

A Single Timer for the Sub-second and Supra-second scales

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Introduction

- Many lines of research converge on the existence of a cut-off between the sub-second and supra-second processes in time perception [1, 2]. The mechanisms supporting this cut-off and their link with the working memory remain unclear [3, 4].
- We tested whether the perceived interval of a test segment relative to a standard segment changes as a function of inter-stimulus interval (ISI).
- Hypothesis:** we predicted differences in the temporal discrimination sensitivity (**difference limen**) between the sub-second and supra-second scales, but no effect on the perceived duration (**constant error**).

Methods | Materials

Three psychophysical studies using a two-interval forced-choice (2AFC) design.

Standard durations (S1):

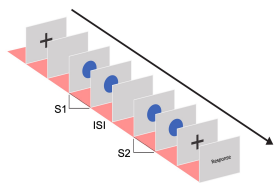
Experiment	Standard duration	N
1	120 ms	37
2	160 ms	39
3	200 ms	39

Comparison durations (S2):

Standard duration $\pm \Delta t$

Four different Inter Stimulus Intervals (ISI):

400, 800, 1600, and 2000 ms

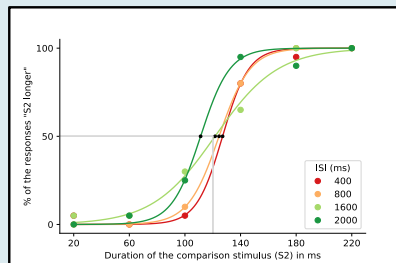


Results

1) Responses

We modeled responses with a logistic function:

$$F(x) = \frac{1}{1 + \exp[-(x - a)/b]}$$



2) Constant error

- CE plotted as a function of ISI.
- The longer the ISI, the shorter the CE (experiments 1 & 2).
- We can observe a decrease of CE with increasing standard duration.

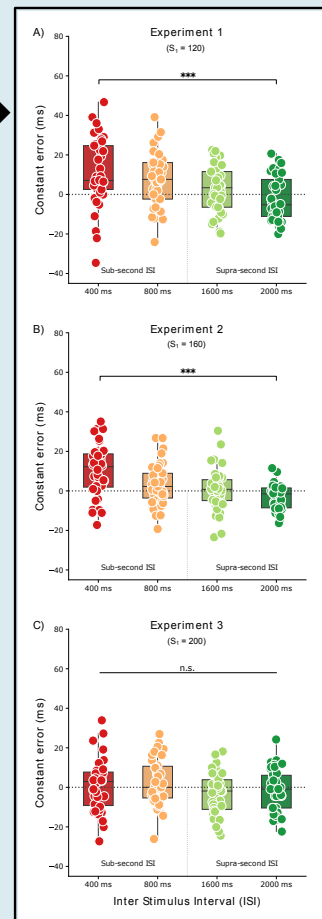
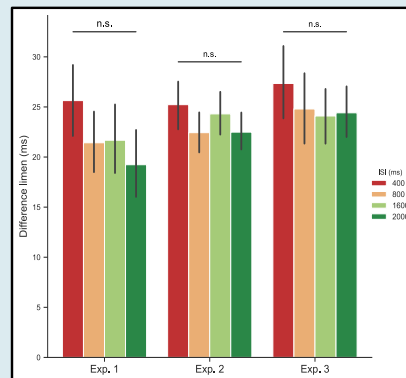
Two indices of performance were extracted from each psychometric function:

- Constant error (CE):** for the subjective perceived duration
- Difference limen (DL):** for the discrimination sensitivity

3) Difference limen

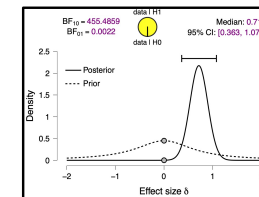
DL plotted as a function of ISI.

DLs values remain without statistically significant changes.



Data Analysis

- The level of statistical significance to reject the null hypothesis was $\alpha = 0.01$.
- All figures, tables, and statistical analyses can be consulted in Open Science Framework: osf.io/tqc87/.

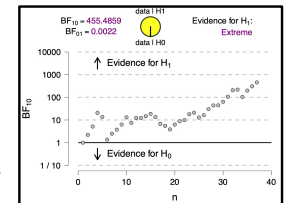


Bayesian paired sample t-test

- T-test between the ISI400 and ISI2000 conditions.
- The Bayes Factor (BF₁₀) indicates that the alternative hypothesis (H1) is 455 times more likely than the null hypothesis (H0).

Bayesian sequential analysis

- This analysis reveals that the evidence for H1 is extreme.
- After 35 participants the evidence becomes extreme.



Conclusion

- Our data does not support the hypothesized that there is a transition between two timing mechanisms at ~1 second.
- The cut-off between the sub-second and supra-second processes is not hard-wired but rather seems to depend on the interaction between ISI and how precisely participants encode standard durations.
- Our data suggest that one single computational mechanism could control temporal processes in the supra and sub second scales.

References

- Buonomano & Maass. (2009). *Nature Reviews Neuroscience*, 10(2), 113–125.
- Rammesayer & Troche (2014). *Acta Psychologica*, 147, 68–74.
- Van Rijn, Hedderik. (2016). *Current Opinion in Behavioral Sciences*, 8:245–249.
- Sperling, George. (1960). *Psychological Monographs* 74 (11):1–29.