Consciousness and Cognition 30 (2014) 184–200

Contents lists available at ScienceDirect

Consciousness and Cognition

journal homepage: www.elsevier.com/locate/concog

Review

Do cortical midline variability and low frequency fluctuations mediate William James' "Stream of Consciousness"? "Neurophenomenal Balance Hypothesis" of "Inner Time Consciousness"

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ARTICLE INFO

Article history:
Received 12 May 2014

Keywords:
"Inner time Consciousness"
William James
Cortical midline structures
Variability
Frequency fluctuations
Functional connectivity

ABSTRACT

William James famously characterized consciousness by 'stream of consciousness' which describes the temporal continuity and flow of the contents of consciousness in our 'inner time consciousness'. More specifically he distinguished between "substantive parts", the contents of consciousness, and "transitive parts", the linkages between different contents. While much research has recently focused on the substantive parts, the neural mechanisms underlying the transitive parts and their characterization by the balance between 'sensible continuity' and 'continuous change' remain unclear. The aim of this paper is to develop so-called neuro-phenomenal hypothesis about specifically the transitive parts and their two phenomenal hallmark features, sensible continuity and continuous change in 'inner time consciousness'. Based on recent findings, I hypothesize that the cortical midline structures and their high degree of variability and strong low frequency fluctuations play an essential role in mediating the phenomenal balance between sensible continuity and continuous change.

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http://dx.doi.org/10.1016/j.concog.2014.09.004
1053-8100/

1. Introduction

1.1. Aims and parts

"Inner time consciousness" describes our subjective experience of time and how that structures and organizes the various contents in our consciousness, the "stream of consciousness" as James (1890a) said. James characterized the "stream of consciousness" by different phenomenal features like the contents in consciousness, the "substantive parts", and the linkages or transitional periods between them, the "transitive parts". The transitive parts themselves can be described by balance between "sensible continuity" and "continuous change". Most importantly, there seems to be a particular balance between sensible continuity and continuous change which makes possible the stream of consciousness in our inner time consciousness. This touches upon what can also be described as implicit time consciousness as distinguished from explicit time consciousness which shall be discussed below in further detail.

Recent neuroscience has developed several theories of the neural correlates of consciousness with the information integration theory (Tononi, 2004; Tononi & Koch, 2008) and the global workspace theory (Baars & Franklin, 2007; Dehaene & Changeux, 2011) being most popular (see Dehaene & Changeux, 2011; Northoff, 2014b recent overviews). These and other theories concern the neural mechanisms of the contents in consciousness, the substantive parts, in general while not addressing specific phenomenal features like the stream of consciousness in inner time consciousness. Recent proposals for the neural mechanisms of inner time consciousness have been suggested and focused on cognitive functions like working memory or iconic memory (Fuster, 1997; Kelly, 2005), affective functions (Craig, 2009b, 2009a, 2010a, 2010b, 2010c; Varela, 1999), or interoceptive functions (Seth, Barrett, & Barnett, 2011; Wittmann, 2013; Wittmann, Simmons, Aron, & Paulus, 2010; Wittmann et al., 2011; Wittmann, Virginie van Wassenhove, & Paulus, 2010). These approaches focus on stimulus-induced or task-evoked activity related to the various functions during perception and cognition of time which allows accounting well for the contents, the substantive parts, in inner time consciousness. One may thus speak of neuro-cognitive, neuro-affective, and neuro-vegetative hypothesis of 'inner time consciousness'.

In contrast, these approaches focusing mainly on contents in time leave open the neural mechanisms underlying the transitive parts, sensible continuity and continuous change. The transitive parts allow for the construction of the ongoing stream of consciousness as experienced in inner time consciousness within which the various contents are temporally integrated. As such the transitive parts may be central for constructing specifically the phenomenal features of the stream of consciousness as distinguished from its contentual features, the substantive parts, as we perceive and cognize them. We may thus need to shift our focus from the neural correlates of the perception and cognition of contents in inner time consciousness, the substantive parts, to those neural mechanisms that are related to the construction of the phenomenal features of inner time consciousness, the transitive parts.