Temporal Reproduction Task Analysis

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This report presents an analysis of a task from research on time perception, involving a single participant and using a hand effector. The task is based on the following article: Pourmohammadi A and Sanayei M (2023), Context-specific and context-invariant computations of interval timing, *Front. Neurosci.* 17:1249502. doi: 10.3389/fnins.2023.1249502. All analyses and visualizations are generated to explore the temporal reproduction task's outcomes and highlight any context-dependent differences between sensory and motor timing.

1. Temporal Reproduction Task Summary Table

Table 1 presents the temporal reproduction data for a single participant (myself) who took part in a temporal reproduction task. The data include the mean reproduction times (Mean ± std) and the range (Min–max) for five distinct temporal intervals (400, 500, 700, 1100, and 1900 milliseconds). This analysis focuses on assessing the accuracy of time reproduction and the variability in responses across different intervals.

As observed in the table, with an increase in the presented interval duration (ts), the mean reproduction time (tr) also increases. This indicates the participant's overall ability to perceive and reproduce varying temporal intervals. However, there are notable differences in the accuracy of reproduction between shorter and longer intervals.

For shorter intervals, overestimation in reproduction is evident. For example, at the 400-millisecond interval, the mean reproduction time is 557.78 milliseconds, which exceeds the actual presented time. This pattern is also observed at the 500-millisecond interval, where the participant perceived the presented time as longer than it actually was. In contrast, for medium intervals, the accuracy of reproduction improves; for instance, at the 1100-millisecond interval, the mean reproduction time is very close to the actual interval. Finally, for longer intervals, underestimation occurs. At the 1900-millisecond interval, the mean reproduction time is 1690.32 milliseconds, which is shorter than the actual presented time.

As shown in the table, the standard deviation is smaller for shorter intervals (205.83 milliseconds for the 400-millisecond interval), whereas it increases with longer intervals (292.86 milliseconds for the 1900-millisecond interval). This increasing standard deviation reflects greater variability in reproducing longer temporal intervals.

The range of reproduction times also expands with increasing interval duration. For example, at the 400-millisecond interval, the range of reproduction is from 129.5 to 1061.92 milliseconds, whereas at the 1900-millisecond interval, the reproduction range is from 1075.64 to 2220.02 milliseconds. This widening of the range highlights the increased imprecision and variability in reproducing longer intervals.

Intervals	Mean std	Min – max
0.4	0.56 0.21	0.13 – 1.06
0.5	0.66 0.16	0.42 – 1.11
0.7	0.83 0.15	0.54 – 1.14
1.1	1.11 0.18	0.77 – 1.43
1.9	1.69 0.29	1.08 – 2.22

Table 1 The mean, standard deviation, and range of tr for interval.

2. Scatter Plot of Simple vs. Reproduce Time

Figure 1 illustrates the relationship between Simple Time (ts) and Reproduce Time (tr) for a single participant in a temporal reproduction task. The positive correlation observed between these variables suggests that as the target interval (ts) increases, the participant tends to reproduce proportionally longer intervals. However, the notable spread of data points around the ideal reproduction line (ts = tr) indicates variability in reproduction accuracy. Points above this line represent overestimations, while points below indicate underestimations, revealing fluctuations in the participant's performance, particularly at longer intervals.

Additionally, mean and standard deviation values for ts and tr, displayed in Figure 1, provide insights into the central tendency and spread of the data. The close proximity of the mean values for ts and tr suggests that the participant generally approximates the target interval accurately. However, the high standard deviation indicates considerable variability in time estimates. This pattern is consistent with Weber's law, which posits that estimation accuracy decreases as interval length increases. Overall, Figure 1 demonstrates that, while the participant attempts to match reproduced times with target intervals, reproduction accuracy is affected by systematic biases and variability, likely due to perceptual or attentional factors.

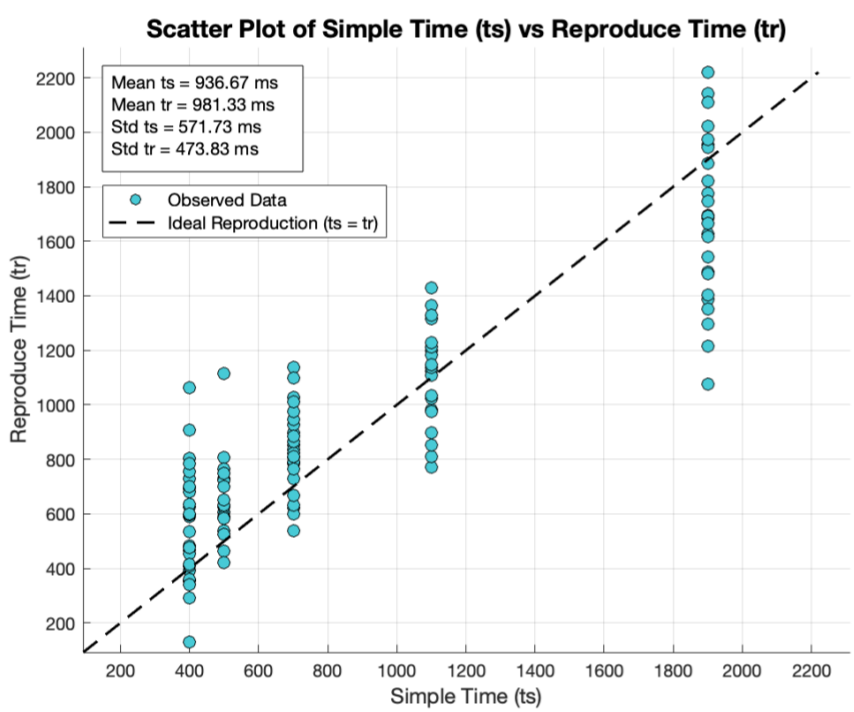

Figure 1. Scatter plot of Simple Time (ts) vs. Reproduce Time (tr), showing the participant's variability in accurately reproducing target intervals.

3. Linear Regression Analysis

The linear regression analysis (Figure 2) shows a clear relationship between the presented time (ts) and the reproduced time (tr). This relationship demonstrates how participants performed in reproducing the presented intervals. From the regression line, we observe that the slope is less than 1, which indicates a compressive bias. This means that for longer intervals, participants tended to underestimate the duration. This is a well-known phenomenon in time perception research. Furthermore, the scatter of the data points around the regression line suggests that participants were more accurate in reproducing shorter intervals, as the variance of these responses was smaller.

In summary, the regression line allows us to understand the overall trend, but the individual differences in accuracy become more apparent when we examine variance in responses.

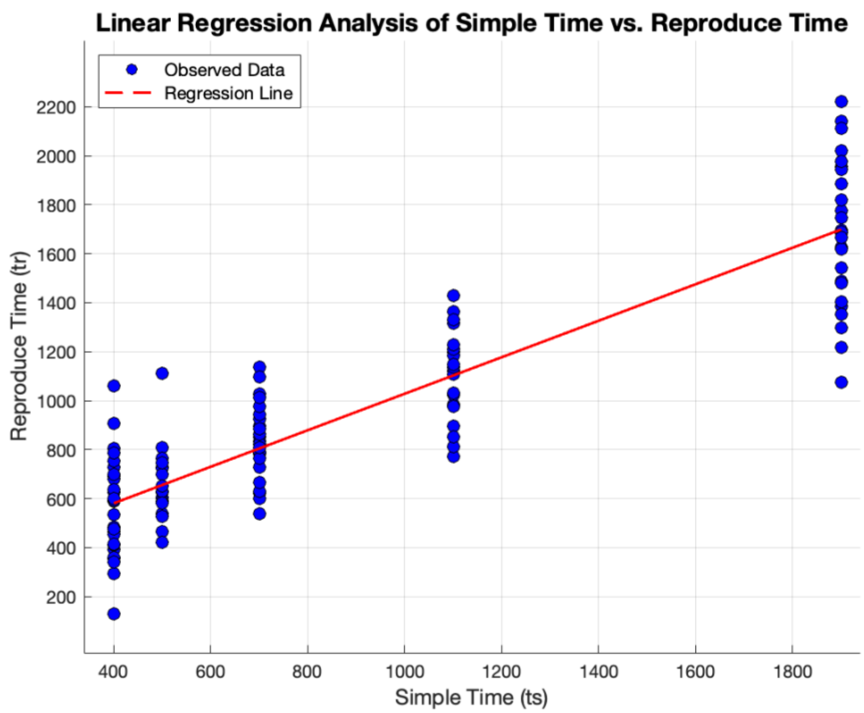

Figure 2: Linear regression of presented time versus reproduced time. The slope shows a compressive bias for longer intervals.

4. Accuracy of Temporal Reproduction Across Durations

The distribution of reproduced time (tr) for different stimulus durations (ts) (Figure 3), indicates that the accuracy of temporal reproduction decreases as the stimulus duration increases. For shorter durations, such as ts = 400 ms and ts = 500 ms, the distributions are narrower and more concentrated, reflecting higher precision in reproducing these intervals. In contrast, for longer durations, such as ts = 1900 ms, the distributions are wider, demonstrating greater variability and decreased accuracy in temporal reproduction.

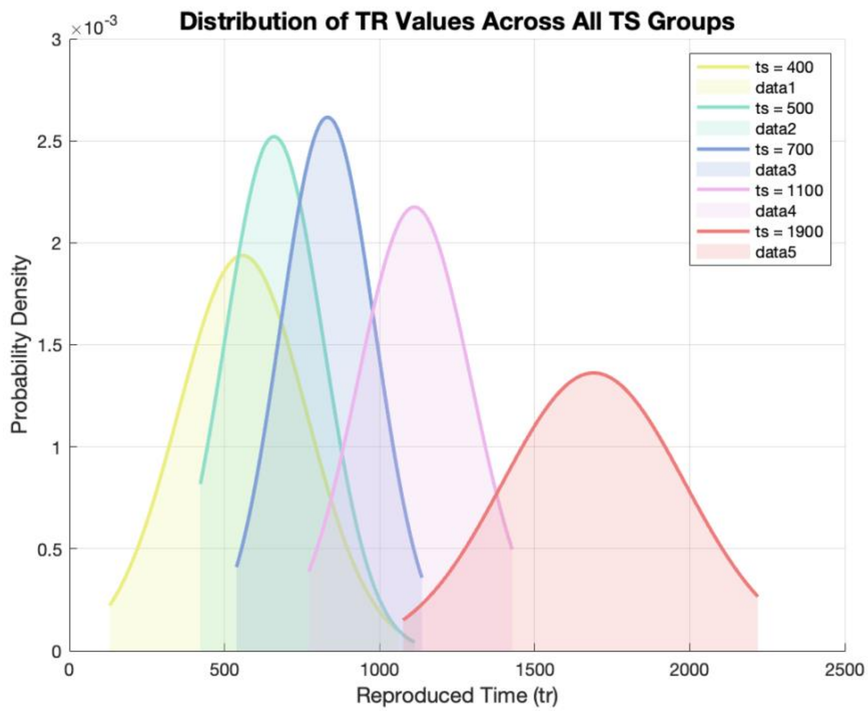

Figure 3: The distribution of reproduced times (TR) across stimulus durations (TS) shows higher precision for shorter intervals and increased variability for longer intervals.

5. Mean Error and Standard Deviation

The mean error analysis (Figure 4) demonstrates the bias participants exhibited at different time intervals. Positive errors in shorter intervals suggest participants slightly overestimated these durations, whereas for longer intervals, participants consistently underestimated the duration. This trend is aligned with previous studies on time reproduction.

Standard deviation increases as the presented intervals lengthen, indicating that participants had more variability in their reproduced times for longer durations. The combination of bias and increased variability suggests that longer durations introduce more cognitive load, leading to less consistent performance.

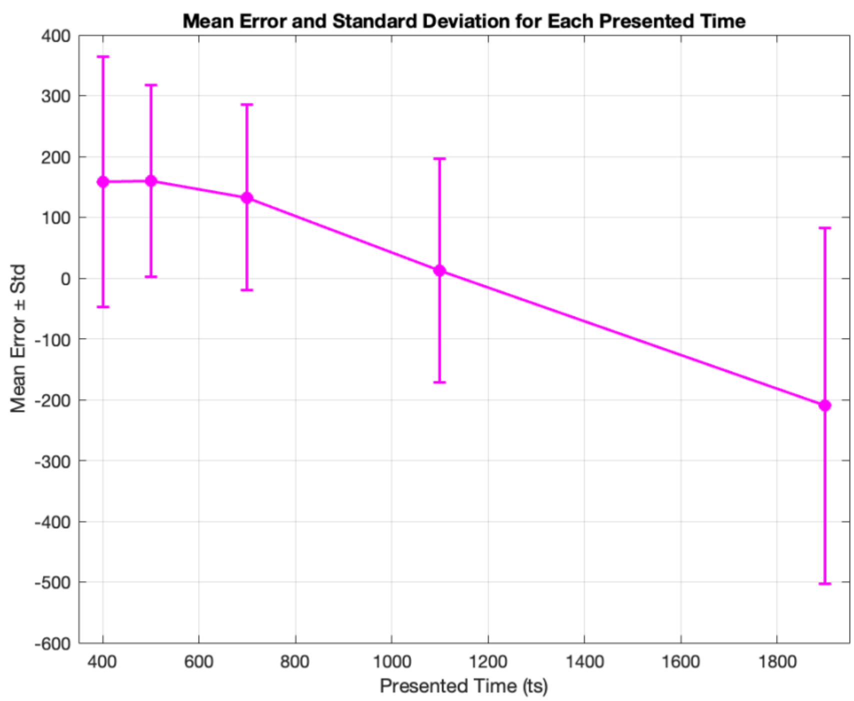

Figure 4: Mean error and standard deviation for each interval. Standard deviation increases with interval length.