Human-Computer Interaction -- INTERACT'03
M. Rauterberg et al. (Eds.)
Published by IOS Press, (c) IFIP, 2003, pp. 789-792

Distribution of Attention and Failure to Save Computer Work

Gregory V. Jones & Maryanne Martin

University of Warwick
Department of Psychology, Coventry CV4 7AL, U.K.
University of Oxford
Department of Experimental Psychology, Oxford OX1 3UD, U.K.

G.V.Jones@warwick.ac.uk

Abstract: Many computer users occasionally forget to save their work and thereby lose it. It is shown that such losses are not purely random in occurrence. Instead, their incidence in everyday computing appears to be a function of variation among individuals in the distribution of attention. The findings are based upon the study of nonspecialist users rather than advanced users, and upon the predictive rather than the taxonomic study of error. The results provide support for the characterisation of user groups in terms of variation in underlying cognitive processes.

Keywords: computer error, selective attention, individual differences, cognitive failure

1 Computing and Attention

Many computer users have experienced on at least one occasion the exasperation of losing a considerable amount of work as a result of forgetting to save it. Other users may have never experienced such a loss. Are the differences in experience among these users merely random in origin, or can they be linked to some more systematic aspect of the user's psychology? Although considerable bodies of research on computing error in general have been reviewed by Sutcliffe and Rugg (1998), and despite this being an issue which impacts on the everyday computing of very large numbers of nonspecialist users, the question appears to have received little consideration. Although this apparent neglect is at first sight surprising, there are a number of factors which make it easier to understand. One is the comparative inaccessibility to systematic investigation of rare events which occur during people's everyday lives. Two other possible factors are more subtle, and relate to implicit differences in priorities among research agenda. Both have been highlighted by Hollnagel and his co-workers.

The first factor, addressed by Marsden and Hollnagel (1996), is that the nonspecialist computer user, for whom the risk of losing work may loom particularly large, has tended to be neglected in favour of the user with relatively specialised computing skills. The second of Hollnagel's arguments that may be relevant to the apparent neglect of the present problem is the claim (Hollnagel, Kaarstad & Lee, 1999) that studies of error have more often adopted the reverse approach, concerned not to predict who will suffer it but instead only to classify retrospectively the type of error and its circumstances. Such neglect may also be viewed as part of a more general failure to investigate at all widely the importance for human-computer interaction of systematic differences among individuals (Dillon & Watson, 1996). Does the existing study of individual differences in human performance provide any indication as to how susceptibility to losing one's computing work might be predicted?

Perhaps the best-researched instrument for investigating cognitive processes of importance in the everyday world is the Cognitive Failures Questionnaire (CFQ) which was introduced approximately twenty years ago by Broadbent and his colleagues (Broadbent, Cooper, FitzGerald & Parkes, 1982), and has now been translated from English into a number of languages, such as German (Klumb, 1995). It contains 25 items that probe common failures in cognitive processing in everyday life to which in principle almost everyone is subject, for example, "Do you fail to hear people speaking to you when you are doing something else?" (Broadbent et al., 1982, p. 15). Computing activity, as a less universally distributed activity (particularly at the time of development, twenty years ago), does not feature at all in the CFQ. Thus if there does prove to be a relation between computing performance and CFQ score, it is indicative of a common reliance upon some more elementary aspect of individual performance. In the case of CFQ scores, it was shown by the present authors (Martin & Jones, 1983) that, in the laboratory, they bear a significant relation to the ability to distribute attention successfully over two (or more) concurrent tasks. This has now been confirmed with a variety of laboratory tasks such as SART (sustained attention to response task; Robertson, Manly, Andrade, Baddeley & Yiend, 1997). Robertson et al. showed that higher CFQ scores are predictive of failures to suppress forbidden responses for sequences of numerical stimuli both among normal and among brain-damaged populations.

Given the general consensus that the CFQ provides a reliable measure of individual variation in attentional ability, it appears that it would be informative to use it in investigating the failure to save computing work in the everyday world. The CFQ does not seem to have been used previously for this purpose, but there is certainly evidence that it is predictive of other types of real-world attentional failure. As an example, Larson, Alderton, Neideffer and Underhill (1997) have shown that there is a significant relation between CFQ score and whether an individual has been injured by falling, and indeed the overall number of times the individual has been hospitalized for treatment to injury (as opposed to treatment for illness).

To investigate whether failure to save computing work in the real world can be related to individual differences in attentional ability, it is desirable to sample from among a relatively homogeneous set of individuals who are substantial users of computers, such as students (see Crook & Barrowcliff, 2001). Further, because users are nowadays usually issued with prompts if they are on the point of failing to save, such failures are relatively rare and it is therefore necessary to aggregate their incidence over a considerable period. The results of two such studies are described here.

2 Findings on Loss of Work

In the first study, a group of 50 third-year undergraduates (mean age 21.2 years) were volunteers. Participants first completed the CFQ, which elicits 25 responses concerning the individual's actions over the previous six months. For each, the responses range from 0 (Never) to 4 (Very often), yielding overall scores with a possible range of 0 to 100. Following this, participants were provided with a series of autobiographical probes based on those used by Larson et al. (1997), the results from which are not described here, together with the following question: "Since you have been at university, how many times have you lost some work on the computer because you forgot to save it? (e.g., before quitting the program)." Four response alternatives were provided: 0, 1, 2, and 3 (or more).

The mean CFQ value was 48.5 ($SD = 9.3$) and Cronbach's alpha was 0.80, indicating high internal consistency. The mean number of computer losses experienced was 0.80, with only a minority of participants, 22, having experienced no such loss. Regression analysis showed that there was a significant linear regression of number of computer losses on CFQ score, $F(1, 48) = 4.27$, $p < .05$, but no significant additional quadratic effect, $F(1, 47) < 1$.

The study thus provides initial evidence of a possible link between individual variation in attentional ability, as assessed by the CFQ, and susceptibility to loss of computer work. It may be noted that the mean CFQ score here, 48.5, is comparable with the level of 52.5 reported for a population of student nurses by Broadbent et al. (1982). To assess the reliability of the link between attention and computer loss, a second study was carried out.

In the second study, a group of 58 first-year undergraduates (mean age 20.7 years) were volunteers. The procedure was similar to that of the previous study, except that number of computer losses and other autobiographical responses were elicited before completion of the CFQ. Also, in order to cover approximately the same duration as in Experiment 1, the initial part of the computer-loss item was modified: "During the last two-and-a-half years (for example, since you started the Sixth Form), how many times have you lost some work on the computer because you forgot to save it? (e.g., before quitting the program)".

The mean CFQ value was 48.6 ($SD = 13.1$) and Cronbach's alpha was again high, at 0.89. The mean number of computer losses experienced was 0.84, with this time a majority of such participants, 33, having experienced no such loss. For this reason, the remaining minority of participants were combined into a single some-loss group. Analysis of variance showed that the mean CFQ level for the some-loss group was significantly higher than that for the no-loss group, at 52.7 (*SD* 14.3) versus 45.5 (*SD* 11.5), $F(1, 56) = 4.53$, $p < .05$. A two-way analysis of variance showed that this result was not influenced by gender, since although there was a significant main effect of gender on CFQ score, $F(1, 54) = 4.75$, $p < .05$, the effect did not significantly interact with that of group (i.e., some-loss versus no-loss), $F(1, 54) = 1.87$.

3 Users and Cognitive Failure

As noted earlier, it has been argued by Hollnagel and his colleagues that within the study of human-computer interaction there has been a tendency to focus on the specialist user rather than the general computer user, and a tendency also to focus on the taxonomy of human error rather than its prediction (Hollnagel, Kaarstad & Lee, 1999; Marsden & Hollnagel, 1996). The studies described here adopt the alternative strategies of focussing on the nonspecialist user and on the prediction of error, investigating whether occasional failures by general computer users to save their work can be attributed to the influence of an underlying psychological factor. The significance of their results provides evidence in favour of the general fruitfulness of these alternative strategies.

Those people who were more likely to lose their computing work were found to be also those individuals who were more susceptible to cognitive failure in general. It is important to note that, at the surface level, the content of the instrument used here for assessing cognitive failure, the CFQ (Broadbent et al., 1982), has no overlap at all with computing. Rather, the evidence is that what the CFQ taps into is variation among individuals in the ease with which the control of attentional processes can be go astray, particular by a failure to inhibit the capture of attention by inappropriate stimuli (Martin & Jones, 1984; Robertson et al., 1997). That is, it appears that systematic variation in the ability to distribute attention plays an important role in determining whether or not individuals, during long episodes of everyday behaviour, succeed in avoiding the accidental loss of their computing work. It is of course hardly necessary to add that, though important, this factor is not exclusive and loss of computer work can occur also for extraneous reasons, such as a machine crash.

At the most general level, the finding that individuals likely to suffer the loss of computing work can be predicted to a significant, albeit limited, degree can be construed as supporting an approach to HCI in terms of individual differences in psychology among computer users. Dillon and Watson (1996) have criticised a tendency at present for the study of HCI to rely on broad functionalist characterisations of user groups, such as their members' experience of particular tasks, their level of technical skills, their knowledge of particular domains, or even merely their age. Improved psychological characterisation of individual differences among user groups is not only of theoretical interest but ought also to be of practical benefit in a range of situations, ranging from training programmes to interface design.

References

Broadbent, D. E., Cooper, P. F., FitzGerald, P. & Parkes, K. R. (1982), The Cognitive Failures Questionnaire (CFQ) and its correlates, *British Journal of Clinical Psychology*, 21, 1-16.

Crook, C. & Barrowcliff, D. (2001), Ubiquitous computing on campus: patterns of engagement by university students, *International Journal of Human-Computer Interaction*, 13, 245-256.

Dillon, A. & Watson, C. (1996), User analysis in HCI - the historical lessons from individual differences research, *International Journal of Human-Computer Studies*, 45, 619-637.

Hollnagel, E., Kaarstad, M. & Lee, H. C. (1999), Error mode prediction, *Ergonomics*, 42, 1457-1471.

Klumb, P. L. (1995), Cognitive failures and performance differences - validation studies of a German version of the Cognitive Failures Questionnaire, *Ergonomics*, 38, 1456-1467.

Larson, G. E., Alderton, D. L., Neideffer, M. & Underhill, E. (1997), Further evidence on dimensionality and correlates of the Cognitive Failures Questionnaire, *British Journal of Psychology*, 88, 29-38.

Marsden, P. & Hollnagel, E. (1996), Human interaction with technology: the accidental user, *Acta Psychologica*, 91, 345-358.

Martin, M. & Jones, G. V. (1983), Distribution of attention in cognitive failure, *Human Learning*, 2, 221-226.

Martin, M. & Jones, G. V. (1984), Cognitive failures in everyday life, *in* J. E. Harris & P. E. Morris (eds.), *Everyday Memory, Actions and Absent-mindedness*, Academic Press, pp. 173-190.

Robertson, I. H., Manly, T., Andrade, J., Baddeley, B. T. & Yiend, J. (1997), 'Oops!': performance correlates of everyday attentional failures in traumatic brain injured and normal subjects, *Neuropsychologia*, 35, 747-758.

Sutcliffe, A. & Rugg, G. (1998), A taxonomy of error types for failure analysis and risk assessment. *International Journal of Human-Computer Interaction*, 10, 381-405.