DRAPER

A Unifying Framework for Defining and Measuring Physical and Cognitive Load

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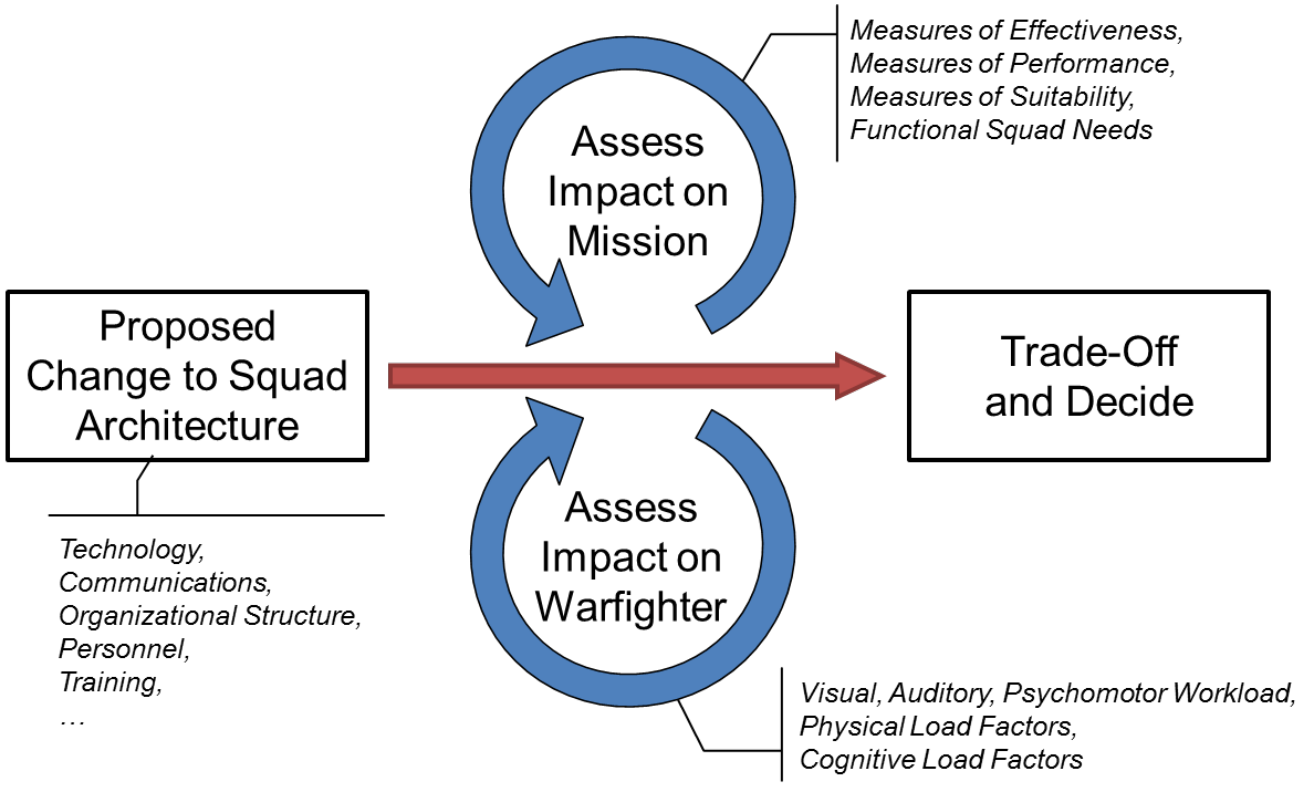
DARPA Squad X Core Technologies (SXCT)

Artist's Concept
Source: DARPA

Seeking to bring unprecedented capability to dismounted U.S. Army and U.S. Marine Corps squads...

Mission vs. Warfighter Impact

…in part by implementing system-level changes to the squad architecture



Two Contributions

1. Framework: Defines human performance in terms of the physical and mental effort that are expended when accomplishing physical and mental tasks

2. “Load factors:” Define the impact of physical and cognitive load on the individual and on the mission

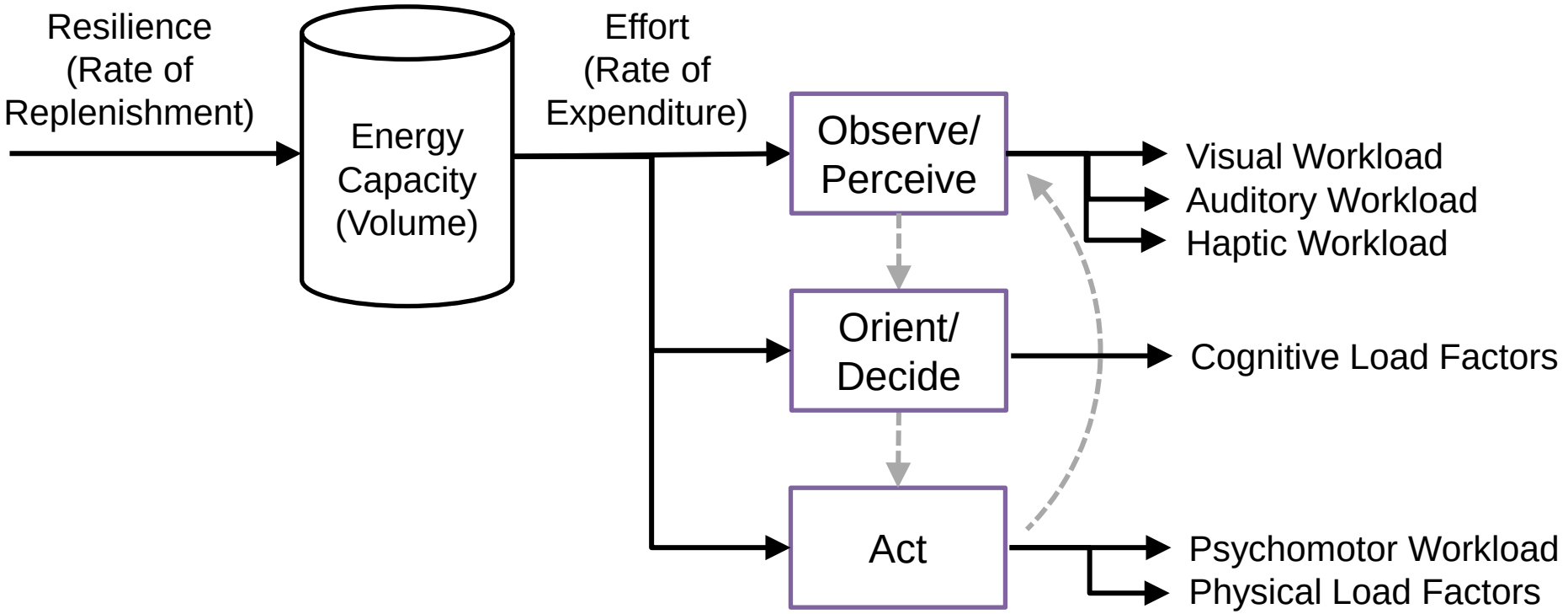
Mental vs. Cognitive Workload

Mental Workload ISO-10075-1:
How hard a part or multiple parts of a person's brain is working during performance of a task

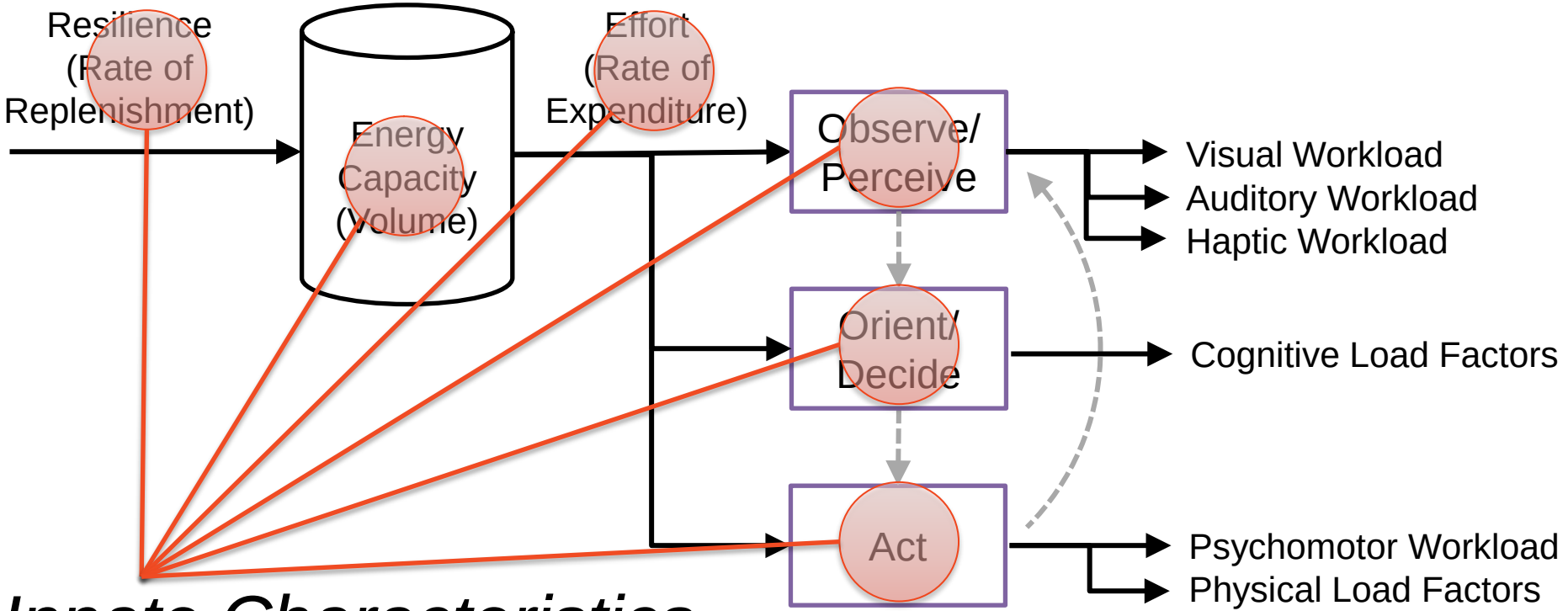
VACP Mental Workload (Mitchell, 2000):

- Visual: Stimuli seen
- Auditory: Stimuli heard
- Cognitive: "Thinking"
- Psychomotor: Movement

Human Performance Framework



Individual Differences Factors



Innate Characteristics

Past and Recent Experiences

Physical Load

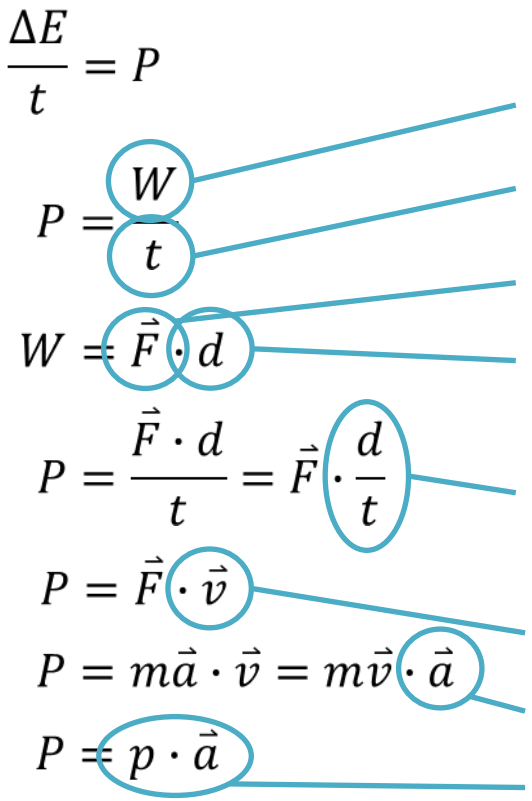
https://upload.wikimedia.org/wikipedia/commons/thumb/6/65/Svetlana_Podobedova_2012c.jpg/309px-Svetlana_Podobedova_2012c.jpg

https://upload.wikimedia.org/wikipedia/commons/3/38/Meb_Keflezighi_2009_London_Marathon.jpg

http://cdn.abclocal.go.com/images/wpvi/cms_exf_2007/news/sports/8759979_448x252.jpg

Strength **Endurance** **Coordination**

Physical Load Factors Derivation



Stamina: Magnitude of physical work performed

Endurance: Duration of sustained physical effort

Strength: Amount of directed force

Posture: Difference between desired and achieved body position

Coordination: Difference between desired and achieved body position over time

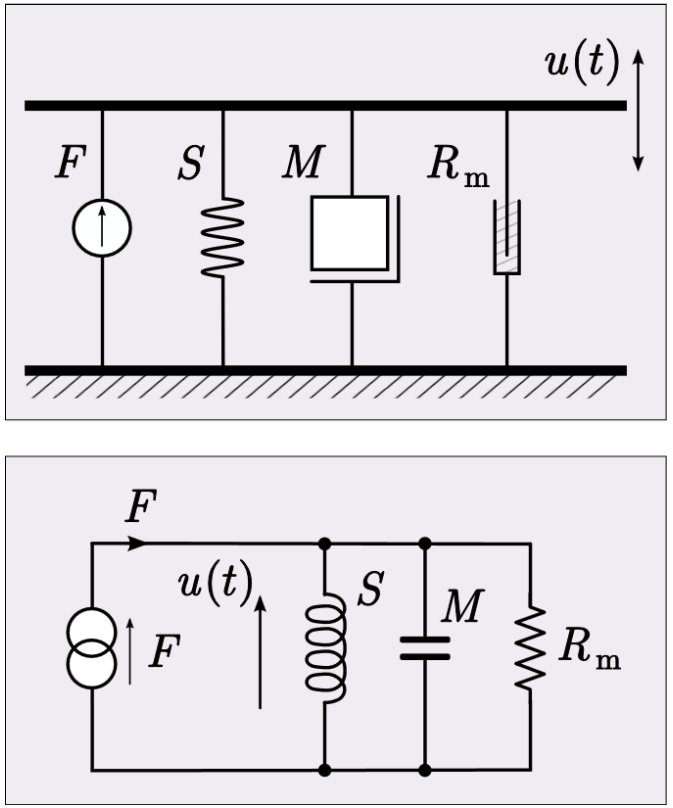
Speed: Linear and angular displacement over time

Acceleration: Ability to change speed over time

Agility: Ability to change velocity vector over time

Cognitive Load Factors Derivation

We often turn to mechanical analogies when non-mechanical systems exhibit behaviors that are analogous to mechanical systems



https://upload.wikimedia.org/wikipedia/en/6/65/Mobility_analogy_resonator_vertical.svg

The Maxwell Analogy (1861) – electrical circuits represented as mechanical systems

Physical and Cognitive Load Factors

Physical Load Factors	Definition
Stamina	Magnitude of physical work performed
Endurance	Duration of sustained physical effort
Strength	Amount of directed force
Posture	Difference between desired and achieved body position
Coordination	Difference between desired and achieved body position over time
Speed	Linear and angular displacement over time
Acceleration	Ability to change speed over time
Agility	Ability to change velocity vector over time

Cognitive Load Factors	Definition
Stamina	Magnitude of cognitive work performed
Endurance	Duration of sustained cognitive effort
Skill	Ability to deal with complexity; ability to oppose cognitive stress
Mental Stability	Ability to regulate or maintain mental state
Sensemaking	Accuracy of projection of future outcomes
Processing Rate	Number of cognitive processes over time
Cognitive Acceleration	Ability to achieve a level of performance when switching tasks and/or states
Cognitive Agility	Ability to incorporate and prioritize new cognitive demands

Future Work

Physical and cognitive load factor decomposition

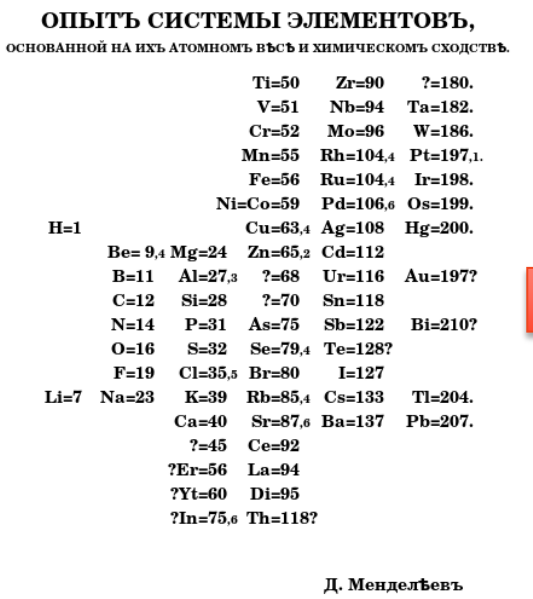
Interaction between physical and cognitive loads

Cognitive load factor operationalization

Applications to team performance assessment

Final Thought

“Periodic Table” for Human Performance



ОПЫТЪ СИСТЕМЫ ЭЛЕМЕНТОВЪ,

ОСНОВАННОЙ НА ИХЪ АТОМНОМЪ ВѢСѢ И ХИМИЧЕСКОМЪ СХОДСТВѢ.

			Ti=50	Zr=90	?=180.	
			V=51	Nb=94	Ta=182.	
			Cr=52	Mo=96	W=186.	
			Mn=55	Rh=104,4	Pt=197,1.	
			Fe=56	Ru=104,4	Ir=198.	
			Ni=Co=59	Pd=106,6	Os=199.	
H=1			Cu=63,4	Ag=108	Hg=200.	
	Be= 9,4	Mg=24	Zn=65,2	Cd=112		
	B=11	Al=27,3	?=68	Ur=116	Au=197?	
	C=12	Si=28	?=70	Sn=118		
	N=14	P=31	As=75	Sb=122	Bi=210?	
	O=16	S=32	Se=79,4	Te=128?		
	F=19	Cl=35,5	Br=80	I=127		
Li=7	Na=23	K=39	Rb=85,4	Cs=133	Tl=204.	
		Ca=40	Sr=87,6	Ba=137	Pb=207.	
		?=45	Ce=92			
		?Er=56	La=94			
		?Yt=60	Di=95			
		?In=75,6	Th=118?			

Д. Менделѣевъ

https://upload.wikimedia.org/wikipedia/commons/thumb/c/ce/Periodic_table_by_Mendeleev%2C_1869.svg/250px-Periodic_table_by_Mendeleev%2C_1869.svg.png

https://en.wikipedia.org/wiki/File:Periodic_Table_overview_(standard).svg

Not all defined, but recognizing an underlying structure to derive new insight

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Thank you

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