Stress in the Office: the Influence of Software-Ergonomic Quality

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Abstract

The transactional stress-model by Lazarus (1999) is used as a theoretical framework to investigate the influence of software-ergonomic quality on irritation, psychosomatic complaints and health problems in computer workers. Two converging studies are discussed, both showing significant effects of software-ergonomic quality. The paper concludes with practical implications drawn from the data.

1 Introduction

Many workers today use computers as tools for accomplishing their daily work. While much research has been done on the specific aspects of *hardware* quality (like specific effects of work with keyboards and screens or the effect of system response times on stress), the effects of *software* quality on workers' experience of stress has rarely been investigated in a systematic fashion.

The aim of this paper is to report two studies on the relationship between the ergonomic quality of a software programme and the experienced stress in computer workers.

2 Theoretical Framework

Theoretical basis of our research is the transactional stress-model by Lazarus (1999) and Lazarus and Folkmann (1984). Rather than assuming a direct relationship between stressors and subjective strain (i.e. consequences of stress), this model proposes a cognitive stance in between: appraisal and coping.

Stressors at the work place are evaluated by the individual. In a primary and secondary appraisal stressors are judged whether they are a threat to the individual and how they can be dealt with. During the primary appraisal the individual categorizes a stimulus as being positive, negative or irrelevant to its own well-being. The recognition of a negative stimulus is usually accompanied by unpleasant emotions or general discomfort. Secondary appraisal then involves a more detailed analysis and the generation of possible coping strategies.

The likelihood of successful coping depends on the available amount of resources. Thus resources can moderate the effect of stressors. Typical resources include decision latitude (control), social support, qualification, knowledge of coping strategies, and social competency. If there are not

enough resources available or the individual chooses inadequate coping strategies, continued exposure to stressors can lead to short term stress reactions like physiological changes (increase in heart rate, blood pressure, hormone levels), decreased performance, frustration, anger, or irritation. If stress is continuously present over longer periods of time short-term reactions may transform into long-term stress reactions like psychosomatic complaints, physical health problems, anxiety, depression, burnout, or absenteeism.

We will use the transactional stress model for investigating the relationship between the ergonomic quality of a software and experienced levels of stress in office workers (see figure 1).

Stressors	Appraisal and Coping	Short-term stress reactions	Long-term stress reactions	Demo-graphics
• Time of exposure to a specific software • Software-ergonomic quality	Resources: • Experience with software • Mastery of software • Social Support	• Irritation	• Psychosomatic complaints • Physical health problems	• Sex • Age

Figure 1: Variables used in our two studies according to the transactional stress model by Lazarus (1999), Lazarus & Folkmann (1984)

According to the model we classify 'software-ergonomic quality' and 'time of exposure to that software' as stressors. During primary appraisal the user decides whether the behaviour of the software (e.g. displaying an error message saying that incorrect data has been entered a week ago) imposes a problem on him/her. In the secondary appraisal he/she generates coping strategies (e.g. correcting the data). The chance of removing a problem rises the more experience a user has with this software and the higher his level of mastery of this software is. The availability and degree of social support (e.g. asking colleagues or supervisors for help) are also important resources to the user. Is software-ergonomic quality low and resources are not available for successful coping stress becomes strain. Short term stress reactions like irritation are the consequences and may result in long term-stress reactions like psychosomatic complaints and even physical health problems. The remainder of this paper will look at empirical data to support the hypothesized relationships.

3 Method

3.1 Description of Study 1 and Study 2

We conducted two questionnaire studies to test the hypothesized effects. The participants of our first study were computer workers of an accident prevention and insurance association with local offices in several places of Germany (N = 444). Over two thirds of the participants rated software packages that were developed exclusively for their employer. Other software included mainly Microsoft Office products. All of the variables in figure 1 were measured.

A second study was designed to verify the data of the first study, regarding the relationship of stressors and resources on short term stress reactions. For practical reasons (e.g. privacy issues) we

abandoned the measurement of long term stress reactions in this study. 472 workers from different industrial sectors (financial services, car industry, pharmaceutical industry, consulting, IT, telecommunications, trade, public services and others) and different company sizes (small, medium and large) in Germany took part and completed the questionnaire. More than 50% of the participants rated Microsoft Office Products, the remainder included a wide variety of standard-software packages like SAP R/3 and independently developed software.

3.2 Instruments

'Software-ergonomic quality' was measured with the questionnaire ISONORM 9241/10 (Prümper, 1993, 1999). The answers in this questionnaire are coded from –3 to +3. 'Social support' was measured with the subscale 'social support' from the KFZA (Prümper, Hartmannsgruber & Frese, 1995). The answers in this questionnaire are coded from 1 ('do not agree') to 5 ('strongly agree'). 'Irritation' was measured with the irritation scale by Mohr (1986). It contains items like 'I have difficulty relaxing after work' or 'I get irritated easily, although I don't want this to happen' with the answers ranging from 1 ('strongly disagree') to 7 ('strongly agree'). 'Psychosomatic complaints' (like headache, disturbed sleep, sensitive stomach) and 'Health problems' (like high blood pressure, stomach ulcer, bronchitis) were measured by scales after Mohr (1986). The answers in the 'psychosomatic complaints' questionnaire are coded from 1 ('never') to 5 ('almost daily'). The 'health problems' questionnaire score is the count of 'yes' answers to 22 health-problems. All other variables were single items: 'Time of exposure to software' in h/week, 'experience with software' in months and 'mastery of software' (ranging from 1='very bad' to 7='very good').

4 Results

4.1 Study 1

Table 1 shows the descriptive and correlational results of study 1. Pearson correlation coefficients support the hypothesis of an influence of 'software-ergonomic quality' on 'irritation' as an indicator for short-term stress reactions ($r=-.34$, $p<.05$). The second highest influence exerts 'social support' ($r=-.28$, $p<.05$) The 'exposure to the software' in hours per week shows no relation to 'irritation' ($r=.01$, $p>.05$). Neither does 'experience' with the software ($r = -.02$, $p>.05$). Self assessed 'mastery' of the software has an influence on 'irritation' ($r=-.18$, $p<.05$).

Running a regression analysis on these data (see table 3), we again find significant contributions of the stressor 'software-ergonomic quality' and the resource 'social support' to 'irritation' levels, whereas the other variables have no statistical influence. Overall explanation of variance is 20% - an astonishing amount since we did not take other stressors and resources regarding working and general life conditions into account.

The effects of short term stress reactions on long term stress reactions are mirrored by the correlations of 'irritation' with 'psychosomatic complaints' ($r=.60$, $p>.05$) and with 'physical health problems' ($r=.46$, $p>.05$).

Table 1: Descriptives and Correlations of the first study

Variable		Mean	SD	1	2	3	4	5	6	7	8	9	10
1	SW-Exposition, h/week	18.26	13.33	(--)[3]									
2	SW-Ergonomic Quality	-.05	1.25	-.07	(.93)								
3	SW-Experience, months	32.64	27.20	-.04	.10	(--)[3]							
4	SW-Mastery	5.34	1.24	.09	**.29**	**.12**	(--)[3]						
5	Social support	3.32	1.01	-.04	**.22**	-.01	**.13**	(.76)					
6	Irritation	3.31	1.43	.01	**-.34**	-.02	**-.18**	**-.28**	(.93)				
7	Psychosom. complaints	2.30	.81	**.23**	**-.18**	-.02	**-.15**	**-.18**	**.60**	(.93)			
8	Health Problems	4.48	2.72	**.14**	**-.10**	.01	**-.14**	**-.18**	**.46**	**.66**	(.64)		
9	Sex[1]	1.53	.50	**.33**	.06	-.02	-.02	.00	-.03	**.18**	.09	(--)[3]	
10	Age[2]	3.86	.97	**-.14**	**.14**	.10	**-.13**	-.03	.08	**.10**	**.11**	**-.19**	(--)[3]

Note: $387 \leq N \leq 443$. Correlations in bold type are significant at $\alpha = 0.05$. Reliabilities (Cronbach α) in brackets. Footnotes: [1] male = 1, female = 2. [2] < 20 yrs = 1, 20 … 29 yrs = 2, 30 … 39 years = 3, 40 … 49 yrs = 4, > 50 years = 5; correlations with age are Spearman-Rho coefficients. [3] single item scale.

4.2 Study 2

Table 2 shows the descriptive and correlational results of study 2. Again 'software ergonomic quality' and 'mastery' of the software show significant correlations with 'irritation' ($r=-.12$, $p<.05$, and $r=-.13$, $p<.05$, respectively). However, this time the effect is not as pronounced as in the first study. The influence of 'social support' remains ($r=-.21$, $p<.05$).

Table 2: Descriptives and Correlations of the second study

Variable		Mean	SD	1	2	3	4	5	6	7	8
1	SW-Exposition, h/week	22.74	13.47	(--)[3]							
2	SW-Ergonomic Quality	.70	.86	-.05	(.85)						
3	SW-Experience, months	37.76	36.35	**.19**	.02	(--)[3]					
4	SW-Mastery	5.53	1.04	**.16**	**.14**	.07	(--)[3]				
5	Social Support	3.99	.80	.04	**.13**	.04	.06	(.64)			
6	Irritation	3.03	1.13	.03	**-.12**	-.03	**-.13**	**-.21**	(.88)		
7	Sex[1]	1.60	.49	.09	**.11**	.08	-.04	.04	.08	(--)[3]	
8	Age[2]	2.98	1.04	.09	.03	**.27**	**-.16**	-.07	**.11**	.02	(--)[3]

Note: $451 \leq N \leq 472$. Correlations in bold type are significant at $\alpha = 0.05$. Reliabilities (Cronbach α) in brackets. Footnotes: [1] male = 1, female = 2. [2] < 20 yrs = 1, 20 … 29 yrs = 2, 30 … 39 years = 3, 40 … 49 yrs = 4, > 50 years = 5; correlations with age are Spearman-Rho coefficients. [3] single item scale.

The regression analysis (see table 3) again shows significant effects of 'software-ergonomic quality' and 'social support' on 'irritation' scores. However, just 6% of the variance can be explained by the regression model.

Table 3: Regression coefficients for irritation in both studies

Independent variables	β in study 1	β in study 2	Dependant variable
SW-Exposition	n.s.	n.s.	Irritation
SW-Ergonomic Quality	-.31	-.10	
SW-Experience	n.s.	n.s.	
SW-Mastery	n.s.	n.s.	
Social Support	-.22	-.18	

Note: Study1: $R^2 = .20$, Study2: $R^2 = .06$; n.s. = not significant at $\alpha = .05$

5 Conclusions

Using the transactional stress model by Lazarus (1999) as a theoretical guide we could show that software-ergonomic quality is an important and stable factor influencing the experience of stress at the computer workplace. Consequences of poor ergonomic quality include not only short-term issues like higher levels of irritation but also more serious psychosomatic and health problems in the computer workforce. As this is adding to the total costs of ownership of software in a company, resources should be provided to ensure software-ergonomic quality (a) through informed assessment and selection of software prior to purchase; (b) by ensuring user-centred design in internal software-development projects, and (c) through ergonomic customizing of standard software packages at the user site (see Hurtienne, Prümper & Linz, 2002).

Another important aspect is social support to the user. If other employees are competent users of their software they can help each other with solving problems and smooth irritation and anger. The time of exposure to a software and the level of mastery of that software play a role in influencing computer worker's stress levels to a lesser degree. The more people sit in front of their screens the more psychosomatic and health complaints they will express. Here it is desirable to introduce work with various tasks and with a lesser share of time spent at the computer. Eventually an excellent qualification of users to enhance their level of software mastery needs to be considered.

But still, questions for future research remain. Although our findings replicate, they suggest different levels of correlations. Is this due to statistical reasons (decreased variability of the 'software-ergonomic quality' score in the second study) or is it a systematic variation due to different people using different software packages?

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