



# Not Necessarily Relaxed: How Work Interruptions Affect Users' Perception of Stress in Remote Work Situations

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**Abstract.** Remote work was ubiquitous during the COVID-19 pandemic to minimize the spread of the virus. However, working away from the actual workplace also presented new challenges. In a study conducted in 2020, a research team from Switzerland examined the effects of acute work stress in a group office setting. Part of the study included examining the effects of work interruptions. We took this as an opportunity to conduct an exploratory study of the subjective perception of work interruptions during remote work regarding stress. Using eye-tracking technology, we investigated the visual attention of subjects within a laboratory experiment while they were repeatedly interrupted while performing a work task. We then processed the experiences in qualitative interviews to reconstruct the social reality of the effects of remote work interruptions. According to our results, we assume that the more personal standards cannot be met in case of interruptions, the stronger the subjective stress experience. This should be further explored in quantitative studies. We were able to draw up further findings in the form of recommendations to managers. For example, unnecessary interruptions should be minimized, or better yet, eliminated. Alternatively, necessary work interruptions should be directed to employees who appear to have more capacity to respect and protect the concentration of busy employees. We hope that further research will follow up on this topic in the future. In this way, robust approaches that promote the mental health of employees in the home office can be formulated to avoid unnecessary stressors, and contribute to effectiveness, efficiency, and well-being.

**Keywords:** Eye-Tracking · Work Stress · Remote Work

## 1 Introduction

### 1.1 Current Situation

Remote working became an integral part of everyday working life in Germany in 2020, 2021 and 2022. After the German Infectious Diseases Protection Act came

into force in March 2020, which primarily served to contain the consequences of the COVID-19 pandemic, 27% of all employees nationwide were already working mostly from home according to a representative survey of employees in April 2020 [3]. Despite sometimes considerable adverse circumstances such as technical incidents and family care problems, 74% of all respondents were either satisfied or even very satisfied with the new, flexible working conditions [4]. Due to increasing digitization and new work approaches, remote work is a phenomenon that deserves special attention. In particular, the effects on employees whose daily work routine have changed in recent years or will change in the future should be researched. A field of research, generated and driven by the digital transformation, gives rise to a closer look in many respects.

## 1.2 Related Work

In a previous stress study which was conducted in Switzerland, a research team investigated the effects of acute work stress in open-plan offices [6]. They evaluated the psychobiological stress reactions, which were measured by changes in salivary cortisol and salivary alpha-amylase as well as heart rate, and the cognitive assessment of the psychosocial stress test. For this research, the Trier Social Stress Test (TSST) according to Kirschbaum et al. from 1993 [7] was used. They were able to show that the group of participants who, in addition to psychosocial stress, were additionally interrupted in their tasks, showed a higher increase in cortisol levels than the group without induced work interruptions. Work interruptions are among the most important stressors in the workplace [13]. Surprisingly, participants in the group with work interruptions rated themselves calmer and in better mood, in contradiction to increased psychobiological stress responses. Therefore, there was no correlation between increased physiological stress and psychological stress perception [6].

That this aspect need not be surprising at all has already been established in an earlier study from 2012 that examined over 358 TSST and TSST-related studies published in PubMed between 1993 and August 2011 [1]. These were systematically reviewed for the relationship between participants' physiological responsiveness to acute stress and subjective reports of affective experience. The researchers reasoned that TSST has been repeatedly shown to reliably stimulate the hypothalamic-pituitary-adrenocortical (HPA) axis and trigger cardiovascular responses, but too little attention has been paid to subjective feelings of stress at this time. Moreover, cognitive, and emotional processes are considered to be the main pathways in triggering the arousal of negative physiological states and thus causing long-term pathological health conditions.

Specifically, Campbell and Ehlert's study [1] examined stress-induced biological and emotional stress responses for a correlation or predictive relationship. Three inclusion criteria were considered: (1) exposure to the standard TSST or slightly modified versions, (2) at least one assessment of subjective emotional stress experience before, during, or after the TSST, (3) reported correlations between acute physiological as well as emotional stress measures. Attention to these aspects led to a cluster of 49 studies, which were then examined in more

detail. It was concluded that significant correlations between cortisol responses and perceived emotional stress variables were found in only about 25% of the studies [1].

Furthermore, the “Transactional Stress Model” of Lazarus and Folkman from 1984 provides information about the development of subjective stress perception. According to this model, stress is caused by a stimulus that hits a person from the environment. This is only classified as stress if the individual considers it to be dangerous and if there is also a lack of resources (e.g., lack of time). However, with the help of a suitable coping strategy, an initially stressful situation can also be re-evaluated under the presence of certain aspects [9]. In addition, Ursin and Eriksen emphasize in their cognitive activation theory from 2004 that the subjective experience of stress results from the evaluation of a perceived stimulus as harmful or threatening [12].

### 1.3 Research Objective

In times of increasing remote work, this study aims to investigate the extent to which digital work interruptions are perceived in terms of subjective stress. Due to the patchy state of studies on this topic, the question arises as to how this form of work stressors affects people and why an interruption is classified as stress.

The research thus aims to reconstruct the perception of work interruptions regarding the perception of stress during remote work and to derive a hypothesis from this, which should be examined in more detail in further studies. This should help to further advance stress research with reference to digital work.

## 2 Methodology

In 2020, Kerr et. al. studied the effects of acute work stress in a group office environment and evaluated the psychobiological stress responses of subjects during presence work. In an experiment, a work situation was created that was as real as possible in an open-plan office. Stress reactivity was then measured via interviews and saliva tests [6]. Furthermore, since the literature so far has mostly provided quantitative research results regarding work interruptions and remote work, the research question in this paper was approached exploratively and qualitatively.

The methodology consisted of two parts: First, we induced a classic remote work situation using a laboratory experiment. We combined this with an eye-tracking study to record the visual attention of the subjects and to support our qualitative research with the results. We then used qualitative interviews to reconstruct the social reality of digital working. Specifically with the experiment, we ensured that the following interviews could address the experiences and perceptions of what was experienced. We decided against research based purely on qualitative interviews. So we avoid the possibility that people away from their remote workplace and outside their working hours would assess the

impact of work interruptions and accompanying stressors differently. The laboratory experiment including eye-tracking was first conducted with all subjects. Immediately after the experiment, the interviews were conducted to be able to directly address the still fresh experiences.

## 2.1 Laboratory Experiment and Eye-Tracking

First, six subjects were invited to participate in the experiment. In order not to falsify the results of the interviews, no one was told in advance what the actual goal of the research experiment was and that the interview would be conducted afterwards. The research was disguised in advance as an eye-tracking study, the content was the analysis of an English text.

**Experiment and Work Situation.** During the laboratory experiment all test persons received the same task by mail: They should prepare a pitch for a presentation on Information Security Awareness (ISA). This should take place digitally via Zoom and be presented to a local institute. The background is that employees of the institute are to be trained on ISA. The presentation is to be supported with the help of a paper on the topic of ISA training via virtual reality [5]. This served as essential source material so that subjects did not have to search the Internet for information themselves. Specifically, the subjects were asked to summarize and present the main statements and the hard facts of the paper on three to four slides. To do this, they did not have to read the entire paper, but rather compile the key findings in the results section. All subjects had 30 min. Afterwards, the results were to be presented via Zoom. The task was not intended to be too difficult, but challenging, so that the subjects were busy for this time. The experiment took place on the premises of the University of Applied Sciences Würzburg-Schweinfurt in the institute building of the Faculty of Computer Science and Business Information Systems. Here, an equal laboratory environment could be provided for all test persons. As usual for a remote working situation, the main working tools were a notebook and a smartphone. Additionally, a DIN-A4 letter pad and a ballpoint pen for handwritten notes were provided (see. Fig. 1). During the experiment, the participants were exposed to the usual influences of a remote work situation. These were interruptions by short phone calls and small work tasks to be completed in between. During the interruptions, subjects were told that a creative presentation was to be made by the presenter in the upcoming Zoom meeting. For this, the participants were to compose and send mails with personal information for the alleged moderator.

**Eye-Tracking.** During the performance of the work task, all subjects wore eye-tracking glasses. The model used was the Glasses 2 from the manufacturer Tobii. The eye-tracking technology was used to clarify further questions in addition to the findings from the interviews. While in the interviews purely the subjective sensations of the participants could be discussed, eye-tracking allowed to



**Fig. 1.** Test Setup: Notebook, Tobii Glasses 2 and Writing Materials

precisely document the visual attention during the experiment. Based on this, a better understanding of the individuals' approach can be formed. Attention before, during, and after the interruptions could be recorded, thus underpinning and enriching findings from the interviews. Two aspects could be illuminated with the help of eye-tracking:

- Impairment of visual attention during interruptions
- Influencing the continuation of the actual main task

## 2.2 Qualitative Interviews

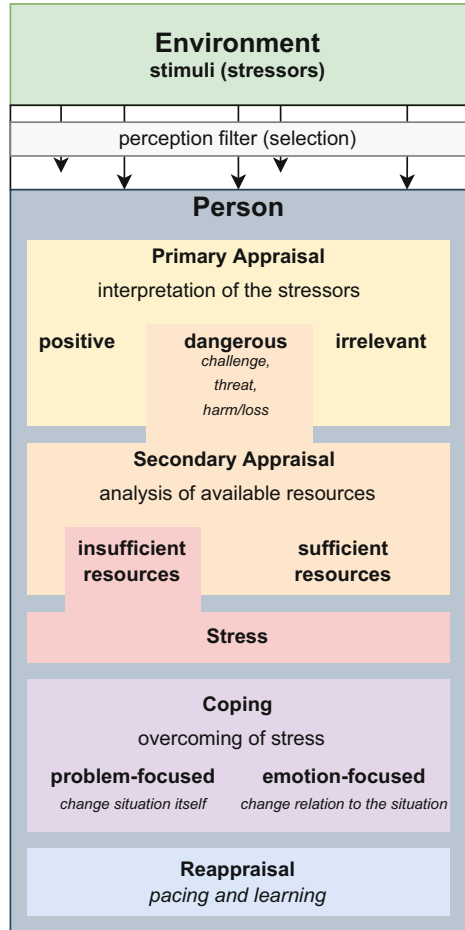
After 30 min working on their main task, the participants received an e-mail with an invitation to a Zoom meeting in which they were to dial in. Once they were in the meeting, the eye-tracking recording was stopped and backed up. Subjects then were allowed to remove their glasses. To avoid confusion, the participants were now informed that there would be no pitch, but that an interview would be conducted about their experiences within the experiment as well as about their everyday digital professional life. After the participants agreed, the interview was recorded, and the processing of the interview guide was carried out. Through the interviews the subjective feelings of the disruptions related to the actual task objective were discussed. The interview guide was constructed using the transactional stress model (see Fig. 2) of Lazarus and Folkman from 1984 [9]. This provided the basis for elaborating the perception of the situation in terms

of the subjective feeling of stress and the resulting experiences. The questions of the interview guide were derived from the stress model. The interview was conducted as a semi-structured interview. This ensured that subjects could talk more about the things that stressed them the most during the experiment. The interview guide was structured according to Misoch’s findings [10].

### 2.3 Evaluation of Data

**Qualitative Interviews.** To analyze the interviews, we first transcribed the recordings so that the participants’ statements were available in textual form. We then drew on the inductive category formation approach according to Kuckartz and Rädiker [8]. Specifically, we used the concept of category formation via focused summary. In doing so, we divided a .docx file into three columns. In the left column, we inserted the original transcript. In the middle column, we summarized the statements of the participants to form superordinate categories and associated subcategories in the right column. By means of assignment, we were then able to assign further text passages either to categories or subcategories or to merge them.

**Eye-Tracking.** The recordings, which were made during the experiment using eye-tracking, were evaluated by visual observation. Usually, heatmaps or gaze plots are suitable for the representation of visual attention. However, these forms of visualization were not suitable for our use case because the observation involved very dynamic work, rather than simply viewing a static image or website. In Sect. 2.1. we already mentioned the main research content for which we used eye-tracking. During the visual observation of the recordings, we observed the sections in which the subjects were interrupted in their work, as well as the time



**Fig. 2.** Own Presentation of Lazarus’ and Folkmans Stress Model [9]

as well as the time

before and after the interruptions. We summarized in a table which participant was working on what and how the interruptions affected the visual attention and the actual processing of the main task.

### 3 Results and Discussion

In the following, we first state the hypothesis H and justify it based on our findings from the eye-tracking recordings and the interviews. Subsequently, we address further effects of interruptions on individuals and present possible recommendations R1 and R2 for managers and decision makers.

#### 3.1 Hypothesis and Justifications

As a result of our work, after analyzing the data, we were able to formulate and justify the following hypothesis H.

**H: The more personal standards cannot be met in the event of an interruption, the stronger the subjective stress experience is.**

Through the interviews we learned that the independent and autonomous processing of a task is always determined by the individuals' own standards or goals - especially in remote work situations.

These standards are:

- Quality
- Strategy/structure or planning/approach
- Self-actualization or perfectionism
- Focus
- Safety mechanisms

Depending on the severity of the interruption, the adherence to these personal standards is disturbed. The subjective stress experience then does not occur directly through the interruption, but through the consequences regarding the non-compliance with one's own standards. For example, the quality can be curbed by the resulting time pressure. Especially if a work result is expected at a certain point in time with a certain quality (e.g., a presentation to a committee), the lack of time becomes a threat to this goal. Consequently, due to the interruption and possibly additional tasks, the own quality standard of the main task must be lowered. The processing is then no longer carried out with the same accuracy.

In addition, the disruption can mean that the own strategy or approach to a task can no longer be adhered to. Remote work is characterized by employees organizing themselves. Therefore, it is necessary to bring structure into the daily work routine. This was also reported by the study participants. Often, there are only framework conditions that must be adhered to. These include, for example, the specific work tasks and goals to be achieved, as well as deadlines for

completion. The time at which the work is to be completed, as well as tools or, if necessary, people who can give tips on how to complete the work, are often freely selectable. Once the workday has been planned and deadlines have been set, there are time frames for the independent processing of the work content. However, if these cannot be used, or at least not optimally, due to interruptions and additional tasks, rescheduling is necessary. This is in contradiction to the original planning. The feeling that the specially planned structure for the workday has been partially or even completely wasted is classified as a subjective feeling of stress. It is similar with the perfectionism of a person with its work. In addition to the expected work result, employees also want to realize themselves in their work and therefore also have their own demand for a perfect result of their work. If this wish cannot be fulfilled due to interruptions and the resulting lack of time, psychological stress also results.

In addition, there is the personal focus. People want to work effectively and efficiently. However, this is only possible with the right focus - especially in the home office. It is therefore important to concentrate on different aspects of a task for a certain period and to focus one's attention only on these aspects. We put this to the test in our experiment. The course of the subjects' focus became comprehensible by recording their visual attention via eye-tracking. For example, we were able to observe the extent to which interruptions interfered with the processing of the task. It became clear that the more interruptions the participants had, the more difficult it was for them to find their way back into the task. This could be seen in the fact that text sections had to be read several times after an interruption. In some cases, the subjects also changed subtasks and decided to work on a different subtask after they had been interrupted. If they were in the process of summarizing a text section in handwritten bullet points shortly before the interruption, they did not continue with it after the interruption and opened, for example, a program for creating the slides. This again contradicts the personal structuring of a task, so that subtasks are processed one after the other. This was described as an enormous burden, since a great deal of concentration was required to refind the task. A lot of mental resources had to be expended to continue with the main task in a focused manner after the interruptions.

Finally, the personal standards include their own safety mechanisms, which were neglected by the test subjects. These were trained by the test persons to avoid that not only the quality suffers due to forgetting or due to an error, but also that rework has to be done, which, depending on the extent, also leads to an increased feeling of stress afterwards. According to the participants, the mechanisms were triggered by carelessness, for example by reading the text carelessly. The reason was again time pressure. Thus, the personal safeguard against a later report by the committee in the supposedly upcoming meeting was no longer given, which created a feeling of fear and sometimes even panic in some subjects. In the interview, the subjects described the noncompliance with these safety mechanisms as a subjective feeling of stress.

### 3.2 Further Findings, Coping Strategies and Recommendations

Through the interviews, we were not only able to address the experiences of the work situation in the laboratory experiment. We also gained further insights regarding what happens in everyday work and about coping strategies for the right handling of stressful situations.

**Frequent Interruptions and Coping.** Participants also reported remote work experiences outside of the experiment. Thus, we could assume that frequent interruptions are more likely to use coping strategies that can be classified as problem-oriented coping according to the transactional stress model of Lazarus and Folkman [9]. According to their own statements, participants were aware of the interruptions each time and would work overtime on the same or another day to cope with the stress. Working on Saturdays was also reported as a possible solution, even if no contractual agreement existed. Alternatively, it was also reported that interruptions are simply no longer noticed after a certain point. This would occur if either the time required for the actual work was no longer sufficient and work content had to be completed at the same time or if effectiveness and efficiency were at risk. In such cases, the main task is given a higher priority and interruptions are rejected or not noticed. In addition, block appointments are used, which are entered in the calendar for superiors and colleagues. The business phone and messenger on the notebook are then also muted to achieve maximum isolation and avoid interruptions.

**Recommendations for Stress Reduction.** At the end of the interviews, all subjects were asked what advice they would give to a supervisor or manager after their experiences and the objective observation and discussion of their own job. Essentially, two main recommendations for avoiding stress emerged from the statements:

**R1: Minimize or eliminate unnecessary interruptions through prioritization to ensure completion of major tasks at the employee's own discretion and to their own standards.**

**R2: Prioritize necessary interruptions/additional tasks, if possible, to those employees who have less work to do, to respect the concentrated work of busy employees.**

Both require preliminary work by the manager or colleagues in the first instance. For example, the first step should be to check the calendar of the respective employee and, if necessary, ask about the time capacity. If a project has gone awry and a lot of time is needed by the people involved to work it through, their concentration should be respected. It would do the company, the manager, and the employee good to direct a potential interruption, if necessary, to the person who is currently available.

It is undisputed that even remote working cannot be completely uninterrupted without further measures. However, we assume that compliance with the above recommendations will already contribute to minimizing the employees' subjective sense of stress.

## 4 Limitations

This research examined, in a purely exploratory and qualitative manner, the effects of work interruptions in digital work and perceptions in terms of subjectively perceived stress. We used Lazarus and Folkman’s transactional stress model (see Fig. 2) to classify the experiences from the experiment. Because physiological responses and effects do not necessarily correlate with psychological responses or subjective experience of stress [1], we limited this study to participants’ sub-objective experiences.

### 4.1 Limitations of the Work Situation

We experimentally investigated the effects of interruptions in digital work under laboratory conditions. We decided against the experiment in the field to obtain results that are as comparable as possible. However, a work situation like the one we induced in the laboratory rarely occurs. We opted for interruptions by phone call and for additional tasks, which were writing a mail. But there are not only such disturbances.

We all know that push notifications on the business phone through all kinds of apps and messengers, notifications of incoming mails or messages, as well as calls via the communication medium used at work (e.g. Microsoft Teams, Skype for Business, etc.) can interrupt us in our work and keep us from doing it. It is the same with interruptions due to updates or failures in hardware and software. The possible disturbances caused by the job, or the devices and software required for it are manifold.

In addition, we can get interrupted in the home office also by our private environment: Construction noise on the street or in the same building, an ambulance driving by, or even our own children can keep us from working. Furthermore, the mailman, the neighbour, our pets as well as the house telephone can also be disruptive factors. Especially in interviews we found out that even our partner (who may not be able to work at home due to his job) can become a disturbance just by his presence and actions. Thus, many factors can interrupt the employee in his work outside the office. Accordingly, we assume that our findings regarding the stress experience in the field would have been significantly sharper depending on the individual disturbance.

### 4.2 Limitations Regarding the Experiment

Due to the increased effort, we decided to have two interruptions by call with additional tasks as well as another call without additional task in a period of 30 min. While other studies have conducted experiments lasting several hours [1, 6] based on the original TSST [7] or TSST-related versions, our experiment is an exception. Furthermore, despite the choice of our work task, which we believe was inherently challenging but not impossible, we cannot rule out the possibility that simply the announced supposed presentation to a panel led to subjective feelings of stress. Although we asked the participants before the experiment

whether they felt relaxed and fit and whether there was a tendency to stage fright or test anxiety, we cannot guarantee whether a tense basic attitude did not arise during the surprising announcement of the supposed presentation of the work results. In addition, we cannot exclude that during the experiment, for example, private messages led to a stress experience, because the subjects used their own notebooks as well as their own smartphones.

### 4.3 Limitations Regarding Comparability with the TSST

While various other studies used the TSST or a modified version of it, we decided to use a work situation as close to reality as possible, even under laboratory conditions. According to the original protocol of Kirschbaum et al. from 1993 [7], the TSST first includes a ten minute preparation time for an interview in front of a panel of managers, as well as its execution (with a duration of five minutes), during which a free speech is to be given. The participants are made to believe that the managers are specially trained to observe non-verbal behavior. In addition, tape recordings and a video analysis are to be made, which leads to the participants having the impression of being under constant observation. Furthermore, after a break, a serial subtraction task is to be performed in front of the panel, which also lasts five minutes. After each error, the subject must start again.

In our opinion, the TSST or a modified TSST version was rather less suitable for our research project. It is still important to consider that the TSST was used to provide demonstrably reliable physiological results [2], which was outside the scope of our research objective. Furthermore, we would like to point out again that the application of the TSST does not necessarily lead to a correlation of physiological stress and subjectively perceived stress [1]. Also the structure of the TSST's tasks is problematic regarding remote work. We tried to induce a work situation as close to reality as possible, which is based on a challenging work task, occupationally induced interruptions, and a supposed presentation of results. A serial subtraction task usually does not occur in remote work, nor does permanent observation, recording and analysis of non-verbal behavior by trained personnel.

Working remote is characterized by actual work and independent processing. In addition, there are meetings with and without webcam use, as well as interruptions induced by work and private life, which disturb employees in their work in various ways. From our point of view, our experiment is therefore less comparable to the use of the TSST, but it better represents the real situation from everyday life. So it was more suitable for our applied, explorative research approach.

## 5 Conclusion

As already mentioned, work interruptions are among the most important stressors in the workplace [13]. Therefore, they deserve special attention among other

disturbing factors. In times of a changing world of work and the shift of work to the home office, we took the findings of the studies by Kerr et al. [6] and Campbell and Ehlert [1] as an opportunity to investigate the effects of work interruptions in digital working regarding the subjective perception of stress. Through our explorative and qualitative research approach, which was divided into a laboratory experiment with the use of eye-tracking as well as subsequent interviews, we were able to gain knowledge and formulate a hypothesis. The transactional stress model of Lazarus and Folkman from 1984 [9] was used to classify the stress experiences. It showed that disregarding personal standards at work leads to greater affective stress the greater the number of standards disregarded in remote work situations. This should be quantitatively verified in follow-up studies. In addition, we were able to gather further findings, for example on stress avoidance by supervisors and colleagues. For example, unnecessary interruptions should be minimized, or even eliminated, and necessary work interruptions should be directed to those employees who have the time capacity for them. In this way, concentrated employees will not be disturbed in their main tasks and their work will be respected. Overall, this research is a first step towards subjective stress research in digital work. Mental disorders are the second most common reason for work disability [11]. To prevent psychological disorders caused by stress and to reduce the resulting pathological consequences, future studies should continue to research these topics and develop approaches to avoid stress in digital work.

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