

Exploring Heterogeneity of Individual Cognitive Workload and Capacity Limitations in a Consecutive Ascending Task

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Background: Cognitive work is a key factor in modern business. More knowledge about the heterogeneity of learning characteristics, limited by respective cognitive resources, might improve learning outcome and will give valuable measures for human-computer interaction.

Cognitive workload is defined as mental resource necessary to perform a specific task. As the task intrinsic difficulty is not equal to the perceived individual workload, mental workload varies among humans (Barrett & Tugade 2004; Williams et al. 2008).

Methods: In total, 150 participants learned a compound set consisting of 2x7 word pairs successively, consisting of a *simple* (~2.5 syllables) and a *complex* (~5 syllables) sublist.

Semester	Prüfung
Student	Professor
Abschluss	Anmeldung
Universität	Hilfsamt
Straße	Übung
Auftritt	Kleiner
Director	Lehrer

simple L_0 (~2.5 syllables)
standard language complexity

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Hochschuljahr	Fachschule
Studiengang	Semesterplan
Klausurfragen	Studienberatung
Lehrstuhlverantwortliche	Nachschreibebüro
Fachgruppenkoordinator	Studienbeihilfe
Examination	Numerus Clausur
Reputation	Hochschulring

complex L_1 (~5 syllables)

Doubling Workload

Aims: The study explores individual cognitive workload and capacity differences by examining the differential reaction of doubling workload compared to the standard language processing demands

Results: On average, 3-4 items are remembered per subset confirming results for pure capacity limitations (Cowan et al. 2001).

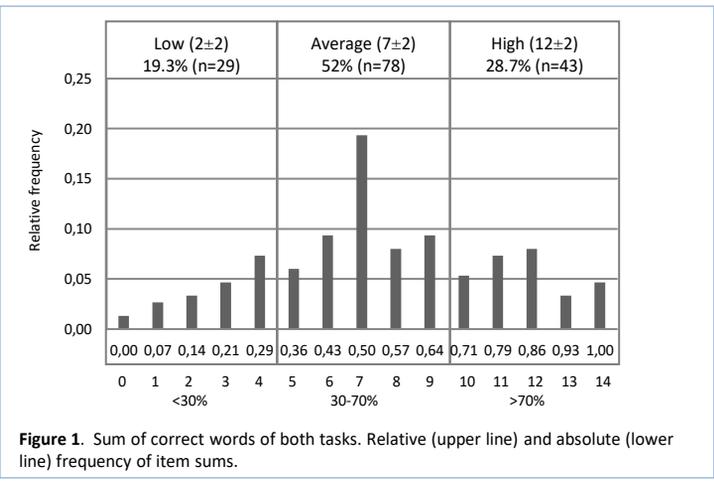
However, 7 items are correctly associated on average when regarding the complete task denoting a profound tendency for an additive effect, reminiscent to Miller's magical 7 (Miller 1956) (see figure 1).

Doubling of Workload
 The average decrease for the complex sublist is ~20.6% and the total reduction is solely ~0.87 items on average (see table 1).

Table 1: Average number of items (and standard deviation) recalled in L_0 and L_1 (n=150).

	<i>simple</i> L_0	<i>complex</i> L_1	L_0+L_1	L_0-L_1
mean	4.24±1.8	3.37±2.16	7.61±3.39	0.87±2.09
median	4	3	7	1

The upper 25% (one quarter is n=38) recall on average 12 items, the bottom quartile 3 items.



Conclusions: Cognitive workload is highly heterogeneous and individually sensitive. The upper one fourth of participants remember 4x more items than the bottom quartile.

To avoid excessive overload (underload), more insight into the nature of the personal capacity limitations is beneficial for customizing working environments, e.g. in human-computer interaction or user experience (UX) design.

All references see:
 Wiebringhaus T Exploring Heterogeneity of Individual Cognitive Workload and Capacity Limitations in a Consecutive Ascending Task GfA 21.-23. Februar 2018 Conference Proceedings C.4.6.; Frankfurt am Main, Germany