



Contents lists available at ScienceDirect

# Consciousness and Cognition

journal homepage: [www.elsevier.com/locate/concog](http://www.elsevier.com/locate/concog)

Review article

## Cognitions about time affect perception, behavior, and physiology – A review on effects of external clock-speed manipulations

Sven Thönes\*, Stefan Arnau, Edmund Wascher

Leibniz Research Centre for Working Environment and Human Factors, Dortmund, Germany

### ARTICLE INFO

#### Keywords:

Time perception  
Time passage  
Duration  
Cognition  
External clock speed  
Appraisal theories  
Motivation  
Mental fatigue

### ABSTRACT

Our understanding of (altered) time perception may benefit from investigating its potential effects upon other psychological and physiological parameters. To date, however, only a few rather isolated studies have experimentally manipulated the subjective passage of time or the amount of apparently elapsed duration in order to investigate such effects. Based on our review of these studies, first, altered time perception can be induced effectively by means of rigged (accelerated or decelerated) external clocks, second, these clock-speed manipulations remain unnoticed by most participants, and third, several psychological, cognitive, behavioral, and physiological variables can be affected, e.g., fatigue, hunger, pain perception. However, the existing studies on time-perception manipulation do not systematically relate to each other and the underlying mechanisms of the observed effects are poorly understood. Based on cognitive appraisal theories and the given empirical results, we propose a cognitive framework for interpreting and explaining the effects of manipulations of time perception.

### 0. Introduction

Time is regarded as a fundamental property of our world and an accurate perception of time is relevant for successful guidance of behavior and well-being. Though, our perception of time is highly subjective and context-dependent. For decades, time perception has been studied extensively as a dependent variable in psychological experiments. By measuring, for example, the perceived duration of a visual or auditory stimulus, or by asking participants how fast time seems to pass in different experimental conditions, various external and internal factors have been isolated that affect our sense of duration and the subjective speed of time passage (for a recent review, see [Matthews & Meck, 2016](#)). However, time perception in terms of perceived elapsed duration or the apparent speed of time passage has rarely been treated as an independent or mediating variable in experimental settings. And yet, the investigation of time perception as a fundamental psychological process in terms of its impact on other cognitive and physiological variables bears a large potential in experimental research. On a theoretical level, models of time perception, such as the prominent pacemaker-accumulator models ([Gibbon, Church, & Meck, 1984](#); [Treisman, 1963](#)), may be refined as being more complex with multidirectional causal relationships between clock components on the one hand and attentional and memory processes on the other hand. Basically, these pacemaker-accumulator models assume an internal clock that consists of a pacemaker emitting pulses and an accumulator collecting or counting these pulses. The amount of collected pulses is positively correlated with the perceived duration of an event, i.e., the more pulses are accumulated, the longer the perceived duration. The clock device is integrated into an information processing system comprising attentional and memory components. Accordingly, it is assumed and has been shown frequently that cognitive processes can affect perceived time (e.g., [Roy, Grondin, & Roy, 2012](#); [Thönes & Hecht, 2017](#); [Tobin & Grondin, 2012](#)). However, it

\* Corresponding author at: Leibniz Research Centre for Working Environment and Human Factors, Ardeystr. 67, 44139 Dortmund, Germany.  
E-mail addresses: [thoenes@ifado.de](mailto:thoenes@ifado.de) (S. Thönes), [arnau@ifado.de](mailto:arnau@ifado.de) (S. Arnau), [wascher@ifado.de](mailto:wascher@ifado.de) (E. Wascher).

remains uninvestigated whether the perception of time, e.g., the state of the internal clock, may also affect other perceptual and cognitive processes. Therefore, on a more applied level, systematic manipulations of time perception or a directed induction of specific time-related cognitions may be used to improve cognitive performance and facilitate motivation (e.g., ‘time is passing quickly – the task is interesting’).

Surprisingly, the idea to investigate perceived time as an independent variable was brought forward in the 1960s already (Rotter, 1969) but it has not been pursued systematically. Only a few rather isolated studies have investigated time perception as an independent variable and reported potential effects of covert manipulations of external (physical) clocks on a variety of dependent measures, such as mental fatigue, boredom, hunger, and pain perception (Craik & Sarbin, 1963; Lewis, Lobban, & Shaw, 1956; London & Monello, 1974; McGrath & O’Hanlon, 1967; Nelson, Nilsson, & Johnson, 1984; Park, Pagnini, Reece, Phillips, & Langer, 2016; Pomares, Creac’h, Faillenot, Convers & Peyron, 2011; Rotter, 1969; Schachter & Gross, 1968; Snyder, Schulz, & Jones, 1974).

In its first part, the present paper reviews the methods and results reported by the past studies and aims at answering three important questions: First, do participants become aware of covert external clock manipulations and what can be done in order to prevent participants from questioning a rigged clock’s accuracy? Second, is it possible to systematically induce an accelerated or decelerated passage of time by means of external clock-speed manipulations? And third, which specific perceptual, cognitive, and physiological parameters may be affected by external clock-speed manipulations?

In the second part, based on the results from our review, we propose a basic cognitive framework that aims at explaining the effects of clock-speed manipulations in terms of attributional processes. Moreover, we will discuss potential future perspectives for this particular line of research with a focus on its significance in relation to current models of mental fatigue (Boksem & Tops, 2008). By using the term (*external*) *clock-speed manipulation* in the present paper, we refer to accelerated and decelerated clocks in the participants’ environment. The term should not be conflated with the concept of an *internal clock* as commonly used in the time perception literature (e.g., Meck, 1983; Wearden, 2008).

## 1. Background and review of the past literature

In modern societies, we are surrounded by a continuously growing number of time keepers. Over the last decades, classic clocks and wristwatches have been complemented by a variety of technical devices, such as computers, mobile phones, and domestic appliances, that accurately display the current time. Importantly, the validity of the temporal cues provided by these social clocks is generally accepted and serves as an organizing principle within our societies: People can fix appointments, plan dates, and structure their everyday life because they have learnt to rely on clocks without questioning their accuracy and regularity. In many western regions, this strong adaptation to clocks is ‘challenged’ twice a year by systematic clock manipulations according to the concept of daylight saving time. In spring, clocks are adjusted forward one hour in order to save daylight in the evening. In fall, clocks are adjusted backward to standard time. Indeed, people seem to react sensibly to these adjustments (e.g., Kantermann, Juda, Merrow, & Roenneberg, 2007). Therefore, the practice of daylight saving time is discussed controversially and negative effects on physiological, cognitive, and behavioral parameters, such as changes in health behavior and sleep quality (Harrison, 2013) as well as increases in traffic accidents (Coren, 1996), have been reported.

Apart from potential effects of clock adjustments according to the procedure of daylight saving time, which are presumably mediated by disturbed circadian rhythms but cannot easily be investigated in a controlled manner, systematic clock manipulations have rarely been studied in an experimental setting. Interestingly, however, such investigations may contribute to our understanding of time perception and its impact on other cognitive and perceptual processes. The strong relevance of clocks in our society, our trust in their accuracy, and our sensitivity to social clock adjustments (e.g., daylight saving time, travel through time zones) suggest that manipulations of external clocks, i.e. perceived time, can affect a variety of perceptual, cognitive, and even physiological parameters.

In an experimental setting, clock manipulations need to be applied cautiously because the participants should not become aware of the manipulation. Therefore, discrete and obvious shifts in apparent time (e.g.,  $\pm 1$  h inside vs. outside a laboratory) do not appear applicable. Previous studies on effects of clock manipulations have focused on adjustments of clock speed. Accelerated and decelerated clocks have been used to manipulate perceived time by inducing the impression of more or less elapsed duration or altered speed of time passage.

We reviewed the relevant past literature and identified 10 studies that manipulated participants’ time perception by means of clock-speed manipulations in order to investigate potential effects on psychological and/or physiological parameters (see Table 1). In all these studies, time passage or seemingly elapsed duration were manipulated by means of accelerated and/or decelerated clocks that were placed in the laboratory and to which the participants had to attend to (implicitly or explicitly). Without telling the participants, the hands of the presented clocks moved faster or slower depending on the specific experimental condition. Crucially, on the one hand, manipulations of clock speed need to be strong enough to affect the psychological (and physiological) measures of interest, on the other hand, the speed manipulations may not become obvious to the participants. Therefore, and with regard to our first question, clock-speed needs to be adjusted cautiously.

### 1.1. (When) do participants become aware of clock-speed manipulations?

The possible effects of experimental clock-speed manipulations most likely depend on successfully keeping the manipulation concealed. Participants need to ‘believe’ in the clock in order to get the impression that time is running or dragging. Presumably, participants will ignore a clock if they suspect it to be inaccurate.

To keep a clock manipulation concealed, experimenters need to instruct the participants to remove their watches (and other clock

Download English Version:

<https://daneshyari.com/en/article/7287835>

Download Persian Version:

<https://daneshyari.com/article/7287835>

[Daneshyari.com](https://daneshyari.com)