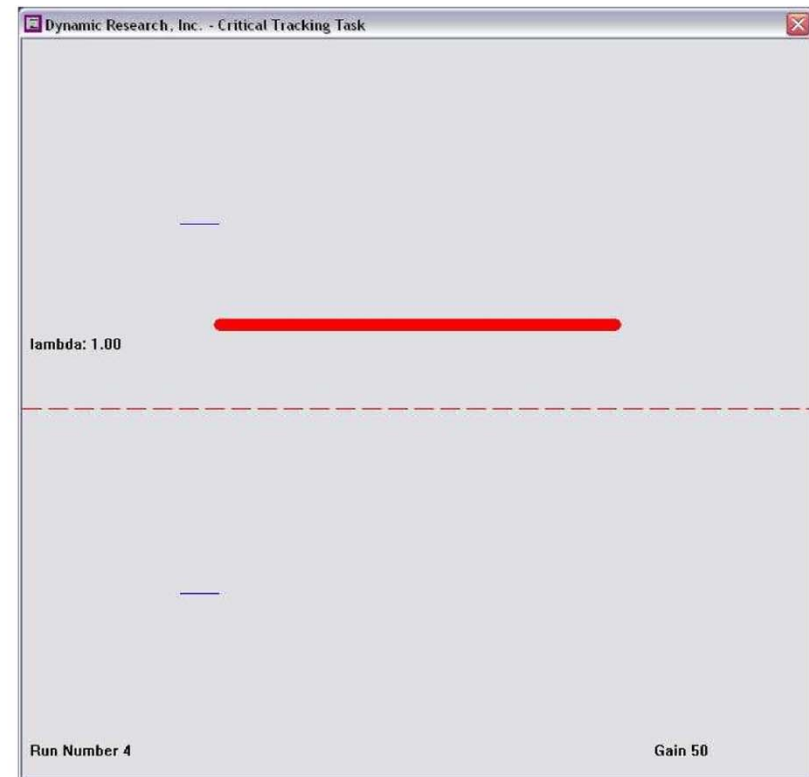
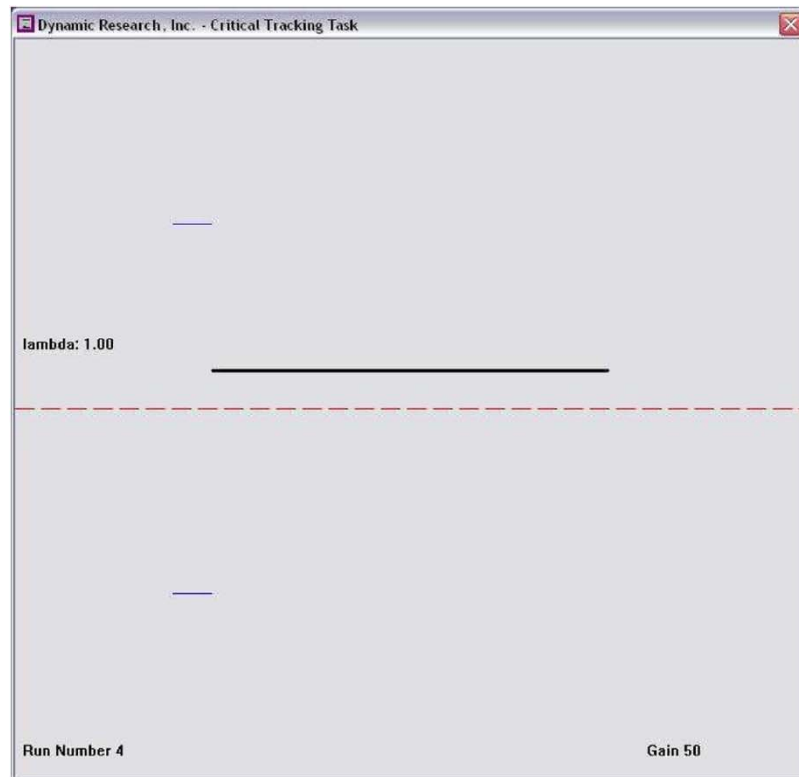

The critical tracking task - A useful tool to assess driver distraction?

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Critical Tracking Task (CTT)



Critical Tracking Task

The CTT is a task “in which a human operator is required to stabilize an increasingly unstable first-order controlled element up to the critical point of loss of control” (Jex, McDonnell, & Phatak, 1966, p. 138)

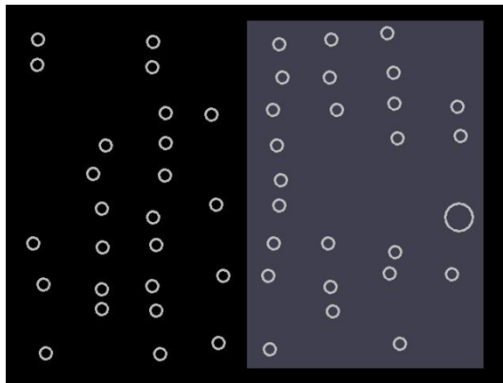
“The operator's task can be likened to the problem of balancing a stick on one's fingertip, with the stick's length decreasing with time.” (Burns & Moskowitz, 1980, p. 261)

Testing the CTT's potential

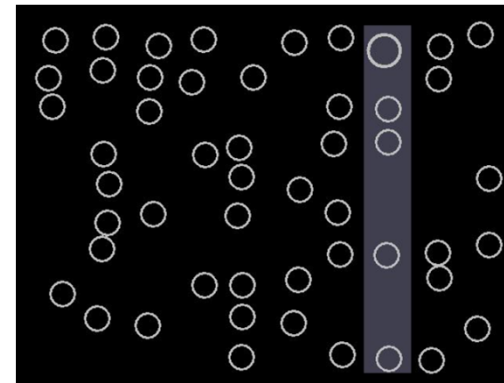
- Implementation of CTT with „constant subcritical instability“
 - Standard deviation of bar position as performance measure
- Experiment I: Artificial secondary tasks (see Mattes & Hallén, 2009)
- Experiment II: Realistic secondary tasks

Experiment I - Artificial secondary tasks

- Visual search - Surrogate Reference Task (SuRT)



easy

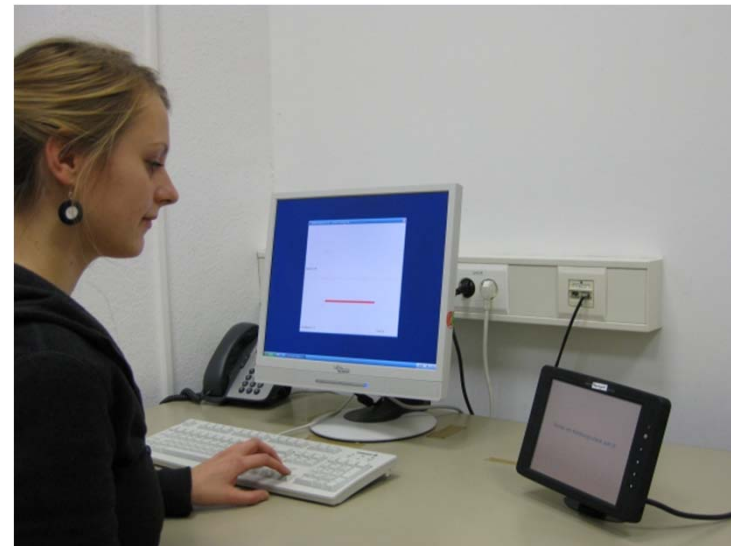


difficult

- Counting task
 - easy: count forwards in steps of two, starting with 212 / steps of five, starting with 45
 - difficult: count backwards in steps of six, starting with 831 / steps of seven, starting with 581

Experiment I - Participants/Setup/Procedure

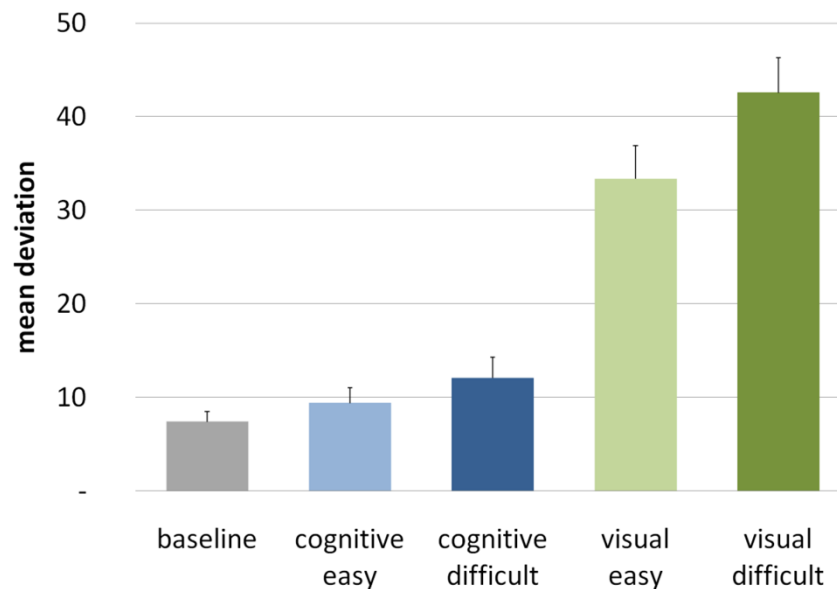
- 24 participants, 21 valid datasets
 - ca. 22 years (SD = 3.2)
 - 16 female, 5 male
- Procedure:
 - CTT practice
 - CTT baseline measurement
 - 1st dual task practice
 - 1st dual task measurement
 - 1st subjective rating dual task (NASA TLX)
 - 2nd dual task practice
 - ...



90sec measurement per trial

Experiment I - Results

- CTT mean deviation



2x2 ANOVA

Task type (cognitive vs. visual)

$F(1, 20) = 86.27, p < .001, \eta_p^2 = .81$

Difficulty (easy vs. difficult)

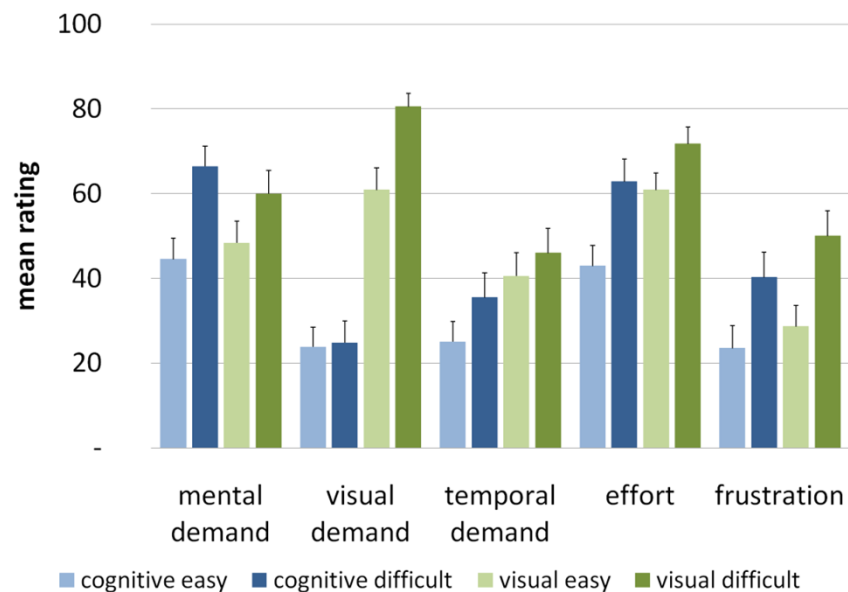
$F(1, 20) = 28.47, p < .001, \eta_p^2 = .59$

Interaction

$F(1, 20) = 10.44, p = .004, \eta_p^2 = .34$

Experiment I - Results

- Subjective rating



	Task type		Difficulty		Interaction	
	F (1,20)	p	F (1,20)	p	F (1,20)	p
mental demand	.10	.760	37.29	.000	4.71	.042
visual demand	82.68	.000	21.91	.000	14.40	.001
temporal demand	9.55	.006	6.82	.017	.88	.359
effort	9.87	.005	29.72	.000	5.76	.026
frustration	3.64	.071	31.13	.000	.60	.447

Experiment II - Realistic sceondary tasks

- Easy destination entry task
 - Few button presses (e.g. destination „Verona” + avoidance of toll routes); calculation of route rather long
- Difficult destination entry task
 - Many button presses (e.g. route „from Dresden, Waldstraße 1 to Berlin, Hauptstraße 1“); calculation of route rather short
- Synchronisation of navigation system & mobile phone
 - Complex management of attention allocation; few button presses

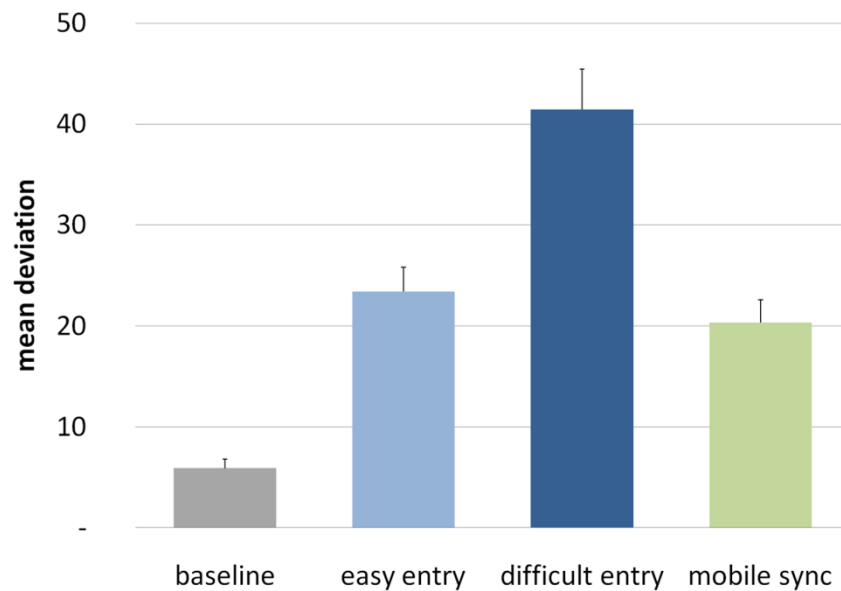


Experiment II - Participants/Procedure

- 25 participants
 - ca. 22 years (SD = 1.5)
 - 18 female, 7 male
- Procedure:
 - CTT practice
 - CTT baseline measurement
 - 1st destination entry practice
 - 1st dual task practice
 - 1st subjective rating dual task (NASA TLX)
 - 2nd destination entry practice
 - ...
 - Mobile phone synchronisation practice
 - ...

Experiment II - Results

- CTT mean deviation



ANOVA

$F(2, 48) = 67.39, p < .001, \eta_p^2 = .74$

Pairwise comparison (Bonferroni corrected)

easy vs. difficult

$p < .001$

easy vs. mobile sync

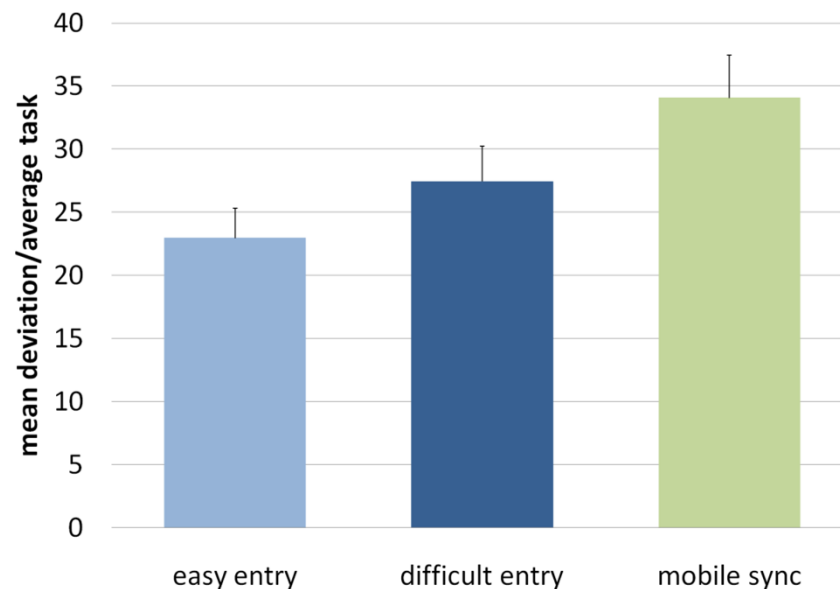
$p = .127$

difficult vs. mobile sync

$p < .001$

Experiment II - Results

- CTT mean deviation, in relation to secondary task time (Harbluk, Mitroi, & Burns, 2009)



ANOVA

$F(2, 48) = 27.81, p < .001, \eta_p^2 = .54$

Pairwise comparison (Bonferroni corrected)

easy vs. difficult

$p = .001$

easy vs. mobile sync

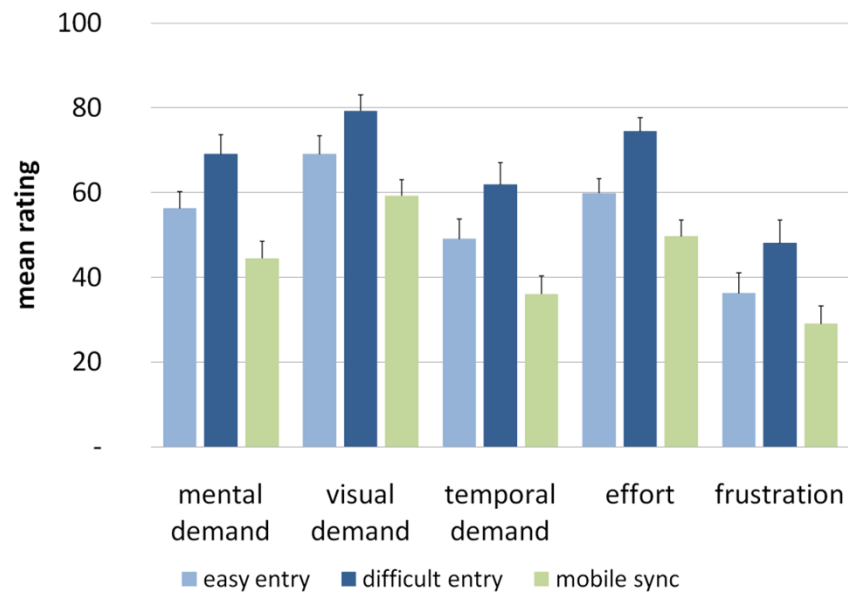
$p < .001$

difficult vs. mobile sync

$p < .001$

Experiment II - Results

- Subjective rating



	ANOVA		easy vs. difficult	easy vs. mobile	difficult vs. mobile
	F (2,48)	p	p	p	p
mental demand	21.98	.000	.002	.026	.000
visual demand	16.83	.000	.004	.084	.000
temporal demand	23.46	.000	.001	.015	.000
effort	33.30	.000	.000	.005	.000
frustration	9.70	.000	.063	.235	.001

Summary

- The CTT is able to differentiate between artificial secondary tasks of different distraction potential.
- The CTT is able to differentiate between realistic secondary tasks of different distraction potential.
- When subjectively assessing the distraction/load elicited by secondary tasks, participants seem to disregard the duration of the distracting/loading secondary task.

References

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Thanks!