

Workflow interruptions, social stressors from supervisor(s) and attention failure in surgery personnel

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Abstract: Workflow interruptions and social stressors among surgery personnel may cause attention failure at work that may increase rumination about work issues during leisure time. The test of these assumptions should contribute to the understanding of exhaustion in surgery personnel and patient safety. Workflow interruptions and supervisor-related social stressors were tested to predict attention failure that predicts work-related rumination during leisure time. One hundred ninety-four theatre nurses, anaesthetists and surgeons from a Swiss University hospital participated in a cross-sectional survey. The participation rate was 58%. Structural equation modelling confirmed both indirect paths from workflow interruptions and social stressors via attention failure on rumination (both $p < 0.05$). An alternative model, assuming the reversed indirect causation—from attention failure via workflow interruptions and social stressors on rumination—could not be empirically supported. Workflow interruptions and social stressors at work are likely to trigger attention failure in surgery personnel. Work redesign and team intervention could help surgery personnel to maintain a high level of quality and patient safety and detach from work related issues to recover during leisure time.

Key words : Workflow interruptions, Social stressors, Attention failure, Occupational stressors, Rumination, Recovery

Introduction

Surgery places high demands on quick decision-making and on the accomplished technical skills of the surgical team. A multidisciplinary surgical team includes surgeons, anesthesiologists, nurses, technicians, and other specialists. Members of the surgical team work hard and experience frequent stressors, such as overtime work, variable shift-work, high demands on concentration, and workflow

interruptions¹). At the same time, leadership quality, close cooperation and teamwork are essential for surgical teams, leading to further demands and accumulating work stress on surgery personnel²).

Organizational stressors like social stressors at work and task stressors like workflow interruptions may distract attention from the primary task at hand^{3–5}). Social stressors at work are a very frustrating stressor that may cause sustained psychophysiological activation, including higher levels of rumination and increased heart rate. Sustained psychophysiological activation is related with increased mental and physiological load, and may thereby distract from the primary task at hand and also persist even after

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work is done, thereby impeding recovery from work³). Like social stressors, we argue that task stressors (e.g., workflow interruptions) may also distract attention from the primary task at hand. As a consequence of workflow interruption, attention is shifted to the distraction and away from the current task. Moreover, the goal of the interrupted action and its position in the action sequence must be stored in working memory to restart the primary task correctly⁶. The new goal of restarting the interrupted task at hand at a later time must be stored in prospective memory^{7, 8}). Therefore, workflow interruptions distract from the primary task and also increase mental work load.

Taken together, social stressors and task stressors are an avoidable threat to attention regulation in surgery personnel⁹). The consequences of attention failure in surgery can be serious for patients and surgery personnel²) who are dedicated to working reliably and responsibly and may start or keep ruminating about their attention failure and conflicts with supervisors even after work⁵). Rumination after work impedes recovery in the evening and during sleep and may cause exhaustion³).

We postulate a correlation exists between interruptions and social stressors (Fig. 1). Interruptions and social stressors are different but have one similar important outcome: they both induce attention failure. Interruptions induce attention failure by increasing attention demands that are limited and social stressors induce attention failure by inducing attention-demanding thoughts about the social relationship with supervisors. Thus the model postulates both interruptions and social stressors directly influence attention failure at work. The current study tests attention failure as the critical link between workflow interruptions and supervisor-related social stressors at work and rumination after work.

Subjects and Methods

Study setting

The present study was part of the larger and overarching project, Work & Cooperation in Anaesthesia and Surgery and Their Impact on Performance as well as on Health & Well-Being, which was conducted at a large Swiss university hospital. The aim of this larger project was to describe work conditions and well-being in surgery personnel and examine relationships to performance indicators not reported in this study. The goal was to derive guidance for work redesign and organizational restructuring of the surgery units to improve health and well-being of surgery personnel.

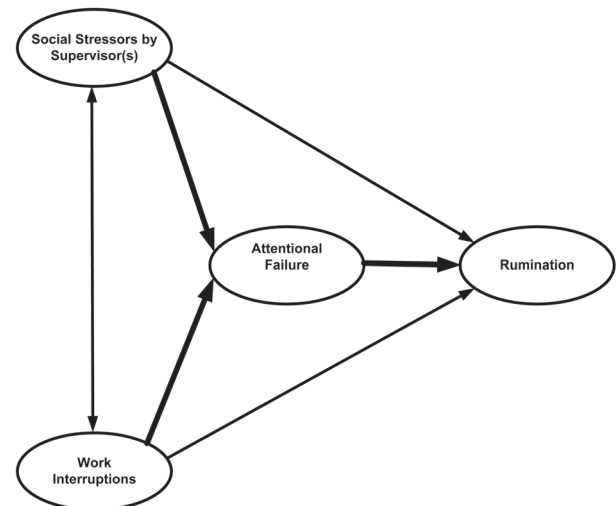


Fig. 1. Model of work-related attentional failure (WCFS attention) as mediator of the effects of interruptions and social stressors on rumination.

The project goals and the design of the project were first presented to the hospital directors. Next, a Master degree study assistant distributed the questionnaires to all surgery personnel at the hospital and responded to questions. The questionnaires included postage-paid envelopes and could be sent anonymously to the study assistant. After two weeks, the same study assistant sent a written reminder to the surgery team.

Study sample

Before the questionnaires were distributed, potential participants gave their consent. In 2010, questionnaires were addressed to all surgery personnel at the hospital, including 335 employees (theatre nurses, anaesthetists, and surgeons). The response rate was 57.9% from 194 questionnaires returned. There were 51.5% female participants. Age was assessed in three categories –13.2% of participants were 30 yr old or younger, 73.2% ranged in age between 31 and 50 yr, and 13.1% were older than 50 yr. The percentage of working time spent in the surgery theatre ranged from 75 to 84%. Participants were anaesthetists (9.5%), anaesthesia nurses (18.5%), surgeons (19.6%), assistant surgeons (8.3%), surgical nurses (31.6%), nurses (10.1%), and technicians (2.4%). A total of 75.4% percent of the sample worked full-time, 14.3% worked between 80% of full-time and full-time, 6, 7% worked between 50% and 79% of full-time, and 3.6% worked less than 50% of full-time.

The study was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration

of Helsinki) and was in accordance to the supervisors of the university hospital.

Measures

Assessment of workflow interruptions

Workflow interruptions were assessed with the Instrument for Stress-Oriented Task Analysis (ISTA)¹⁰. The scale consisted of four self-report items with a 5-point Likert format (1=*very rarely/never*, 2=*rarely*, 3=*occasionally*, 4=*often*, 5=*very often*). The items used were “On average, how often are you interrupted by your supervisor during the course of your work activity? (e.g., by questions)”, “How often are you interrupted by other colleagues during the course of your work activity?”, “Do you often have to interrupt your current work activity because something important comes up?”, and “How often does it occur that you must work at several tasks simultaneously, and must jump back and forth between these tasks?” Given the similar wording in the first two items, we allowed for correlated errors of measurement between these two items that were used as indicators in structural equation modelling¹¹. The internal consistency of the scale was satisfactory (Cronbach’s alpha=0.81).

Assessment of attention failure

Attention failure was assessed with the subscale on attention failure from the Workplace Cognitive Failure Scale (WCFS)¹². The scale consisted of four self-report items with a 5-point Likert format (1=*very rarely/never*, 2=*rarely*, 3=*occasionally*, 4=*often*, 5=*very often*). The four items used in the study were (How often you...) “Do not fully listen to instruction?”, “Day-dream when you ought to be listening to somebody?”, “Do not focus your full attention on work activities?”, and “Are easily distracted by co-workers?” A fifth item of the original subscale was precluded from study. The item “Fail to notice postings or notices on the facilities bulletin board (s) or e-mail system” was not included in the analysis because in another study including surgery personnel it was rated unfit for important aspects of surgery work. The internal consistency of the scale was satisfactory (Cronbach’s alpha=0.81).

Assessment of social stressors at work

Work-related social stressors were assessed with the scale by Frese and Zapf¹³. The scale consisted of three items with a 5-point Likert format referring to social climate at work and conflicts with supervisors (1=*strongly agree*, 2=*agree*, 3=*undecided*, 4=*disagree*, 5=*strongly disagree*). The items used in the study were “My supervi-

sor always assigns the pleasant tasks to particular people”, “When an error occurs, the supervisor always blames us but never himself”, and “Around here, one gets reprimanded even for little things”. The item “My supervisor pushes all the time” was not included in analysis because in a test trial, some participants judged the item to have a rather positive meaning. The internal consistency of the scale was satisfactory (Cronbach’s alpha=0.84).

Assessment of rumination after work

Rumination was assessed with a self-report scale from Mohr and colleagues¹⁴. The survey consisted of three items scaled with a 7-point Likert format (1=*agree strongly*, 2=*agree moderately*, 3=*agree slightly*, 4=*undecided*, 5=*disagree slightly*, 6=*disagree moderately*, 7=*disagree strongly*). The survey asked the question, “How much do the following statements apply to you?” and used three items to gather measurements: “I have difficulty relaxing after work”, “Even at home I often think of my problems at work”, and “Even in my vacations I think about my problems at work”. An advantage of the rumination scale is that standardization values are available¹⁵. Thus, the mean values from this study can be directly compared with those provided by other samples. The internal consistency of the scale was satisfactory (Cronbach’s alpha=0.87).

Statistical analysis

Structural equation modelling was used to model the latent path structure of the hypothesised model. Items of questionnaire instruments were used as indicators of latent variables. A scale-free least square method, which is appropriate for relatively small data set with non-normal distributions, was used for estimation. The indirect path hypotheses were tested through AMOS 18.0, which included a bootstrap test of the indirect effects. Preacher and Hayes proposed bootstrapping because it is more robust in small samples than other approaches¹⁶. Bootstrapping, a non-parametric resampling procedure, is an additional method advocated for testing indirect effects that does not impose the assumption of the normality of the sampling distribution. Bootstrapping is a computationally intensive method that involves repeated sampling from the data set and estimating the indirect effect on each resampled data set. By repeating this process very often (we scheduled 10,000 times), an empirical approximation of the sampling distribution of the indirect (mediation) path is built and used to construct confidence intervals for the indirect effect.

A test of a hypothesised structural equation model should also include a test of a plausible alternative model. An

Table 1. Descriptive statistics and internal consistencies (Cronbach's alpha) for all study variables

| | Items | Range | M | SD | Cronbach's alpha |
|---|-------|-------|------|------|------------------|
| (1) Age (1=below 30 yr, 2=31–50 yr, 3=older than 50 yr) | 1 | 1–3 | 1.19 | 2.00 | n.a. |
| (2) Sex (1=86 women, 2=82 men) | 1 | 1, 2 | n.a. | n.a. | n.a. |
| (3) Work interruptions | 4 | 1–5 | 2.65 | 0.92 | 0.81 |
| (4) Social stressors from supervisor(s) | 3 | 1–5 | 2.04 | 0.92 | 0.84 |
| (5) Attention failure | 4 | 1–5 | 1.95 | 0.57 | 0.81 |
| (6) Rumination | 3 | 1–5 | 2.87 | 1.34 | 0.87 |

n.a.: not applicable

Table 2. Intercorrelations of all study variables

| | (1) | (2) | (3) | (4) | (5) |
|---|-------|--------|---------|---------|--------|
| (1) Age | | | | | |
| (2) Sex (1=86 women, 2=82 men) | 0.17* | | | | |
| (3) Work interruptions | 0.07 | –0.09 | | | |
| (4) Social stressors from supervisor(s) | –0.09 | –0.16* | 0.23** | | |
| (5) Attention failure | –0.11 | –0.05* | 0.34*** | 0.25*** | |
| (6) Rumination | 0.08 | 0.16* | 0.12 | 0.17* | 0.24** |

N=168. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ one-tailed

alternative approach is the person model, which postulates the opposite direction of causality, namely that attention failure is a stable individual characteristic of action regulation. The assumption in the person model is that attention failure induces workflow interruptions; that is, interruptions at work are self-induced by being inattentive and social conflicts with supervisors increase because individuals are criticized for being inattentive. Hence, interruptions and social stressors at work might then mediate the effects of attention failure on rumination. Because of the directional hypothesis, the 5% alpha level was one-tailed¹⁷.

Results

Table 1 shows the mean values of rumination and other study variables. For rumination, normative data exist so that mean levels can be compared with other samples. Results showed the sum value of the rumination scale ($M=8.6$, $SD=4.0$) is lower than the level in a representative group of 1,389 hospital employees of comparable age between 30 and 40 yr ($M=10.3$, $SD=4.6$)¹⁵. The mean level of workflow interruptions was 2.7 on the 5-point scale ($SD=0.9$) and social stressors from supervisors were low on average ($M=2.0$, $SD=0.9$). The mean level of attention failure was also low ($M=1.9$, $SD=0.6$).

Table 2 shows correlations between all study variables. In line with the hypotheses, social stressors with supervisors, workflow interruptions, attention failure, and

rumination were positively and significantly related. (Only the correlation between rumination and workflow interruptions was marginally significant, $p=0.06$).

Test of indirect effects in structural equation analyses

The hypothesised mediation model represented the empirical data very well ($\chi^2(70)=47.25$, $\chi^2/df=0.68$, $p=0.98$). The standardized root mean square residual (SRMR) is an absolute indicator of model fit and was 0.05. A value of 0.05 or below is considered a good fit¹⁸) (zero indicates perfect fit). As shown in Fig. 2, significant direct paths were observed from workflow interruptions to attention failure ($\beta=0.36$, $p < 0.01$), from supervisor-induced social stressors to attention failure ($\beta=0.21$, $p < 0.05$) and from attention failure to rumination ($\beta=0.24$, $p < 0.05$). The test of indirect mediation effects using a bootstrapping approach within AMOS resulted in a significant indirect path from workflow interruptions → attention failure → rumination ($\beta=0.07$, CI 90=0.013 to 0.138) and a significant indirect path from supervisor-induced social stressors → attention failure → rumination ($\beta=0.051$, CI 90=0.007 to 0.108). The hypothesised model of indirect effect represented the empirical data well; however, alternative models may be equally good or even better. In the alternative person model the joint indirect path from attention failure via workflow interruptions and supervisor-induced social stressors to rumination was not significant ($\beta=0.01$, CI 90=–0.051 to 0.092).

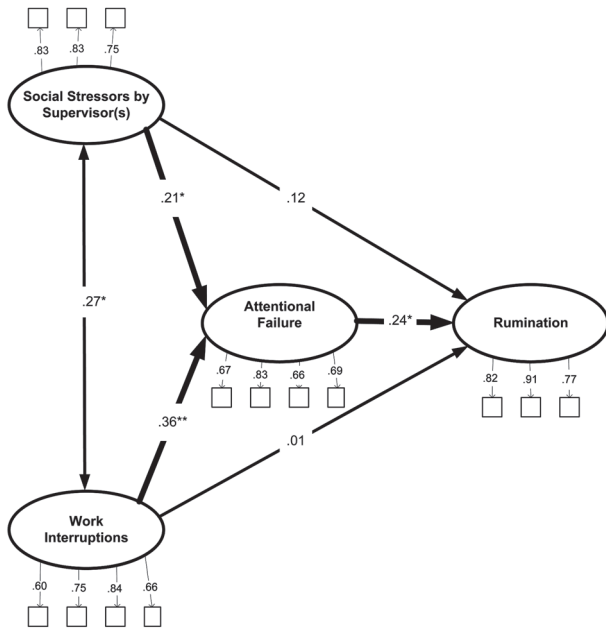


Fig. 2. Structural equation model-based results.

Discussion

Surgery personnel need competencies beyond skill, education, and expertise that can be described as non-technical skills divided into interpersonal skills and cognitive skills¹⁹. Interpersonal skills comprise sufficient, early, and clear communication, taking leadership, teamwork skills, adequate briefing, joint planning, sufficient time spent in team preparation, adequate resource management, seeking advice from other team members and giving feedback to them, actively coping with time pressure, one’s own stress reactions and those of other team members, and taking short breaks to reduce fatigue and adequate workload distribution. Cognitive skills include high situation awareness, early anticipation of problems, continuous risk assessment, taking perspectives in decision making, good adaptive strategies that increase flexibility¹⁹. The results of this study pertaining to interpersonal skills show that social stressors occurring from supervisor interaction are due to lack of leadership skills and poorly developed interpersonal skills that are likely to impede subordinate’s attention to the primary task at hand. Good cognitive skills of leaders may also contribute to avoiding unnecessary interruptions. Good cognitive skills that include adequate situation awareness and anticipation of problems help to avoid misunderstanding and problems and thereby reduce unnecessary workflow interruptions². On the one hand, the low average levels of attention failure found in this

study may reflect good competencies in attention regulation among surgery personnel. On the other hand, results show that attention failure is likely a consequence of social stressors from supervisors and supervisor-induced workflow interruptions. Thus, an intervention that addresses communication and cooperation on the team level may be fruitful even with skilled surgery personnel. Team communication and cooperation help to shape a shared mental model of the task. A good shared mental model was shown to contribute to increased necessary workflow interruptions and to fewer unnecessary interruptions²). Communication has been listed among the three most frequent causes of errors for many types of sentinel events in health care²⁰. Both social stressors and unnecessary interruptions can be reduced when information and communication procedures are improved by team training²¹). Team training should improve backup behaviour, closed-loop communication and other procedures of safe communication that are part of crew resource management (CRM) training that works well in aviation and health care²²). In addition, work and task redesign that results in the reduction of unnecessary workflow interruptions decreases attention demands by improving the ease of information availability (e.g. documentation of the steps of a surgical procedure, necessary medical devices for surgery, and use of the WHO surgical safety checklist²³). Another aim in task redesign should be to introduce mandatory attention checks that have to be done before proceeding with the task (e.g. pre-surgical verification of work flow). Task redesign should also comprise use of memory aid (e.g., electronic patient data available) and use of clear signals and distinctive choice alternatives (e.g., use of different plugs and sockets for different functions, use of distinctive labels for different medications, and distinctive labels for surgical accessories including loops, sutures, dressings, implants, etc.)²⁴.

Results showed that rumination in surgery personnel was lower than in a representative group of 1,389 hospital employees of comparable age¹⁵). The reason for this might be that after surgery has started, surgery personnel do not have much control on how and when and with whom they do the task⁶). Many degrees of freedom and uncompleted tasks often trigger rumination after work, thus, having relatively little autonomy might correspond to less rumination. In addition, surgery personnel also have few unfinished tasks and goals, because they always finish the job before leaving work⁶). Having completed tasks may also reduce rumination.

CRM and task redesign can be expected to reduce work-related rumination during leisure time that impedes

recovery because this study showed work conditions are indirectly linked to rumination, while the alternative person model showed no indirect link between attention failure via work conditions and rumination. Thus, CRM and task redesign can be expected to maintain and improve employee health and patient safety²²).

Limitations

Study limitations include the cross-sectional design and use of self-report questionnaires. Thus, further studies should be longitudinal and also include task observation^{25, 26}. Individual differences in personality traits that are related to attention failure should be controlled for as potential confounders. For instance, further studies should control for individual differences in conscientiousness²⁷. Furthermore, this study was conducted in a large Swiss university hospital. Thus, the results found cannot be generalized and future studies should provide further empirical evidence for this pattern in other hospitals.

Conclusion

Employee health is related to patient safety²⁸). Accordingly, employee education, work stressors, hours of work, and working conditions could also be related to patient safety. Attention failure is common in the operating room and may result in errors, as operation personnel with lower hierarchy often experience social stressors and report that they are afraid to speak up about errors²⁹). It is known that nurses are afraid to challenge the surgeon, even in the face of observed errors, as nurses are often bullied by surgeons^{30, 31}). All of this may jeopardize patient safety. The training of surgeons to do a preoperative briefing has resulted in preventing errors and improving patient safety because the operating personal was encouraged to speak up when errors occurred²⁹). Thus, attention failure seems to be a promising intervening cognitive process in cognitive-oriented research on workflow interruptions¹), leadership²), and employee health and patient safety in surgery teams²⁷). CRM and task redesign may help to make hospitals safer places for surgery personnel and patients²).

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