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Batching, Error Checking and Data Collecting: Understanding Data Entry in a Financial Office

Judith Borghouts, Duncan P. Brumby and Anna L. Cox
UCL Interaction Centre, University College London, UK
{judith.borghouts.14, d.brumby, anna.cox}@ucl.ac.uk

Abstract. Data entry is a core computing activity performed by office workers every day. Prior research on this topic has tended to study data entry in controlled lab environments. In this paper, we interviewed nine financial administrators from two large universities to learn about their practices for conducting data entry work. We found that financial information often has to be retrieved from multiple electronic and paper sources, and involves briefly keeping items in memory when switching between sources. Interviewees reported that they batched a lot of data entry tasks into a single session to complete the work quickly, and mitigated the risk of data entry errors by time-consuming practices of double-checking. However, prior lab studies suggest that double-checking is a poor strategy as it takes time and people are poor at spotting errors. This work has implications for how future data entry research should be conducted.

Introduction

Data entry is a common task: office administrators have to manually enter considerable amounts of information. Beyond the work setting, many people complete similar data entry tasks, such as entering bank details when making payments online. What challenges do people experience when performing data entry tasks in the workplace?

Despite data entry often being a relatively straightforward task, errors happen and the consequences can range from mildly annoying to very severe. Mistyping your credit card details will stop a payment from going through, yet in other cases, errors can be much more serious: in 2015 one data entry error accidentally caused $6 billion US dollars to be transferred from a UK bank to a US hedge fund (Arnold & Martin, 2015).

Studies have shown that creating interfaces to slow down data entry (Gould et al., 2016), by requiring additional information (Wiseman et al., 2013) or using alternative input technology (Oladimeji, Thimbleby & Cox, 2011) can reduce error rates in the lab. However, it is not clear how such solutions would work outside of the lab (e.g. Gould et al., 2016). In lab studies, users are given clear instructions and are given the data to enter. In everyday computer use, data entry tasks might not be so clearly prescribed (Evans & Wobbrock, 2012). These tasks are done in a wider task context, which can influence how people carry out the task. It is therefore important to not only look at people's typing performance using a well-structured task, but also at data entry in the environment in which these tasks are normally performed. How do people organise their work within office environments, and what are their reasons for doing their work this way? Does it differ from behaviour seen in laboratory studies of data entry?

In this paper, we present a situated interview study with nine office workers from financial administration offices. Our aim was to learn about the type of data entry tasks people deal with in a workplace and the task strategies they adopt. This paper describes commonly observed workarounds seen in office settings when people do data entry. For example, if people have to navigate away from the data entry system to collect data, they often choose to hold items in memory, even though they have tools available to reduce their workload. This paper contributes to further data entry research: in order to develop interventions that support people in data entry tasks, it is important to understand what these tasks look like in practice.

Related Work

Numerous lab studies have investigated the strategies people adopt while entering data. In a typical study, the procedure is highly structured. The participants are given data by the researchers and enter this into an interactive device. Such studies have demonstrated how people allocate their attention between the source and the interface (Gray et al., 2006), and how interface design choices can impact both where people look and the prevalence of errors (Oladimeji et al., 2011).

Given the potentially severe consequences of data entry errors, efforts have been made to develop and evaluate interventions to increase accuracy and prevent errors. For example, Li et al. (2016) demonstrated that participants in a lab can be motivated to be more accurate through both rewarding good behaviour and punishing poor behaviour. However, Wiseman et al. (2015) has shown that the existence of a secondary task has a negative impact on checking behaviour. Similarly, Gould et al. (2016) studied the effectiveness of a lockout system in a number entry task. The lockout system disabled the interface for a few seconds after each number was entered, and was found to be effective in encouraging people to check and detect errors. However, when the intervention was moved from a monotask setting to a multitasking environment a longer lockout made people more likely to switch to other tasks instead (Gould et al., 2016; Katidioti & Taatgen, 2013). Data entry tasks are often conducted in office environments in which work is fragmented by interruptions (Mark, Gonzalez & Harris, 2005). Tasks can be spread across different media and involve going in and out of several applications (Bardram, Bunde-Pedersen, & Soegaard, 2006; Su, Brdiczka, & Begole, 2013). While an increasing number of devices are being used to help manage this fragmentation (e.g. Jokela, Ojala, & Olsson, 2015), it is still up to users to organise their work across these devices. How do people carry out data entry tasks in these type of settings?

Given the fragmented nature of an office workplace, it is not clear to what extent results from the laboratory will transfer into effective interventions if implemented in a workplace. In order to design effective data entry interfaces that support accurate task execution, it is important to understand the situated environment in which people conduct data entry tasks, how they conduct these tasks and why. In this paper we investigate how data entry work is organised in a finance office environment, and explore people's current data entry practices within this setting.

Method

As the nature of the study was exploratory, semi-structured interviews were used. The method allowed us to gain insight into people's motives behind adopted strategies and potential situational factors influencing their practices. Furthermore, the method was useful for recalling incidents when certain strategies did not work or caused errors, and people had to employ workarounds.

We conducted semi-structured interviews with financial administrators at their workplace. This user group deals with processing financial data as part of their job, and it is important that data is entered accurately, but there is also time pressure to finish work by a deadline. They were asked about their data entry work, and asked to show the data entry system and information sources they worked with.

Participants

Nine participants (four male), aged between 18 and 52 (two participants wished to not disclose their age), took part in the study. They were employees from two public universities and their work involved receiving requests for payment, checking the information of these requests was correct, and entering the information, along with additional administration data, into a financial computer system. People's level of experience differed: some participants had just started doing this type of job, whereas other participants had been working in Finance for 17 years. All participants were reimbursed with a £10 Amazon gift voucher.

Procedure

The interview took place at the participant's workplace. Participants were verbally informed about the study and were asked to read and sign a consent form giving further information about the study. After this, participants were asked to talk about their work. Interview questions asked about data entry tasks, and the physical and organisational environment in which this work was done. To support their explanations, participants showed their data entry system and documents they use for data entry tasks. They also demonstrated entering data into their data entry system, and showed the steps involved in this task. The interviews lasted around 40 minutes.

Data collection and analysis

A voice recorder was used to capture the interviews. One participant did not wish to be audio recorded and one interview could not be audio recorded due to technical issues, so for these two interviews notes were instead taken by the researcher with pen and paper. For the remaining seven interviews, notes were only made of observations that could not be captured on the audio recordings, such as work artefacts that were shown to the researcher during the interview. We made photographs of the work environment, and collected screenshots of the data entry systems. All audio recordings were transcribed verbatim. The transcripts and notes were analysed using thematic analysis (Braun & Clarke, 2006).

Findings & Discussion

The purpose of this study was to gain a better understanding of the situated context in which people conduct data entry tasks in a finance office setting, and how people organise their data entry work within this setting. In this section we report the key themes from our data.

Validating payment requests

All participants mentioned a large part of their data entry work was checking that forms had been completed correctly, and performing further calculations on financial values. Participants reported receiving different requests for payments, which could include expense claims from staff, salary slips, and invoices. Before entering any data, they first had to check that information on these requests was correct (e.g., checking expense codes, missing data, checking the expenses on a claim form against the original receipts). In many cases further calculations had to be performed, typically on financial values. For example, they had to make sure that the total sum of individual expenses was correct, foreign currencies were correctly converted, and net salaries had to be calculated from gross salaries. These calculations had to be done manually and some of these were described as time-consuming:

> "It [the system] doesn't give you a quick calculation from net to gross. And that usually is very, very, time-consuming, because it could take up to 20 minutes to half an hour." (P9)

Entering data from multiple information sources

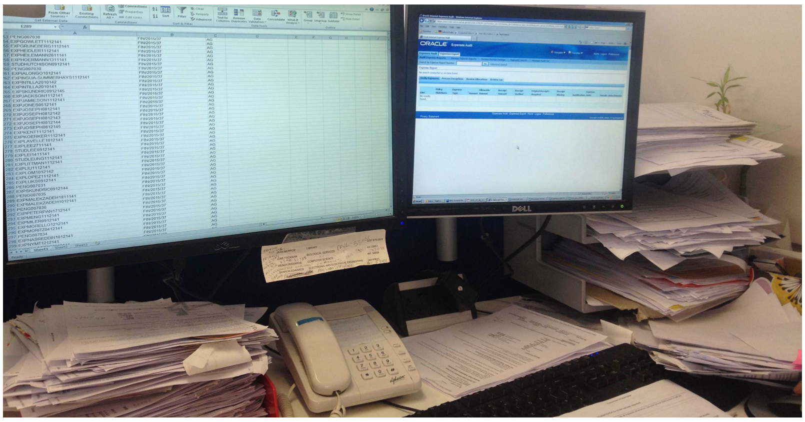

Figure 1. Data had to be entered into an electronic computer system (right screen), but first had to be retrieved from electronic spreadsheets (left screen) and paper documents.

After checking that the data on the form was correct, workers had to enter this information, along with additional data from other sources, into the data entry system. Figure 1 shows a photo of a typical work environment, and captures a couple of examples of the data sources from which data had to be retrieved. Information for completing a single payment request could be spread across Excel spreadsheets, work e-mails, PDF documents or databases. Some documents, such as receipts and claim forms, had to be given on paper. The sources discussed in this study usually contained a range of data, not all of which was relevant to the task. Workers had to find the information they needed and enter it into the data entry system. This created opportunities for errors to be made. P4 felt it was much easier to make errors when copying from paper, and preferred digital files. However, the multitude of digital sources people dealt with introduced the challenge of limited screen space to present it all.

The use of multiple information sources is in line with previous studies that showed the fragmented nature of an office workplace (e.g. Mark et al., 2005; Su, Brdiczka, & Begole, 2013). It was common that people had to go in and out of different windows to collect information. If participants had to find information in a digital document or website, they had to navigate away from the data entry system, look up and find the relevant information, and then come back. P7 mentioned that switching between multiple screens for one task made the task more difficult:

> "It can be quite complicated, and there are quite a lot of different screens to input." (P7).

It was surprising to learn that the software tools that were used for these data entry tasks often filled the entire screen and could not be minimised. Rather than writing information down, participants often tried to hold the information in their memory when switching back to the entry system:

> "I wouldn't necessarily have to [memorise it], it's more […] if you have to keep flicking back to different things, it's sometimes just easier to try and remember it. But you can obviously take the long version and keep flicking back to the correct screen." (P3)

This memory-based strategy is explained by previous lab studies suggesting people make strategic use of their internal and external resources to minimise time, and do not always minimise use of memory (Gray et al., 2006). In lab studies, people are occasionally required to briefly hold items in memory, and are not given any tools to decrease their memory load (e.g. Li et al., 2016). It is interesting to learn that even when the tools were readily available in the workplace, people often still chose to memorise data rather than writing it down. Though participants were aware they did not have to remember information, they thought it was easier and faster than looking it up or writing it down. However, this strategy carries the risk that they misremember it and make entry errors. People reported they sometimes went back to the wrong screen and entered the information in the wrong document:

> "If you, by mistake, left that menu, and went into another linking menu that comes up with somebody else's payroll number, you would never know that you're inputting somebody else's calculation into another record. You have to be so careful." (P9).

The information sources contained task-irrelevant information as well, and it would sometimes take a while before the right data to enter was found. Finding the right data from multiple sources amongst task-irrelevant information differs from the set-up of most data entry studies conducted in the lab (Gould et al., 2016; Healy et al., 2004; Li et al., 2016; Oladimeji et al., 2011). In these studies, participants are usually given a clear presentation of the task and data to-be-copied, in order to evaluate their performance. For example, in Gould et al. (2016) a computer screen only presented one number at a time and participants had to enter this number into one entry field. In contrast, before people in the current study could type data they had to spend time looking up information.

Strategies to improve data entry efficiency

Participants reported that they often had a considerable amount of data to enter. For processing expenses alone, the amount of financial numbers to enter could be in the region of 6,000 numbers a day. In order to complete data entry tasks in an efficient manner, participants structured their work to complete similar tasks related to the same activity, rather than switch between activities. They deliberately ‘batched’ and saved up payment requests, to process and enter a large amount of data in one sequence. P1 mentioned it was too disruptive to only process two or five payment forms and then switch to other tasks. P4 mentioned he does them all at once because he gets the forms in a bulk, and feels time pressure from his supervisor to finish the task quickly, rather than spread it over time. Seven other participants received forms on an ad-hoc basis, but still deliberately saved them until they had a large amount of data entry work and then processed them in bulk in a single session. They preferred to focus on one task at once, and some people stated that it made them faster in entering data after a while:

“The expenses are done in a bulk, rather than separated over a period of time. When I’m doing it lots at a time, I think once you get into sort of the hang of it, it gets done a lot quicker.” (P6)

This finding further supports previous lab studies showing people adapt strategies to minimise time (Gray et al., 2006). Focusing on one task can be beneficial, as multitasking and task interruptions can cause omission errors (e.g. Back et al., 2012; Mark et al., 2005). However, in the case of a data entry task, batching too many tasks in one sequence can make people faster but can also increase typing errors (Healy et al., 2004). This speed-accuracy trade-off was also reported by participants in the current study. For instance, P3 mentioned people’s tendency to save up and then quickly enter data as the major reason for errors:

“They [Colleagues] have to do it by a certain time so they’re a bit rushing and then it’s… just typos.” (P3)

Checking methods to catch data entry errors

As soon as an office worker had checked the data and entered it, it went to a colleague who would then check if the entries were correct, and enter it again into the system. Data was checked and re-entered by several different people before the payment request was finally submitted and processed. People’s experience with this checking method differed: P3 was positive about it, and felt an error would be caught eventually because it goes through so many different checks in the system. In contrast, P9 argued that this made people less careful about making errors:

“The departments actually sometimes treat us as a checking system [laughs], but they shouldn’t really.” (P9)

The checking method is similar to Reason’s (1990) Swiss Cheese model, where multiple checking layers are used to minimise the risk of errors. Entering data twice is considered to be an effective method of checking for errors, as it is unlikely the same error will be made twice (Barchard & Verenikina, 2013). However, it can also be time-consuming as it requires double labour. Furthermore, in this study people not only had to enter, but also check that the to-be-entered data was correct, and people are generally poor at visually spotting errors (Wiseman et al., 2013). Despite being widely applied in practice, there is no strong support for the effectiveness of double-checking either (Li et al., 2016). One of the reasons people may not detect errors when checking a colleague’s entries is confirmation bias, which occurs when people selectively attend to stimuli that confirm one’s belief (Lewis, 1986). People may expect data entries to be correct: participants reported they regularly received erroneous data, which had previously been checked and approved by several people:

“Errors could also be things that are missed during the checking.” (P8)

P8 and P9 were the last persons at their office to check data before it would finally be submitted to the system for payment. They commented that even at this last stage it was still quite common to spot numerous data entry errors:

“We’ve been keeping a record of the errors from expenses, so...yeah there are quite a lot!” (P9)

When an error was spotted it was disruptive, as sending the form back slowed the process down, and the task could not be completed until the error had been corrected by the person who had submitted it.

Conclusion

Data entry research has traditionally used controlled studies to quantitatively measure people’s performance using different data entry interfaces. However, the extent to which these findings can be generalised to the contexts in which people actually do their work is unknown. This study explored data entry in a financial office environment, and analysed users’ own explanations of their adopted strategies within this context.

Some factors contributing to people’s strategies are difficult to study in a controlled environment, such as the organisation culture. However, other findings from this study could improve the way data entry tasks are modelled in lab-based experiments. For example, we found that entering data is only one part of the broader data entry task flow. While data entry tasks in the lab are relatively straightforward and well-organised, they differ from tasks seen in this study where the data to enter is spread across different sources, and takes time to collect together. Future lab-based studies could require participants to first collect data from multiple sources, in order to see how it affects data entry performance. Having an experimental task that is more closely modelled to a situated task will give a better understanding to what extent different interventions are applicable. For example, slowing people down in data entry has shown to reduce errors in the lab (Gould et al., 2016, Wiseman et al., 2013), but this intervention may not work if people are holding items in memory.

Prior studies have shown that if it takes more time to gather data from one physical source, people will avoid multitasking and rely more on memory (Back, Cox & Brumby, 2012; Borghouts et al., 2015). This was also reported in the current study: when switching between different sources participants held items in memory, which is more error prone than using external resources (Gray et al., 2006) such as pen and paper or a digital note taking tool.

People dealt with large volumes of data to enter, and saved up data entry tasks to enter them in one session. This strategy makes people quicker but also less accurate in entering data (Healy et al., 2004). It would be worthwhile to conduct future studies that explore more effective strategies to batch data entry. Data entry interfaces that slow people down have been shown to reduce errors (e.g. Gould et al., 2016; Oladimeji et al., 2011), but these lab studies tested up to 240 number entries, whereas participants in the current study reported they often had to enter around 6,000 numbers a day. Future studies should evaluate the applicability of data entry interfaces over time, when large amounts of data need to be entered.

To detect errors, people reported relying on double-checking strategies, even though it is known to be ineffective (Li et al., 2016). Because people know entries will get checked by someone else, they may not check as properly.

These memory-intensive, batching, and double-checking strategies have been shown to be error-prone in lab studies (e.g. Gray et al., 2006; Healy et al., 2004; Li et al., 2016). Looking at these strategies in isolation, it may seem people pick suboptimal working strategies. However, there were probably contextual reasons for why people did their work this way. For example, P4 did not spread data entry tasks over time because he felt time pressure by his boss to finish it. In addition to lab studies, it is therefore important to consider the wider task context when studying and designing for data entry tasks.

The study relied on people's own explanations of their practices. This gave us insight into reasons why people may employ certain strategies, and through this method we were able to discuss critical incidents which would be unlikely to be uncovered through observation alone. A limitation of relying on people's self-reporting however is that they may not do what they say they do (e.g. Randall & Rouncefield, 2014). Though people gave short demonstrations to support their explanations, they were not shadowed doing their work for longer periods of time. The interviews have given insight into factors that could potentially influence people's strategies. Future observational or logging studies would be useful to complement people's explanations and corroborate findings.

This study has shown how data entry at the workplace differs from tasks used in the lab, and the type of strategies that people adopt. Future lab studies might incorporate elements of these situated work practices to improve ecological validity so as to get a better understanding of how effective different interventions, such as lockouts and alternative input interfaces, are on improving data entry performance.

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