Mental Fatigue and Motivation

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Summary

Mental fatigue is a common phenomenon in the workplace. It is a condition that occurs after performing a demanding cognitive task for a long time. In most cases, when individuals are mentally fatigued, performance levels decline. For example, accuracy decreases, error rates increase, response times become slower, and people become less engaged with the main task. This thesis investigated why this happens.

One of the major theories of mental fatigue, the so-called motivational theory of mental fatigue, suggests that mental fatigue is caused by amotivation, which is a condition where individuals are no longer willing to invest more effort to do a particular task, so when individuals perform a task for a long time, they lose the motivation to continue with that task. This also implies that when an individual is still motivated to do the task, the individual will stay engaged with the task and maintain performance.

In general, there are two types of motivation: extrinsic and intrinsic. Extrinsic motivation is a type of motivation to attain rewards and to avoid punishments. In contrast, intrinsic motivation is a type of motivation to do an activity because of the inherent enjoyment of the activity. To investigate the effects of extrinsic and intrinsic motivation on mental fatigue, we performed two different experiments.

In the first experiment (Chapter 2), we investigated the effect of *extrinsic* motivation on mental fatigue, and asked participants to continuously perform a demanding working memory task for 2.5 hours and alternated two different conditions: reward and nonreward. In the reward conditions, participants were offered monetary rewards for good performance. We played a distracting video continuously in both conditions to measure task disengagement. To have thorough analyses, we used three types of measures: subjective, performance, and physiological measures. We hypothesized that if extrinsic motivation were an essential factor in mental fatigue, participants over time would be able to maintain their performance and attention to the task in the reward conditions.

The results of the first experiment showed that extrinsic motivation represented by monetary rewards in reward conditions did affect task performance. Participants reported becoming fatigued over time and when monetary rewards were absent in nonreward conditions, performance indeed decreased, because participants invested less mental effort physiologically and were less engaged with the task. In contrast, they were able to maintain performance in reward conditions. Moreover, the physiological measure suggested that participants invested more mental effort to stay engaged with the task, maintaining performance.

In the second experiment (Chapter 3), we investigated the effects of *intrinsic* motivation on mental fatigue. We asked participants, who liked playing Sudoku puzzles, to play the puzzles for three hours in two alternating conditions: low-level motivation (LL) and high-level motivation (HL) conditions. In LL conditions, the

puzzles were designed to be less enjoyable by presenting new puzzles before the old puzzle was solved, whereas in HL conditions, participants were allowed to finish the puzzles normally. As with the first study, we played a distracting video continuously in both conditions and used three types of measures: subjective, performance, and physiological measures. We hypothesized that if intrinsic motivation were an essential component in mental fatigue, participants would be able to maintain performance and attention to the task in HL conditions over time.

The results of the second experiment showed similar effects as the first study. Although participants reported becoming fatigued over time, they were able to maintain performance levels by investing more mental effort in HL conditions. On the other hand, participants invested less mental effort and were more susceptible to distractions in the LL conditions.

These two studies suggest that motivation, both extrinsic and intrinsic motivation, is indeed an essential factor in mental fatigue. Participants exerted more mental effort when motivated to maintain task performance but exerted less mental effort when demotivated, causing performance to decrease.

Even though it is evident that motivation is an important factor in mental fatigue, the underlying mechanism by which motivation affects performance while fatigued was still unclear. Therefore, we tried to make a cognitive model of the processes underlying the mental fatigue effects in Chapter 4. As a mechanism to explain the effects of motivation on mental fatigue, we proposed goal competition. The assumption of goal competition is that there is a competition between the main task goal and others, possibly future goals that can be triggered by perception or by memory. If motivation for the main task decreases, other goals can win this competition, which leads to a drop in motivation and later affects task performance. To test the mechanism, we tried to simulate the results of three different mental fatigue studies (our own and two other experiments that manipulated motivation). In all models, we quantified motivation as the level of goal activation. We manipulated the goal activation of the task in each model so that it decreased linearly over time in low motivation conditions, while the activation value of the task goal remained constant in high motivation conditions.

The models produced the results that we had predicted: task performance of the models remained constant in high motivation conditions and decreased in low motivation conditions. The results were highly similar to the experimental data.

In summary, our findings support the motivational theory of mental fatigue. The way that motivation affects task performance even when individuals are mentally fatigued is from their willingness to keep exerting mental effort, and because they cannot find better alternative actions. Therefore, instead of exerting unnecessary effort, individuals will choose the least demanding action, for example, maintaining focus but lowering performance, having a rest break, or doing nothing. To retain performance levels and avoid being distracted by unrelated task stimuli, individuals need to maintain their levels of focus on and attention to the main task. Nevertheless, even though mental fatigue is a common phenomenon that affects productivity at work, high motivation is the way to counteract its effects.