
Broadening the occupational scope by combining survey analyses, field experiments, and cortisol reactivity.

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Summary

Why?
Work-related learning has become imperative in a dynamic and rapidly evolving professional environment. A gradual shift from ‘hand to head’ has irreversibly changed contemporary work, and increasingly requires various forms of learning and memory. Pressure and the obligation to learn, however, may also cause stress, and as a consequence learning and stress at work have become increasingly interwoven. The scientific literature, however, is ambivalent on the exact relationship between both. That is, while some claim that occupational learning buffers stress, others convincingly describe the detrimental effects of acute work-related stress on learning and memory. Yet others put forward both facilitating and impairing influences of stress on learning, with mechanisms dependent upon stress hormones regulation. In effect, there is a need for more knowledge to substantiate claims whether “Learning reduces stress” and/or “Stress inhibits learning”.

How?
Various methodological tools are used to operationalize various pieces of the relationship between occupational learning and stress. A methodological pluralism is established by combining (longitudinal) survey analyses, field experiments, and tools adapted from cognitive psychology and neuropsychology that zeroed in on the requirements of specific occupational settings. This combination enables the introduction of observable behavioural outcomes, the investigation of various types of learning and memory, and the distinction between acute and chronic stress. Furthermore, in an attempt to reconcile emergentism and epiphenomena, a pragmatic reductionism is applied with assessments of salivary cortisol as a non-invasive biomarker. More specifically, the research consists of the following studies ( chapters 2 to 7):

Chapter 2 starts from the ‘match’, or congruence, between specific job characteristics and examined its effect upon learning and strain. A longitudinal survey study explored both the learning and the strain hypotheses of the Job Demands-Control (JDC) model in a multi-profession sample (N = 994) of the Dutch working population. In line with previous research, results showed that the basic JDC predictions (i.e., main and additive effects) hold to some extent, but that the more complex assumptions (i.e., multiplicative and dynamic time effects) are far more difficult to detect. Above all, in the current sample the relationship between learning and strain proved to be incompatible with the JDC assumptions.
Chapter 3 empirically maps the learning potential of the workplace by adopting a learner-centered stance on the question: “Wherefrom do employees learn at the workplace?” First, the psychometric properties of a newly developed generic scale for workplace learning opportunities were determined ($N = 1,016$). Next, the scale was applied upon a follow-up cohort of Dutch employees ($N = 772$). Results showed that a taxonomy containing six learning forms (i.e., learning-related task execution, colleagues, supervisors, reflection, exploration, and organizational facilitation) fitted the data best and that, in the present heterogeneous sample, the execution of tasks related to learning best reduced stress and led to most self-perceived learning.

Chapter 4 exploits a window of opportunity during a reality-based handgun shooting workshop that committed police officers and military personnel to perform under increased pressure (i.e., the risk of being shot at with marker ammunition). A between-subjects field experiment ($N = 36$) assessed anticipated distress, subjective stress, and the secretion of cortisol stress hormones. The observed stress was then put in relation with a self-perceived learning outcome and with factual working memory performance. Results showed that the risk of being shot at caused more anticipatory distress, subjective stress, and increasingly triggered cortisol secretion. Intriguingly, while stress endurance deteriorated working memory performance, participants in the high-realism group simultaneously self-perceivably learned more.

Chapter 5 examines the effects of a highly-intense prisoner of war exercise in the course of a Special Forces (SF) selection procedure. A between-subjects experiment ($N = 27$) was organized to test a pre-designed SF selection tool and to perform cognitive reliability analyses under intense stress. Subjective stress, cortisol reactivity, as well as post-stress effects on three important memory processes (i.e., short-term memory, working memory, and declarative memory) were investigated. Results demonstrated the effectiveness of the selection tool and showed that exposure to high-intensity stress led to increased subjective stress and to robust cortisol increases. The experienced stress levels impaired SF candidates’ cognitive performance significantly.

Chapter 6 extends the previous study both in content (i.e., by linking immediate and prolonged stress effects) and in methodological sophistication. Although both are innovative, the in-depth exploration of the path processes between stress and declarative memory was the crux of the current study. Two illustrative multiple mediation analyses ($N = 22$), involving distribution-free asymptotic and resampling strategies, demonstrated that cortisol secretion in itself, rather than subjective strain or the experimental treatment, affects learning and memory performance. The exploration of such micro-level mechanisms can be occupationally important and is well in line with endeavors in neuroergonomics.
Chapter 7 explores the impact of excessive arousal on a multiple-trial path learning task. In a controlled field experiment (N = 61), parachuting stress was assessed subjectively and through cortisol as a biomarker. The occupationally relevant learning task assessed post-stress learning capacity and zeroed in on the effect of task complexity. Following parachuting, subjective stress levels and salivary cortisol reactivity differed significantly between groups. While overall path learning performance was impaired significantly after the jump, examination of the learning curves showed similar learning at onset of the trials that bifurcated increasingly as the task gained complexity, thus suggesting a moderating effect of task complexity.

Conclusions.
The final chapter integrates and combines the research’s most important findings. This led to seven conclusions. A first, obvious conclusion is that the precise relationships between stress and learning are fundamentally influenced by the type of learning and/or stress under investigation. Consequently, the second conclusion is that a correct exemplification of the relationship is a slippery slope and, when queried about it, one can only reply with a nuanced: “It depends”. A third conclusion is that the effect of acute naturalistic stress depends to a large extent upon the complexity of the learning and memory task, with the more complex tasks becoming increasingly degraded. Fourth, employees may learn from context-relevant stress, but the attentional process is costly and depletes the cognitive capacities required for secondary cognitive functions. An important finding for cognitive assessments in high-reliability professions is therefore that people may simultaneously feel that they learn more out of context-relevant stress, while their factual learning and memory performance decreases. A fifth conclusion is that there are several workplace learning opportunities to exploit, but that particularly the daily performance of learning-relevant tasks seems to reduce stress and to lead to a feeling of more learning. In-depth analysis on a micro-level further revealed that memory performance under intense stress is mediated by cortisol secretion, rather than by subjective stress or by undergoing a stress treatment. A seventh and final conclusion is that there is reason to assume that the current broadened methodological approach – by definition marked by diversity – simultaneously bears the germs of a cross-methodological convergence that has the potential to create intriguing opportunities for future research.