



The effects of sex, age, and interval duration on the perception of time

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ABSTRACT

The present experiment examined the interactive effects of sex, age, and interval duration on individual's time perception accuracy. Participants engaged in the duration production task and subsequently completed questionnaires designed to elicit their temporal attitudes. The overall group of 100 individuals was divided evenly between the sexes. Five groups, each composed of 10 males and 10 females, were divided by decades of age ranging from 20 to 69 years old. The specific time estimation task was an empty interval production procedure composed of 50 trials on each of four different intervals of 1, 3, 7, and 20 s, respectively. The presentation orders of these intervals were randomized across participants but yoked across the sexes within each of the respective age groups. Analysis of the production results indicated significant influences for the sex of the participant while age did not appear to affect estimates of these short durations. Temporal attitudes, as reflected in responses to time questionnaire inquiries, did however exhibit significant differences across age. The contending theoretical accounts of such sex and age differences are considered and explanatory accounts that present a synthesis of endogenous and exogenous causal factors are discussed in light of the present pattern of findings.

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1. Introduction

From earliest human history, the problem of time has represented a frustrating puzzle for all of philosophy and science (e.g., Augustine, 397; Fraser, 1987; Russell, 1915). The need for an understanding of time has pervaded the science of psychology from its very inception through the present day concerns of cognitive and neurosciences (see Dennett & Kinsbourne, 1992; Harrington, Haaland, & Knight, 1998; Michon, 1985; Michon & Jackson, 1985; Poppel, 1997). Yet time perception has persistently failed to establish any meaningful position within general theories of behavior. Previously, this shortfall was attributed to the inability of time perception researchers to link their specific theories directly with more mainstream psychological issues such as memory and attention (Adams, 1964). However, as Block (1990) has trenchantly noted: 'time can no longer continue to be ignored by psychologists who propose models of non-temporal behavior, because non-temporal behavior does not exist.' Many reasons persist as to why time perception still fails to occupy a central role in contemporary psychological science. However, perhaps the most obvious obstacles remain the vast differences that are observed between

individuals in their perception of even the most common intervals of duration (Doob, 1971; Rammsayer, 1997).

When asked to estimate even a brief interval of time in the order of a few seconds, there is a remarkable range of responses that accrue across different individuals. This is seen generally as a problem, since we frequently wish to derive general or nomothetic principles that hold across all people (Eagleman et al., 2005). To some, this behavioral variability proves to be a source of great frustration. For others, individual variation is the path through which one understands the essence of behavior itself (cf., Cronbach, 1957). However, even when we tackle this issue of individual variation head-on, we still seek commonality on some level in order to identify potential systematic sources of effect across sub-groups of individuals. In line with this concern, the present work examines the impact on response capacity of two characteristics that are commonly used to group individuals together, namely their sex and their age.

With respect to sex differences in time estimation, there are a number of extant results which have served to confirm the presence of significant sex difference which were observed spectacularly by MacDougall (1904) at the turn of the 20th Century (cf., Delay & Richardson, 1981; Hancock, Vercruyssen, & Rodenburg, 1992). In contrast to these positive reports, others have indicated no sex differences in time estimation (e.g., Getsinger, 1974; Roekelein, 1972). Even within those studies that have observed significant sex differences there remain potentially disturbing

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inconsistencies. For example, some reports demonstrate that females underestimate durations with respect to males (e.g., Axel, 1924) while others show exactly the opposite effect (e.g., Harton, 1939). Much of this confusion is the result of a misunderstanding of the nature of the different methods used to assess time perception (see also Hornstein & Rotter, 1969). When these methodological differences are resolved, the vast majority of studies show a consistent pattern (and see Block, Hancock, & Zakay, 2000) that is, when using the production technique, females underestimate brief intervals of time with respect to males. It should, however, be carefully noted here that this general statement actually says nothing about absolute levels of accuracy of estimates themselves as the respective accuracy levels tend to vary across differing studies.

The consistency of sex differences is further clarified by the detailed evaluation of studies that reported negative findings. Such an analysis reveals the very interesting trend that the negative reporting studies rely overwhelmingly on a score derived from a single response from each individual. In contrast, studies that use multiple trials have almost ubiquitously found reliable sex differences. Thus, Block et al. (2000) in their formal meta-analysis of this overall area of research, found that both trial and estimation methods were amongst the most significant modifying variables (and see also Bindra & Waksberg, 1956; Clausen, 1950; Guay & Salmoni, 1988, for discussions of time estimation methods).

A number of other influences can also modulate the presence or absence of a sex difference in time estimation. For example, the size of recorded sex differences appears to vary according to the sensory modality that is used to present the target interval of concern (Roekelein, 1972). Also, the time-of-day at which performance is measured (Hancock et al., 1992) and the ego strength of the individual involved (Getsinger, 1974) appear to further modulate the degree of difference reported. In previous work, we (Hancock, Arthur, Chrysler, & Lee, 1994) have also demonstrated that the presence or absence of light in the testing environment differentially affects how men and women estimate brief intervals of time. In sum, there appears to be a consistent but often small effect for sex on the estimation of brief intervals of time that is tempered by a variety of interactive influences.

If sex differences account for some of the individual variation in time perception, another factor that has been proposed as an important influence is a person's chronological age. With respect to age effects, the overall picture is less certain than that for the sex of the individual (see Block, Zakay, & Hancock, 1998; McCormack, Brown, Mylor, Darby, & Green, 1999). In looking to understand the overall area, Block (1990) identified three main aspects of time perception, namely succession, duration, and temporal perspective. These three aspects differ in terms of the absolute time intervals involved. Often, succession is concerned with differences in the order of milliseconds while duration tends to focus on intervals of seconds, through minutes, up to hours. Temporal perspectives frequently references periods as long as years or even a whole lifetime (Hancock, 2010). The nature of the current experimental findings on age and time perception is thus considered in light of this tri-partite differentiation of relevant measurement intervals (and see Block et al., 1998).

It has frequently been proposed that there are strong effects of age on one's temporal perspective and the well-known subjective acceleration of time with aging is often cited as support for this effect. Support for such an assertion comes from sources as diverse as poetry (Campbell, 1802), introspection (Cohen, 1967; Nitardy, 1943), biochemical analysis (DuNouy, 1937), and experimental (Bull, 1973) as well as synthetic approaches (and see Hancock, 2002). There are a number of differing theoretical interpretations of this phenomenon of speeded time perception with age (see Janet, 1877; Lemlich, 1975). The specific causal structure of this

phenomenological acceleration has yet to be articulated fully. The effects of aging upon succession and simultaneity are even less clear. The consensus in the gerontological literature is of a progressive slowing of responsivity with age (Birren & Schaie, 1990). Therefore, we might suspect a progressive diminution in ability to judge the fine-grain temporal succession of events with age. However, this is a problematic assertion in the face of known individual differences in capability across chronological age. Also uncertain are the specific effects of age on duration estimation (cf., Rammsayer, Lima, & Vogel, 1993; Surwillo, 1964), especially brief intervals of the order of seconds (but see Craik & Hay, 1999; Poppel, 1988; Rammsayer, 2001).

Together, age and sex have been shown to interact in affecting performance on some forms of temporal task such as simple and complex reaction time (Fozard, Vercruyssen, Reynolds, Hancock, & Quilter, 1994). It is likely that any mechanism or mechanisms that underlie speeded reaction time also influence time perception. Consequently, the present work examined the effects of both age and sex in conjunction on the production of brief intervals as well as assessing temporal attitudes of these self-same individuals. There are some findings that have been previously reported on the combined influence of age and sex (see Bull, 1973; Espinosa-Fernandez, Miro, Cano, & Buela-Casal, 2003). Bull (1973) for example, examined these influences but only at durations that well exceed the brief number of seconds used in the present work. In contrast, Espinosa-Fernandez et al. (2003) have reported on the estimate of one specific interval (i.e., 10 s) which is directly comparable with the range of the presently selected durations. Although comparisons are here drawn between the current findings and this previous outcome, it is still the case that a full picture of the combinatorial sex and age effects on the estimation of brief temporal intervals has yet to be unequivocally established.

Solving the riddle of the vast individual differences in time estimation will obviously depend upon the further articulation of the influence of specific person-related factors. However, it is not only the variations intrinsic to the individual tested that have proved the sole barrier to the integration of time perception into the heart of psychological science. As well as such inter- and indeed intra-individual variability, we remain at present unsure whether there is one central mechanism or potentially several discrete, connected mechanisms involved in the production of and perception of temporal intervals ranging from seconds to minutes and on to months, years and the full length of a lifetime (see Hancock, 2010). While it is reasonable to postulate that memory-based effects have a stronger influence as the perceived interval increases, we are still seeking to understand the perception of brief intervals in and around what William James (after E.R. Clay) termed the 'specious present' (see James, 1890). One can argue that this contention centers around which appropriate physical interval it is that connotes the experience of the present moment, or what Gray (2009) has recently termed the 'saddle' of temporal experience. If there are a number of discrete contributions to the perception of the present moment then assessment across the intervals that have been proposed to represent the potential bounds of this saddle should reveal such thresholds as discontinuities in the pattern of outcome responses. It is this proposition that is explored therefore as part of the present experiment. Thus, given the foregoing observations, the purpose of the present experiment was to evaluate the effects of sex and age on the ability to produce response across a range of short duration intervals from 1 to 20 s and to compare such responses with those from questionnaires designed to elicit attitudes toward longer intervals of time. The theoretical foundation of the work is centered on the search for a unified endogenous temporal mechanism which is purported to vary systematically across individuals of different age and sex (see also Poppel, 1988; Treisman, 1963) and brief intervals of time in the order of seconds in duration.

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