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Time-asymmetric presuppositions in time perception research

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Abstract

Systematic under-reproduction of time has been interpreted as a misperception of time and, therefore, seems to contradict basic assumptions of pacemaker-accumulator models. An alternative explanation of this phenomenon is proposed, based on methodological constraints regarding the direction of time, which cannot be manipulated in experiments on time perception. Results from two experiments demonstrate that the direction of reproduction errors depends on the direction of the dimensional change (i.e., ascending vs. descending values). Specifically, these results support the assumption that temporal under-reproduction does not reflect a genuine misperception of time, but rather a methodological artefact. Generally, the results demonstrate that time-asymmetric presuppositions about reality need to be considered in experiments on time perception.

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1. The under-reproduction of time

The adequacy of pacemaker-accumulator models (e.g., Treisman, 1963) has been challenged by the finding of systematic errors in time reproduction tasks (Wackermann & Ehm, 2006). In such tasks, a standard interval of a specified duration is presented, and the participants are then asked to reproduce its duration by stopping a second interval at exactly the same time. Applications of these tasks consistently reveal a systematic under-reproduction of durations, i.e., reproduced intervals are shorter than the standards (Eisler, 1976). This phenomenon has been interpreted as a systematic misperception of time, and as such, it seems to conflict with basic assumptions of pacemaker-accumulator models (Wackermann & Ehm, 2006; Wackermann, 2005).

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The conception of an internal pacemaker with a varying pulse rate can explain temporal misperceptions, when a translation between the direct experience and the abstract numerical representation of durations is required. But in time reproduction tasks, both the standard and the reproduction interval is directly perceived and no translation into conventional time units (e.g., seconds or minutes) is required. An altered pacemaker rate should therefore affect the perception of both intervals to the same extent, which would result in accurate performance even if time is perceived as speeded up or slowed down (Wackermann & Ehm, 2006; Wearden, 2004).

Several models of time perception can explain the phenomenon of time under-reproduction. For example, the attentional-gate model (Zakay & Block, 1997), the parallel-clock model (Eisler, 1975), and the dual klepsydra model (Wackermann & Ehm, 2006). However, all of these models are based on the assumption that the systematic errors in time reproduction tasks are caused by a misperception of time.

We will argue for an alternative explanation of the phenomenon, which is based on a methodological constraint in timing experiments (Riemer, Trojan, Kleinböhl, & Hölzl, 2012). According to this interpretation, the systematic under-reproduction of time does not reflect a misperception of time, but rather a general judgement bias.

2. The arrow-of-time dilemma

Time reproduction involves a high degree of uncertainty. During the reproduction phase, participants are uncertain about the equality between the standard and the reproduction interval. The perceived likelihood for this equality varies as a function of elapsed time (Fig. 1). It increases steadily during the reproduction phase until the point of objective equality of both intervals is reached, and afterwards it decreases again. However, participants are not able to exactly determine the point of objective equality, and therefore their judgements are based on a less restrictive criterion (red horizontal line in Fig. 1) than the maximum of the curve. If the perceived likelihood of equality exceeds this criterion, participants accept this value and terminate the reproduction interval.

The under-reproduction of temporal intervals becomes entirely comprehensible, when we consider an essential methodological constraint we are confronted with in time perception experiments. It is the mere fact that perceived time runs always in the same direction. To present an interval of 5 s, we have to start at zero and then continually increase this interval. We cannot start at a value of 10 s, and then continually decrease this interval. All other dimensions, for example pitch and brightness, can be presented in ascending and descending values, only in time perception experiments we are constrained to ascending values. Together with the application of a less restrictive criterion for equality judgements, this necessarily results in an early termination of the reproduction interval (Fig. 1).

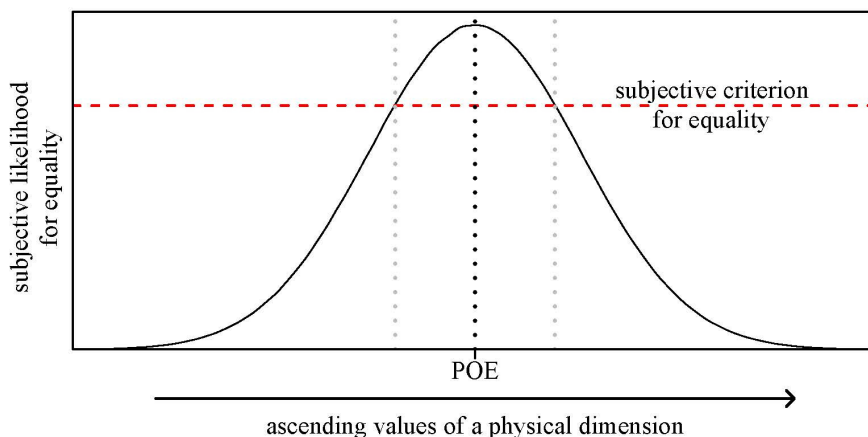


Fig 1: Course of the subjectively perceived probability for the equality between standard and reproduction interval.

If this judgement bias, and not a misperception, is the reason for the under-reproduction phenomenon in timing experiments, the conclusion would be that the under-reproduction of time does not result from the fact that shorter

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