CHAPTER 1

Distorted Multisensory Experiences of Order and Simultaneity

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1 Introduction

In order to deal appropriately with the events in its environment, an animal must perform at least two essential actions. It must be able to identify or characterize an event, and it must also be able to determine when the particular event occurred in relation to other events. [...] “Meaning” requires that the unitary bits of information be kept in a proper sequence. 

Efron, 1963a

In his 1963a paper, Efron points out the importance of event identification and event ordering for the construction of meaning. Given that we live and thrive in a multisensory environment, Efron’s ‘unitary bits’ include information from multiple sensory modalities that may be complementary, contradictory or at some level of equivalence. The percept of these sensory ‘bits’ of information as synchronous and unified leads to the percept of a multisensory event rather than multiple, independent sensory events (Vatakis & Spence, 2010). Research to date has shown that the human perceptual system maintains the percept of synchrony between two sensory streams even though these streams may be processed/presented close but not exactly in time (Vatakis, 2013). The maintenance of a synchronous percept is accomplished through the hypothesized existence of a temporal window of integration (TWI; i.e., the interval in which no signal discrepancy is perceived, anything beyond this interval will normally be perceived as being desynchronized or asynchronous; e.g., King, 2005; Spence & Squire, 2003; Vatakis & Spence, 2010; Vroomen & Keetels, 2010). We, thus, have ‘moments’ (or ‘functional moments’ as per Wittmann, 2011) that have no perceivable duration and can be perceived as simultaneous or ‘somewhat’ simultaneous (yet order cannot be perceived) and ‘moments’ that are successive with specific and detectable order of presentation (e.g., Pöppel, 1985, 2004;
Vatakis and Bakou2 Wittmann, 2011). These ‘moments’ are integrated into ‘event intervals’ (or ‘experienced moments’; Wittmann, 2011) that compose our percept of a continuously flowing multisensory event. But how these ‘moments’ and ‘intervals’ associate/interact so as to provide the continuously flowing in time experience of multisensory events?

The majority of clinical research in timing has focused on the ‘event interval’ level (e.g., Allman, 2011; Buhusi & Meck, 2005), while multisensory ‘moments’ and their integration have been understudied, thus, ignoring the potential link of the experience of intervals according to the synchrony and unity of moments. For example, it may be the case that high pacemaker rates may be associated with higher temporal resolution of the timing mechanism(s), which, in turn, should result in lower temporal discrimination thresholds (i.e., better performance and, thus, smaller TWI); Rammsayer & Classen, 1997; Wenke & Haggard, 2009). Such associations have not been attempted partially due to that fact that researchers in the two areas of focus – synchrony perception and interval timing – have been working in isolation, but also because the mechanisms governing the integration of multisensory moments to event intervals have not been elucidated. Given, therefore, the previous focus on interval timing in clinical populations, in this chapter we will review the literature on multisensory temporal processing in various disorders/conditions in an attempt to draw some first conclusions and encourage future research on the association of multisensory temporal integration, interval timing, and event perception.

2 Multisensory Temporal Integration: A First Look

Our everyday and effortless (as it seems) experience of multisensory events, which are temporally and semantically unified, allows for faster and more accurate detection, discrimination, and localization of targets at hand. Thus, the multisensorial nature of our experiences, not only makes life more enjoyable, but also provides valuable behavioral and perceptual benefits (Calvert, Spence, & Stein, 2004). These benefits along with the altered percepts that are born out of crossmodal interactions (e.g., the McGurk effect, the visual influence on the perception of audiovisual speech; MacDonald & McGurk, 1978) have lead to a vigorous body of research on multisensory processing during the last 20–30 years. Given the ‘young age’ of this area, multisensory temporal integration have primarily been investigated in healthy participants, while the majority of studies with patients experiencing a disruption of audiovisual perception could potentially be interpreted as a consequence of other neurological deficits (e.g., Böhning, Campbell, & Karmiloff-Smith, 2002; Campbell et al.,