makers (those who look at the entire problem) would have higher scores for graphic presentations than would analytical decision makers (those who focused on details). The latter would be expected to react more positively to tabular presentations. His results showed that heuristic decision makers in the graphic training group had the better results. Lucas suggested that decision style should be considered when planning the presentation mode.

The effect of color versus black-and-white graphics has been the topic for several research studies. Tullis [20] found little difference between color and black-and-white graphics in speed and accuracy of interpretation. However, subjects overwhelmingly preferred color graphics to those that were black-and-white. Subjects appeared to find color pleasing and stimulating, perhaps indicating that the use of color could have an effect on user acceptance of a system.

Benbasat and Dexter [3] suggested that claims made about color-enhanced graphics should be subjected to some qualification. Results from their experiment showed that color influenced decision quality and time performance and that color seemed more beneficial for graphical reports. The greatest impact however, was on field-dependent subjects as identified by the Group Embedded Figures Test. Benbasat and Dexter suggested that the personality type of the decision maker should be considered when deciding color presentations.

Similar results regarding personality and the effects of color were found in earlier studies [1,2]. A series of laboratory experiments was conducted to determine the effects of graphical and color-enhanced information presentation on decision quality, decision making time, use of information, and perception [4]. Results indicated that color had a positive effect on decision making effectiveness. The benefits of color were more strongly associated with graphical than with tabular presentations and appeared to influence performance during the learning process. The greatest effects of color were related to the cognitive style of the decision maker. Color seemed to help field-dependent individuals — those who had difficulty in differentiating parts from the whole — to identify relationships more easily and to discriminate among the items.

A role that has been largely ignored in graphics research and that may explain the equivocal results of various studies is that of task [4]. Both the differing nature of the tasks and a match between task and presentation method could be at fault.

In a series of studies exploring roles of task environment in decision making, effectiveness of traditional tabular reports was compared with computer-generated graphics [8]. Claims for superiority of graphic presentations were not supported. The authors suggested that the effectiveness of graphs was dependent on the task and could not be generalized to all situations.

In another series of experiments in which task was held constant, results indicated that graphics enhanced decision-making speed when the report was designed directly to assist problem-solving situations [4]. When graphs did not provide additional perspective to the problem, no advantages were found for graphs over tabular reports. Because of the precise nature of experimental tasks, subjects experienced difficulty in obtaining accurate values from the graphical reports. When given the option of requesting a report, the number of reports requested and the time spent in analyzing them dropped for the graphical group. The authors suggested that the subjects recognized limitations of the graphs in presenting the precise data needed for the problem.

Research Questions

Despite conflicting research on the effectiveness of graphics in decision making, it seems reasonable to assume that with widespread availability of computer graphic packages, graphic use will continue to flourish. From a technological standpoint, we are on the brink of a revolution in the potential of computer graphics. For example, one state-of-the-art graphics software package currently in popular use has a 16-color selection. A recently introduced package boasts 1,000 colors. The resolution possible in computer graphics is increasing to a point of detail that competes with color photographs. Graphics software packages of unknown capabilities are likely to continue to be developed at an accelerated rate.

The powerful features of some computer-generated graphics will give rise to new forms of graphics. In time, computer graphics may become more like short, animated video presentations. Still, the abilities of humans who interact with computers remains relatively constant. There seems to be no underlying rationale into which software is developed nor how it will be used, and because we are entering a new computer-generated graphics revolution, now is the time to refocus on the human element.

What software advances would be most useful to people? What guidelines should users develop so that these graphic capabilities are put to their best use? Are there pitfalls to avoid in the use of computer graphics that do not exist with other types of graphics?

The capabilities for moving (dynamic) graphics are currently available to many users. Dynamic graphics have the ability to draw the viewer's attention to specific parts of a graph through the use of motion and cumulative graphics. Dynamic graphics introduce a new dimension to the already complex issue of graphics and decision making. Dynamic graphics, as opposed to static (still) graphics, offer further avenues of research.

Although comparisons of dynamic and static graphics do not appear in decision-making literature, such comparisons do appear in educational psychology literature. Reynolds and Baker [17] propose that selective perception influences learning in the following manner:

Importance———> Attention ———> Learning

Therefore, if dynamic graphics can increase perceived importance of certain portions of information by use of motion, Reynolds and Baker would suggest that learning will be increased. Reynolds and Baker [17] found that interactive graphics increased attention, but not learning.

In a second study from the educational psychology literature, McGurk and Saqi [16] found that both deaf and hearing students had greater recall of information presented in dynamic graphics than information presented in static graphics. McGurk and Saqi suggest that, in part, this superiority of dynamic graphics may come from the change of dynamic graphics across time. With a graph which is changing, the subject must "integrate visual information over time in order to achieve identification of the stimulus [16, p. 308]." This integration over time may increase retention.

Because issues of importance, attention, and retention are relevant to decision-making, the proposition that using dynamic graphics could help in problem-solving situations does seem logical to test. The primary purpose of this study is to compare static and dynamic graphics in a problem-solving situation.

Research Question 1: Do individuals who use dynamic computer-generated graphics to assist in problem-solving have greater accuracy than do individuals who use static graphics?

If use of dynamic graphics does increase problem-solving accuracy, then a logical extension of dynamic graphics benefits would be that problem-solvers using dynamic graphics would be more confident from choosing the best problem solution.

Research Question 2: Does the use of dynamic computer-generated graphics affect the confidence that individuals have in their decisions?

THE METHOD:

Subjects

The sample consisted of 179 students enrolled in six sections of two upper division management courses at a major state university in the Southeast. The sample was 48 percent female and 52 percent male. The average age was 22.05 with an age range of 19 to 37.

Stimulus Materials

Subjects were given a problem with eight potential solutions. This problem was one with which students are familiar scheduling classes for an academic term. The task was to choose the class schedule that would allow the most hours of work at a part-time job. In the problem, the student had to register for three classes; two being offered at one time each. The student was to decide which of eight possible times to take the third class. The problem was constructed so that there was one best solution. (See Appendix for problem's text and its correct answer.)

The independent variable in this study was the mode of presentation in which the information was presented. As a control, subjects in one group received information in text only — offset copied on white paper.

Individuals in a second treatment level received identical text with static (still) graphics. The graphics, weekly color-coded schedule charts, identified class and work times available for each of the eight choices. This presentation was done on a personal computer using *Storyboard*, a color graphics software package.

Subjects in the third treatment level received a presentation which included the same text administered to the other treatment levels. This text was accompanied by dynamic graphics. These graphics were the same as viewed by the second group, but they were presented in a cumulative (additive), dynamic fashion.

The presentations in the second and third treatment levels were projected onto a 60-inch by 60-inch screen using rear-screen projection. Because the scheduling problem was quite complex, subjects in the second and third groups were also given a brief, written problem summary.

Measurement Instrument

Subjects in all treatment conditions received the same instrument to measure the two dependent variables. Accuracy, the first dependent variable, was assessed by two questions. First, the subjects were asked which was best of the eight possible solutions. The second question was, "I will be able to work _____ hours at my part-time job by choosing the section above." Subjects selecting the correct solution and determining a correct number of work hours permitted by the solution were classified as accurately solving the problem; all other responses were classified as inaccurate.

The second dependent variable was the degree of confidence that the selected solution was correct. This was measured using one seven-point Likert-type scale with responses ranging from "very sure" to "very unsure."

Procedure

Although subjects solved the problem independently, they received the stimulus materials in groups ranging from 18 to 48. The text-only treatment was administered to 37 subjects; 73 subjects received the static graphic presentation, and 69 subjects received the dynamic graphic presentation.

Subjects in the text-only treatment were told that they were about to receive a handout that required solving a problem. They were allowed to use scratch paper to analyze the problem. After these verbal instructions, subjects received a handout that included the problem, the eight possible solutions, and a questionnaire with the measures of the dependent variables.

Subjects in the two graphics treatments were told that they were about to view a presentation that would describe a problem for them to solve. They were allowed to use scratch paper in analyzing the problem. Subjects then received a handout that included a brief problem summary and the questionnaire. When all participants had received the handout, the presentation began.

The registration problem was wholly explained in either the text or the presentation. No further instructions were given verbally.

Results

The statistical test used to answer Research Question 1 was logit analysis using the minimum logit chi-square method developed by Grizzle, Starmer, and Koch [10] (also see [13]). Logit analysis is a logical extension of the chi-square test. It tests a linear model based on the categorical variables. Because the model is linear, results are similar to ANOVA results. If an independent variable has three or more levels, contrasts can be performed to identify the source of significant independence of categories.

Table 1 shows the frequencies of responses by treatment group.

Table 1
FREQUENCIES OF RESPONSES TO REGISTRATION PROBLEM

Response	Text	Dynamic	Static	Total
Incorrect	25	54	69	148
Correct	12	15	4	31
TOTAL	37	69	73	179

As shown in Table 2, the logit analysis was highly significant. Because the study included three treatment levels, contrasts were performed to determine the source of the significant independence.

Results of the first contrast indicate that there is no significant difference in the distribution of the frequencies of responses in the Text and Dynamic treatments. The second and third contrasts show that the distribution for the Static treatment is significantly different from the distributions of the Text treatment and the Dynamic treatment. In summary, the highly significant logit analysis is primarlily caused by Static response frequencies being different from the other two sets of response frequencies.

A second logit analysis was also performed to address Research Question 1. This analysis included only those subjects who chose the correct solution (questionnaire item 1). The purpose of the second test was to examine the frequencies of correct and incorrect responses to questionnaire item 2 the number of hours the correct solution would permit the respondent to work at the part-time job — among those subjects. These frequencies are shown in Table 3.

Table 2
LOGIT ANALYSIS AND CONTRASTS FOR REGISTRATION PROBLEM

Test	df	Chi-Square	p
Main effect for treatment	2	11.61	.003
Contrasts:			
Text & Dynamic	1	1.43	n.s.
Text & Static	1	11.52	.0007
Dynamic & Static	1	7.02	.008

Table 3
FREQUENCIES OF RIGHT SOLUTION RESPONSES

Response	Text	Dynamic	Static	Total
Hours Incorrect	1	11	11	23
Hours Correct	12	15	4	31
TOTAL	13	26	15	54

Table 4 shows the results of the logit analysis and contrasts for these data. The overall logit analysis was significant. The contrast for theDynamic and the Static treatment responses was not significant. The contrasts for Text with Dynamic and for Text with Static were significant. These results suggest that subjects in the Text group who chose the correct solution were more likely also to determine the correct number of hours than were subjects who received either graphic presentation.

To address Research Question 2 — the issue of confidence — a t-test was performed for each treatment level. Results of these tests are shown in Table 5. Because three t-tests were performed, Bonferroni adjustments were made to the p-values of all three tests. The p-values in Table 5 reflect this adjustment. In the group receiving the dynamic graphics,

Table 4
LOGIT ANALYSIS AND CONTRASTS FOR RIGHT SOLUTION RESPONSES

Test	df	Chi-Square	p
Main effect for treatment	2	9.15	.01
Contrasts:			
Text & Dynamic	1	3.81	.05
Text & Static	1	8.58	.003
Dynamic & Static	1	3.50	n.s.

subjects who solved the problem had a higher mean confidence of correctness than subjects who did not correctly solve the problem.

Table 5
t-TESTS FOR TREATMENT LEVELS

Treatment	Response	Mean Confidence	t	df	p
Text	Incorrect	5.92	.72	35	n.s.
	Correct	6.17			
Static	Incorrect	5.87	.78	70	n.s.
	Correct	6.25			
Dynamic	Incorrect	5.81	3.34	46.3	.003
	Correct	6.60			

No significant differences were found for the other two groups. These results show that, for the Text and Static groups, the mean confidence for subjects who correctly solved the problem was not significantly higher than for those subjects who did not solve the problem correctly.

Discussion

This experiment was designed to provide some preliminary findings on the usefulness of computer-generated graphics in problem-solving situations. The results of this study should be tempered by Lucas' [14] proposition that decision-making style is a mitigating factor in graphics research; however, the results support several conclusions.

First, in response to Research Question 1, the problem-solving accuracy of individuals who used dynamic computer-generated graphics to solve the registration problem had a greater accuracy than individuals who used static computer-generated graphics. Twenty-two percent of individuals who received the dynamic presentation answered both items correctly. Only five percent of those who received the static presentation answered correctly.

The second conclusion is more perplexing. Accuracy of individuals in the control group who received text only was not significantly different from accuracy of the group that received the dynamic graphics. Additionally, accuracy of the group who received static graphics was less than the accuracy of the group that received text only.

One possible explanation for these findings is the degree to which interaction with information is either passive or active. The Text treatment is clearly the most active involvement: without reading, organizing, and choosing a strategy for problem solving, the individual would have no clue of the correct solution.

However, the computer-generated graphics offer the potential to be more passively involved with the information. An individual could have a general understanding of the prob-lem by viewing graphics without reading accompanying text in detail. The graphics imply a structure to problem analyzing while individuals who receive only text must interact more actively with information to derive their own structure to analyzing the problem.

Results tend to suggest that subjects who received the dynamic graphics treatment were more interactive with information than those subjects who received static graphics treatment. However, they were less interactive with information than those subjects who received text treatment.

Although perhaps unanticipated by the end-user, this characteristic may be one of the major advantages of software that offers dynamic graphic capabilities.

In summary, it may be that individuals who receive no graphics must work harder to understand the problem, i.e., they must become more involved in the process rather than simply relying upon the graphics to show themwhat seems important. The result of becoming more actively involved is a superior understanding of the problem and its possible solutions.

Computerthink

An extension of this line of reasoning leads to a third conclusion: Individuals who receive text accompanied by graphics may be prone to "computerthink." Janis [12] proposed the idea of "groupthink" — a term used to describe the result of some group interactions where individual group members cease critically analyzing decision alternatives and comply with group majority views. Under conditions of groupthink, groups make decisions that group members, acting alone, would generally not make. Computerthink is a parallel situation in which individuals stop critically analyzing a problem and rely upon the supposed expertise and infallibility of the computer to provide them with a solution that is both obvious and correct.

The second logit analysis done in this study is evidence of this difference in critical analysis of the registration problem. Of the individuals who received the text only treatment and chose the correct answer in item 1 (those who scheduled the course at the optimum time), 92 percent knew the number of hours that the solution permitted them to work in the part-time job. Only 58 percent of the dynamic group and 27 percent of the static group knew how many hours the correct solution would permit.

These results suggest a contrast in critical problem analysis. Ninety-two percent knew the correct number of hours because they had critically analyzed the problem: there was no other way to answer item 2 correctly. The choices of the remaining 42 percent of the dynamic group and 73 percent of the static group in the second logit analysis indicate that it clearly was possible to choose the correct solution without critically analyzing the problem. Only those individuals who had answered items 1 and 2 correctly, effectively analyzed the problem.

There is good reason to believe that computerthink will increase in the future. For example, receipt of one's first computerized bank statement twenty years ago was sufficient reason to double-check all calculations because of a general refusal to believe that computers performed without miscalculation. Today, an ingrained belief that computers never make mistakes has nurtured a generation to the point where individuals are willing to "trust" computers.

For simple and routine computations like those on bank statements, this blind trust may be reasonable. However, in problem-solving applications, the trust is not always justified, not because the computer is or may be wrong but rather because the computer generated presentation may imply that there is only one approach to solving the problem. In the registration problem, graphic presentations supplied a structured format for solving the problem; with computerthink, individuals may rely upon the structure of the computer-generated graphics as a critical analysis substitute.

A fourth conclusion is that individuals who had the assistance of dynamic graphics were most likely to know whether their solution was correct or incorrect. In response to Research Question 2, the use of dynamic graphics as opposed to static graphics or text did seem to help clarify the degree of confidence individuals had in their decisions.

Summary

This experiment found that individuals who use dynamic computer-generated graphics had greater problem-solving accuracy than did individuals who used static computer-generated graphics. The study also found that individuals who used dynamic graphics were most likely to know whether or not their decision was sound.

Results of this study also raise the potential of computerthink a lack of critical analysis in decision-making caused by the assumption of the computer's superior ability. Although such a dependence may be valid for mundane, repetitive mathematical calculations, it may be unwarranted in situations of creative problem-solving.

REFERENCES

[1] Benbasat, I. and Dexter, A.S. "Value and events approaches to accounting: An experimental evaluation," *Accounting Review*, Volume 54, 1979, pp. 735-749.

[2] Benbasat, I. and Dexter, A.S. "Individual differences in the use of decision support aids," *Journal of Accounting Research*, Volume 20, Number 1, 1982, pp. 1-11.

[3] Benbasat, I. and Dexter, A.S. "An experimental evaluation of graphical and color-enhanced information presentation," *Management Science*, Volume 31, 1985, pp. 1348-1364.

[4] Benbasat, I., Dexter, A.S., and Todd, P. "An experimental program investigating color-enhanced and graphical information presentation: An integration of the findings," *Communications of the ACM*, Volume 29, 1986, pp. 1094-1105.

[5] Chervaney, N. and Dickson, G. "An experimental evaluation of information overload in a production environment," *Management Science*, Volume 20, 1974, pp. 1335-1344.

[6] Christie, B. (Ed)*Human Factors of the User-System Interface*, North-Holland, Amsterdam, 1985.

[7] DeSanctis, G. "Computer graphics as decision aids: Directions for research," *Decision Science*, Volume 15, 1984, pp. 463-487.

[8] Dickson, G.W., DeSanctis, G., and McBride, D.J. "Understanding the effectiveness of computer graphics for decision support: A cumulative experimental approach," *Communications of the ACM*, Volume 29, Number 1, 1986, pp. 40-47.

[9] Gerrity, T.P. "Design of man-made machine systems: An application to portfolio management," *Sloan Management Review*, Volume 12, Number 2, 1971, pp. 59-75.

[10] Grizzle, J.E., Starmer, C.F., and Koch, G.G. "Analysis of categorical data by linear models," *Biometrics*, Volume 25, 1969, pp. 489-504.

[11] Ives, B. "Graphical user interfaces for business information systems," *Management Information Systems Quarterly*, Special Issue, 1982, pp. 15-47.

[12] Janis, I.*Victims of Groupthink*, Houghton Mifflin, Boston, 1972.

[13] Kritzer, H.M. "An introduction to multivariate contingency table analysis," *American Journal of Political Science*, Volume 22, 1978, pp. 187-226.

[14] Lucas, H.C. "An experimental investigation of the use of computer-based graphics in decision making," Management Science, Volume 27, 1981, pp.757-768.

[15] Lucas, H. and Nielson, N.R. "The impact of mode of presentation on learning performance," Management Science, Volume 26, 1980, pp. 982-993.

[16] McGurk, H. and Saqi, S. "Serial recall of static and dynamic stimuli by deaf and hearing children," *British Journal of Developmental Psychology*, Volume 4, 1986, pp. 305-

310.
[17] Reynolds, R.E. and Baker, D.R. "The utility of graphical representations in text: Some theoretical and empirical issues," *Journal of Research in Science Teaching*, Volume 24, 1987, pp. 161-173.
[18] Senn, J.A. and Dickson, G.W. "Information system structure and purchasing decision effectiveness," *Journal of Purchasing and Materials Management*, Volume 10, 1985.
[19] Takeuchi, H. and Schmidt, A.H. "New promise of computer graphics," *Harvard Business Review*, Volume 58, Number 1, 1980, pp. 122-131.
[20] Tullis, T.S. "An evaluation of alphanumeric, graphic and color information displays,"Human Factors, Volume 23, 1981, pp. 541-550.
[21] Watson, C.J. and Driver, R.W. "The influence of computer graphics on the recall of information," *MIS Quarterly*, Volume 7, 1983, pp.45-53.
[22] Yates, J. "Graphs as a managerial tool: A case study of Du Pont's use of graphs in the early twentieth century,"*Journal of Business Communication*, Volume 22, Number 1, 1985, pp. 5-33.

APPENDIX

Assume that you are a senior in the College of Business Administration. You are registering for your last quarter before you are to graduate. To graduate this quarter, you must take three classes. Two of them are BUS 450 and BUS 481, courses required in your major. They are offered at the following times:

BUS 450: 9:00-9:50 Daily

BUS 481: 3:00-4:50 Tuesday and Thursday, 4:00-4:50 Friday

You also have to take BUS 345, a course required for all business majors. It is offered at 8 different times.*Your goal is to take BUS 345 at the time that will let you work the most hours at your part-time job.*

To help pay for your college expenses, you have a part-time job working as a clerk in a local store. You have had this job for three years and would like to keep this job for this last quarter. However, to do that, you must meet the store manager's stipulations as follows:

1) Store hours are from 8:00 to 6:00 Monday through Friday.

2) You must work at least 20 hours per week, (although you wish to work as many as possible).

3) You may choose your hours, but:

a) they must be in blocks of four hours or more.

b) you must have the same weekly schedule for the entire quarter.

4) For ease of scheduling other employees, the manager prefers that you begin work only at the beginning of an hour; for example, 1:00 instead of 12:45 or 1:30.

From your experience working in this job for the past three years, you know the following points:

1) The store is near campus. Therefore, you can walk directly from class and be at work by the beginning of the next hour.

2) If you are leaving work to go to class, the manager will allow you to leave work early so that you can get to class on time. In these situations you are paid for the full hour.

3) The store allows you a short lunch break on paid time. Therefore, scheduling classes and work back-to-back throughout the day is not a problem.

Because you are trying to pay as much as you can toward your college expenses, you want to choose the section of BUS 345 which will allow you to work as many hours as possible.

BUS 345 is offered at the following times:

1) 8:00-9:50 Monday and Wednesday, 8:00-8:50 Friday

2) 10:00-11:50 Monday and Wednesday, 10:00-10:50 Friday

3) 1:00-2:50 Monday and Wednesday, 1:00-1:50 Friday

4) 3:00-4:50 Monday and Wednesday, 3:00-3:50 Friday

5) 8:00-9:50 Tuesday and Thursday, 9:00-9:50 Friday

6) 10:00-11:50 Tuesday and Thursday, 11:00-11:50 Friday

7) 1:00-2:50 Tuesday and Thursday, 2:00-2:50 Friday

8) 3:00-4:50 Tuesday and Thursday, 4:00-4:50 Friday

Questionnaire

Which section below allows you to work the most hours possible at your part-time job? Choose only one.

____ 1) 8:00-9:50 M & W, 8:00-8:50 F
____ 2) 10:00-11:50 M & W, 10:00-10:50 F (correct)
____ 3) 1:00-2:50 M & W, 1:00-1:50 F
____ 4) 3:00-4:50 M & W, 3:00-3:50 F
____ 5) 8:00-9:50 T & Th, 9:00-9:50 F
____ 6) 10:00-11:50 T & Th, 11:00-11:50 F
____ 7) 1:00-2:50 T & Th, 2:00-2:50 F
____ 8) 3:00-4:50 T & Th, 4:00-4:50 F

How many hours per week will you be able to work by choosing to register for the section you chose?

"I will be able to work ________ hours at my part-time job by choosing the section above."

How sure are you that the BUS 345 section you selected is the best possible of the 8 possible choices?

____ Very sure
____ Sure
____ Somewhat sure
____ Neither sure nor unsure
____ Somewhat unsure
____ Unsure
____ Very unsure

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