Subjective Evaluations of Data Checking Techniques

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Abstract

Several data checking techniques are commonly used to eliminate data entry errors. In double entry, users enter the data a second time, and the computer compares the two entries. In visual checking, users visually compare the paper data sheet with the entries on the computer screen. In read aloud, one person reads the data aloud from the paper data sheet and another visually checks the data on the computer. With all techniques, the users then correct the errors they found. This study compared subjective evaluations of these three data checking techniques. This research is important for two reasons. First, if two data checking techniques are equally effective, we can recommend the one that is preferred. Second, this comparison allows us to identify weaknesses of each technique in order to improve them.

Forty-eight undergraduates were randomly assigned to one of the three data checking techniques. Afterwards, they evaluated their assigned technique by rating 16 adjectives on a 5-point scale. We compared the three groups using ANOVA.

The three techniques had significant differences on the adjectives "accurate" ($F(2, 47) = 5.74$, $p = .006$) and "reliable" ($F(2, 47) = 7.91$, $p = .001$). Double entry was perceived as the most accurate and reliable, followed by visual checking, and finally read aloud. No other differences were significant.

Previous research has shown that double entry is far superior to visual checking in terms of reducing data entry errors (Barchard & Pace, in press), but has found no significant differences between double entry and read aloud (Verenikina et al., 2012). Our results stand in stark contrast to these objective findings: read aloud was perceived as being far less accurate and reliable than double entry, and visual checking was perceived as being better than read aloud. Researchers should therefore be encouraged to use double entry, which is perceived as being more accurate and reliable, and which actually is. Future research should provide additional evaluations of the actual accuracy of these techniques, both to combat the misperception that visual checking works, and the misperception that read aloud does not.

Introduction

The purpose of our research is to consider individuals' subjective opinions about three data checking techniques: double entry, visual checking, and read aloud. In general, these three data checking techniques are used to ensure that errors found in data are reduced so that results based on the data are as accurate as possible.

Research data help us examine many issues in life by determining whether certain hypotheses are correct. When data are not correct, our conclusions can be affected drastically (Burchinal & Neebe, 2006). With just one data entry error, a significant t-test or correlation can be made non-significant (Barchard & Pace, 2008). Therefore, it is imperative that we check data in the most efficient way possible.

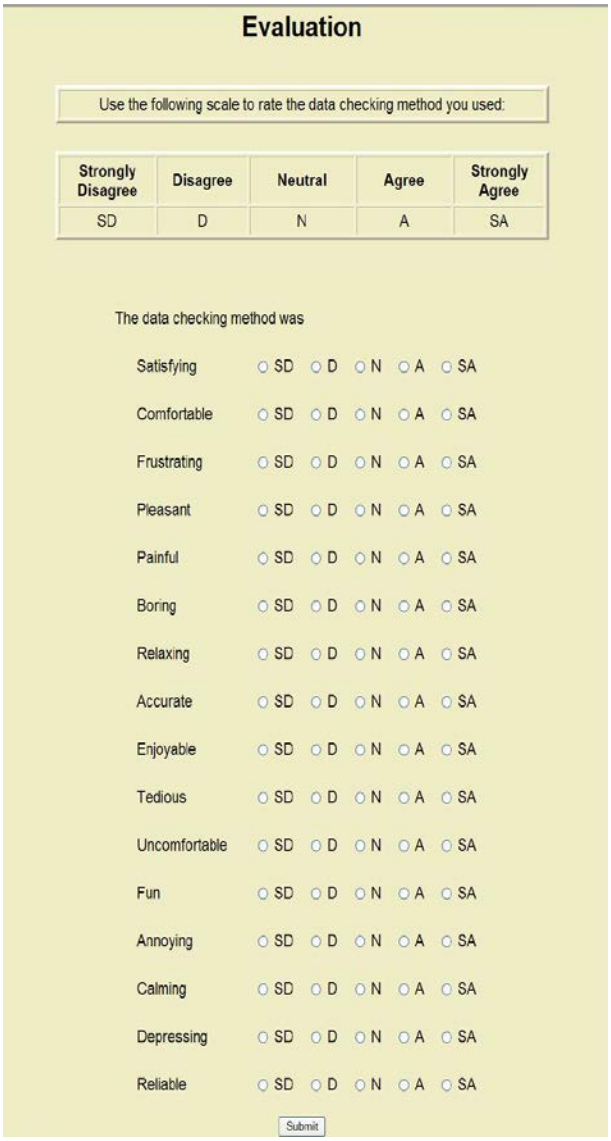
For a data checking technique to be the most efficient, it needs to be both accurate and user-friendly. A particular technique may be ignored because of the discomfort it causes the user, even if that technique is the most effective in reducing errors. If researchers do not like or do not have faith in a certain technique, then they probably will not use it. Therefore, it is important to consider what people think about the techniques, so that we understand what they prefer and what they do not prefer.

Several data checking techniques are commonly used to detect and correct errors. This paper will focus on three data checking techniques: double entry, visual checking, and read aloud. In double entry, the user enters the data a second time, and the computer compares the two data entries. If there is a difference between the two data entries, the computer notifies the user, who then corrects the error. In visual checking, the user visually compares the data on the paper data sheet with the entries on the computer screen and corrects any errors found. In read aloud, one person reads the data aloud from the paper data sheet while another visually checks the data on the computer, correcting any errors.

Some researchers have compared these data checking techniques to determine which is most effective. When double entry has been compared to single entry and visual checking, double entry has been found to be the most accurate, whereas visual checking doesn't even reduce more errors than single entry (Barchard & Pace, in press). A second study confirmed that double entry is superior to visual checking, but found no significant differences between double entry and read aloud (Verenikina et al., 2012). Therefore, both are viable techniques, if they are acceptable to users.

Unlike the other two data checking techniques, the read aloud technique involves two people. When two people check data, the process is more effective because it allows users to detect errors that may be missed by a single person (Nihei, Terashima, Suzuki, & Morikawa, 2002). In addition, when people look at data on a computer for long amounts of time, they may become bored and tired (Healy, Kole, Buck-Gengler, & Bourne, 2004). Boredom and mental fatigue may lead to more errors being ignored (Kole, Healy, & Bourne, 2008). These effects may be eliminated by having two people work together because two people share the workload. It is therefore possible that read aloud will be preferred over double entry.

Research on the subjective opinions of data checking is important for two reasons. First, if two data checking techniques are equally effective, we can recommend the one that is preferred. Second, it allows us to determine the strengths and weaknesses of each technique. This allows us to modify the techniques, so that we can make them more user-friendly.



Evaluation

Use the following scale to rate the data checking method you used:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
SD	D	N	A	SA

The data checking method was

Satisfying	○ SD	○ D	○ N	○ A	○ SA
Comfortable	○ SD	○ D	○ N	○ A	○ SA
Frustrating	○ SD	○ D	○ N	○ A	○ SA
Pleasant	○ SD	○ D	○ N	○ A	○ SA
Painful	○ SD	○ D	○ N	○ A	○ SA
Boring	○ SD	○ D	○ N	○ A	○ SA
Relaxing	○ SD	○ D	○ N	○ A	○ SA
Accurate	○ SD	○ D	○ N	○ A	○ SA
Enjoyable	○ SD	○ D	○ N	○ A	○ SA
Tedious	○ SD	○ D	○ N	○ A	○ SA
Uncomfortable	○ SD	○ D	○ N	○ A	○ SA
Fun	○ SD	○ D	○ N	○ A	○ SA
Annoying	○ SD	○ D	○ N	○ A	○ SA
Calming	○ SD	○ D	○ N	○ A	○ SA
Depressing	○ SD	○ D	○ N	○ A	○ SA
Reliable	○ SD	○ D	○ N	○ A	○ SA

Submit

Method

Participants

A total of 48 participants (26 females and 22 males) participated in this study for course credit. Their ages ranged from 18 to 39 (mean 22, standard deviation 5.26). The participants included African American (12.50%), Asian (22.92%), Caucasian (41.67%), Hispanic (14.58%), Pacific Islander (6.25%), and Other (2.08%).

Measures

This study used a self-report questionnaire that includes 16 items. Each of the items is measured on a 5-point Likert scale, which ranges from (1) "Strongly Disagree" to (5) "Strongly Agree."

Procedure

The participants used the computer for the entire study. First, they watched a video that explained how to use Excel. Second, they were randomly assigned to a technique. They did not know that there were other data checking techniques involved in the research. They only learned about the one that they were assigned. Third, they watched a video that explained how to use the particular technique. The participants were then given a set of data so they could practice their assigned technique. This set included five fake participants. After this, the participants checked data from twenty fake participants. Finally, after they completed checking the data, the participants were asked to complete the subjective evaluation of the technique they used. This evaluation took two to five minutes.

Data Analysis

We performed a one-way Analysis of Variance (ANOVA). Our dependent variables were the 16 items from the evaluation form. Our independent variable was the group to which participants were assigned. This variable had three levels: double entry, visual checking, and read aloud.

Results

Participants rated double entry as significantly more accurate ($F(2, 47) = 5.734$, $p = .006$) and more reliable ($F(2, 47) = 7.91$, $p = .001$) than the other techniques. No other differences were significant. See Table 1.

Table 1
Means of Data Checking Techniques for the Evaluation Items

	Means of Data Checking Techniques				
Items	Double Entry	Visual Checking	Read Aloud	F	*p*-value
Satisfying	4.00	3.69	3.30	1.60	.214
Comfortable	3.84	3.54	3.90	.33	.721
Pleasant	3.32	3.46	3.10	.27	.764
Relaxing	2.76	2.77	2.80	.01	.993
Accurate	4.28	3.62	3.10	5.73	.006
Enjoyable	2.88	3.08	2.60	.58	.564
Fun	2.56	2.77	2.30	.58	.566
Calming	2.92	2.92	2.90	.00	.998
Reliable	4.20	3.31	2.80	7.91	.001
Frustrating	3.64	3.15	3.80	.91	.411
Painful	3.76	3.54	4.20	.84	.437
Boring	2.32	2.31	2.10	.16	.855
Tedious	2.12	2.15	2.10	.01	.987
Uncomfortable	3.64	3.23	3.10	.75	.478
Annoying	3.32	2.38	2.90	3.07	.056
Depressing	4.00	3.92	4.40	.68	.512

Note. df = 2, 45

Discussion

In this paper, we examined what participants thought about each data checking technique. Double entry was rated as significantly more accurate and reliable than visual checking and read aloud. This result is in concordance with previous research, as double entry has been shown to be the most accurate of the three techniques (Barchard & Pace, in press; Verenikina et al., 2012).

Although there were no differences between the three data checking techniques on the remaining 14 items, it is interesting to note the items that received high ratings for each technique. Double entry received high scores (above 4 on a 5-point scale) for the following four adjectives: accurate, reliable, satisfying, and depressing. Participants may have rated this technique as satisfying because they may enjoy the visible accomplishment of typing the data and could see that they were eliminating a lot of errors. However, they may have found it depressing because they themselves made data entry errors, and the computer alerted them to their mistakes. Visual checking did not receive any ratings above 4 on a 5-point scale. Its highest average score was for depressing. Read aloud received high scores (above 4 on a 5-point scale) for two adjectives: painful and depressing. Perhaps read aloud was considered painful because some individuals did not enjoy interacting with others, or preferred to work alone. Alternatively, perhaps concentrating their visual attention on the computer screen for so long was tiring on their eyes. It is interesting to note that double entry was the only technique that was consistently described as accurate and reliable by the users. While all techniques were considered depressing, double entry received a vote of confidence from the users in this study.

There are a few limitations to our study because of our sample. Undergraduate students may not be involved in any research and may not understand the importance of data or data checking. Subjective opinions might be substantially different in a group of research assistants who regularly do data entry. Also, there is a chance that some of these participants may not have had enough computer training before participating in the study. If this is the case, experienced data entry personnel (who would have somewhat more computer training) might provide different subjective opinions.

Despite our findings, more research is needed on the subjective opinions of data checking. First, future research should compare subjective opinions of people who are actually engaged in significant amounts of data checking. We need to ensure that the preference for double entry extends to people who actually do data entry. In addition, it would be useful to discover what the participants consider to be the most important attributes of data checking techniques. Perhaps it does not matter how "fun" or "enjoyable" the technique is, as long as it is accurate. Alternatively, perhaps it is essential that a technique be considered "fun," so that volunteers will actually complete data checking tasks. Second, future research could explore whether age makes a difference in preference of data checking techniques. People who are older (60-75 years) tend to complete fewer data entry tasks, are slower at completing these tasks, and attain fewer skills after practicing than those who are younger (20-59 years) (Czaja & Sharit, 1998). There might be differences in the preferences of younger and older people, as well as between the various data checking techniques. Finally, future research could have participants each check the data for all three techniques. It is possible that the participants would think differently of the techniques if they had something with which to compare them.

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