# The Workload Curve: Subjective Mental Workload

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**Objective:** In this paper I begin looking for evidence of a subjective workload curve.

**Background:** Results from subjective mental workload assessments are often interpreted linearly. However, I hypothesized that ratings of subjective mental workload increase nonlinearly with unitary increases in working memory load.

**Method:** Two studies were conducted. In the first, the participant provided ratings of the mental difficulty of a series of digit span recall tasks. In the second study, participants provided ratings of mental difficulty associated with recall of visual patterns. The results of the second study were then examined using a mathematical model of working memory.

**Results:** An *S* curve, predicted a priori, was found in the results of both the digit span and visual pattern studies. A mathematical model showed a tight fit between workload ratings and levels of working memory activation.

**Conclusion:** This effort provides good initial evidence for the existence of a workload curve. The results support further study in applied settings and other facets of workload (e.g., temporal workload).

**Application:** Measures of subjective workload are used across a wide variety of domains and applications. These results bear on their interpretation, particularly as they relate to workload thresholds.

**Keywords:** mental workload, working memory, mathematical models

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## INTRODUCTION

I find—and perhaps this is your experience as well—that an easily managed mental task can become, with just the slightest amount more mental demand, decidedly unmanageable. The relationship between unitary increases in cognitive load and the subjective experience of mental demand seem nonlinear; perceived mental workload is hardly affected at all by increases in demand under low cognitive load but rises quickly and disproportionally as the limits of the cognitive system are approached. In the context of subjective rating scales, it would appear that sometimes 5 is closer to 6 than to 4. That is, the cognitive load required to move a subjective workload rating from 5 to 6 is less than that required to move the rating from 4 to 5. This relationship, which is the basis of my central hypothesis, should take the shape of an *s* or sigmoid curve, as notionally depicted in Figure 1.

The hypothesized asymptote at the top of this *S* curve is the predictable result of using a finite scale (subjective mental workload) to evaluate a conceivably infinite quantity (mental load). Once workload is rated a 10 on a 1-to-10 scale, it does not matter whether task load proceeds to double or triple or quadruple. In each instance, subjective workload shares the basic quality of being "too much" and is therefore a 10. At the lower end of the scale, however, there is a finite beginning to the scale and the workload. There, the relationship between perceived and actual load could be linear, a power function, exponential, and so on. I propose that, as seen in Figure 1, where subjective ratings of workload are low or moderate, something resembling a power function will be observed. With very low subjective workload, unitary increases in cognitive load will result in modest increases in subjective ratings. As subjective workload increases, however, the rater will become more sensitive to his or her diminishing resources, and unitary increases in cognitive load will result in increasingly large jumps in subjective ratings. Throughout the