Modulation of Perceived Duration by Contextual (Motion) and Dopaminergic Factors: An Integrated Psychophysical, Functional Imaging, Electrophysiological, and Psychopharmacological Approach

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Research Abstract

Ever since humans have thought of time and its perception, they have associated it with motion (see Aristotle, -350; Spencer, 1855). Since Leibniz (passim Vailati, 1997) and Einstein , motion has been conceptualized in relativistic terms. Perception of time must then also be relative or contextual. For example, when estimating the duration of an event (“explicit timing”) the same objective duration can appear subjectively shorter or longer depending on how much attention is paid to the passage of time (“time flies when you’re having fun” or “a watched pot never boils”; James, 1890), or how fast the stimulus is moving (Brown, 1995; Kanai et al, 2006). The temporal information inherent in motion can also be used to optimize behavior by allowing us to anticipate when an event will occur (“implicit timing”). For example, when crossing a busy road we use the motion trajectory of an oncoming car to determine whether we have enough time to cross safely. However, the extent to which explicit or implicit timing is sensitive to the motion of an environmental context, rather than to motion of the focal stimulus itself, is as yet unknown. One of the major objectives of the present project is to examine how contextual motion effects modulate the perception of time during both explicit and implicit timing and to assess the neurophysiological substrate of such modulation. The perception of time is not exclusively dependent on stimulation factors (such as motion) however. It is also modulated by internal factors, such as the neurochemical state of the subject. The neurotransmitter dopamine (DA) has been shown to play a critical role in time estimation (e.g. Meck 1986; Meck 1996; Rammseyer, 1997; Coull et al. 2010). The second major goal of this project is to examine how DA modulates time perception, during both explicit and implicit timing, and to explore whether it interacts with contextual (motion) effects in both healthy humans and monkeys. Presumably because of significant losses of their dopaminergic neurons, Parkinson’s Disease patients are known to be impaired in judging time (Artieda et al 1992; Harrington et al, 1998; Rao et al. 2001). The third objective of the project is to assess contextual timing modulation in PD patients. Here we propose a multidisciplinary experimental approach of contextual and dopaminergic modulation of explicit and implicit timing making use of a unitary experimental paradigm. The paradigm allows the exploration of these factors within identical experimental conditions using three complementary techniques (psychophysics, electrophysiology and fMRI). It will be used with both humans (psychophysics, fMRI) and monkeys (psychophysics, electrophysiology), and with both healthy volunteers and patients with Parkinson’s Disease.

Hence, the three focal issues addressed are:

• Visual motion contextual effects on explicit and implicit timing and their neuroanatomical (fMRI) and neurophysiological (electrophysiology) substrate

• Dopaminergic effects on explicit and implicit timing in healthy volunteers

• Explicit and implicit timing in PD patients

Further information available at:

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