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Present self, past self and close-other: Event-related potential study of face and name detection

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ABSTRACT

A growing body of evidence suggests that information regarding the past self and other people is processed similarly. However, there is not much evidence supporting this notion at the neural level. In this event-related potential (ERP) study we examined processing of one's own marital and family name (i.e., present and past self-name, respectively) and images of present and past self-face in comparison to names and faces of others (the close-other, famous and unknown person). Amplitudes of P300 (a late ERP component associated with attention, emotion, and autobiographical memory) to self-face and self-name, either present or past, was enhanced in comparison to famous and unknown faces and names. No differences, however, were observed between the past and present self-names as well as between past and present self-faces. Moreover, P300 amplitude to the past self-face was enhanced in the right hemisphere in comparison to the close-other's face, whereas P300 amplitudes to the past self-name and the close-other's name did not differ. Thus, our results indicated that information related to non-physical aspects of the past self were processed similarly to the close-other.

1. Introduction

The sense of self-continuity seems to be an essential aspect of the human consciousness (Gallagher, 2000; Moran et al., 2006; Morin, 2006). It is related to autobiographical memory and it is based on the ability to consolidate different and temporally separated pieces of self-related information into a one coherent whole (Conway, 2005; McAdams, 2001). Life brings substantial changes (both physical, e.g., weight gain/loss and situational, e.g., start of a new job) as time passes, and these changes imply significant modifications of self-related information. As the self continually evolves, the self-concept is updated in order to account for these alterations (Demo, 1992; Deutsch et al., 1988).

A growing body of evidence indicates that people distance themselves from their past self when they perceive self-changes, even regarding their past self as 'another person' (Libby & Eibach, 2002; Pronin & Ross, 2006; Wilson & Ross, 2003). This is especially the case when recalling past behaviors and situations that are discrepant with the present self-concept. On such occasions people frequently adopt a third-person perspective, as if looking not at themselves but at someone else (Libby & Eibach, 2002). Additionally, people asked to form images of past events in which they participated often claim to see them from the perspective of an external observer (e.g., Cohen & Gunz, 2002). Also, attributions made about the past self resemble attributions made about others rather than attributions regarding the present self (Pronin & Ross, 2006). All in all, it seems that following numerous personal changes people may process information about their past selves as information about others.

The topic of changes to the self across time has been the focus of many research groups. However, only a few attempts have been recently made to unravel the neural basis of temporally-distant selves. For both the present and distant time-periods, previous studies investigated self-reflection (D'Argembeau et al., 2008, 2010; Luo et al., 2010), subjective mental time (Arzy, Collette, Ionta, Fornari, & Blanke, 2009), and self-face recognition (Apps, Tajadura-Jimenez, Turley, & Tsakiris, 2012; Butler, Mattingley, Cunnington, & Suddendorf, 2013).

In one of the earliest studies in this field, evaluations of psychological characteristics of one's own person and the other (friend) were conducted for both the present and a past time periods while functional magnetic resonance imaging (fMRI) data were collected (D'Argembeau et al., 2008). The degree of activity in cortical midline structures (CMS) was significantly influenced by both the target of reflection and period of time. The ventral and dorsal medial

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prefrontal cortex (MPFC) and the posterior cingulate cortex were more recruited when reflecting on the present self than when reflecting on the past self or when reflecting on the close friend, with those two conditions showing no differences. In a follow-up study, the MPFC activity was higher when reflecting on the present self than when reflecting on both past and future selves (D'Argembeau et al., 2010). The effects of temporal perspective, however, were not modulated by the trait valence.

Interestingly, this impact of emotional valence on the neural basis of self-evaluation across time was reported in an event-related potentials (ERP) study (Luo et al., 2010). In that study, for both present and past selves, the process of evaluation of negative traits in comparison to positive traits, resulted in higher amplitudes of a late positive ERP component (so-called late positive complex—LPC) in the 650–800 ms time window. The behavioral findings of this study indicated that for each temporal self, participants had consistently less negative and more positive views of themselves, in line with studies on self-enhancement (Leary, 2007; Sedikides & Gregg, 2008).

Arzy et al. (2009), in turn, investigated subjective mental time, i.e., 'self-projection' of oneself to different time points not only with respect to one's life events but also with respect to one's faces from different past and future time-points. Participants were asked to imagine themselves at one of three different self-locations in time: 'now' (the present time), 'past' (8 years in the past) or 'future' (8 years in the future). Face images of the participant as well as a famous person (George Clooney) were modified in such a way that they represented the participant's and Clooney's face appearing as 4, 12 and 20 years younger (past faces) or older (future faces). In one part of their experiment, faces of the participant or of Clooney were shown and participants were asked to indicate whether the presented face represented the participant's/Clooney's appearance before (relative-past) or after (relative-future) the imagined self-location in time. Similarly, in the other part of the experiment participants were asked to indicate whether the presented event from their personal life or world history occurred before or after the currently imagined self-location in time. Analysis for past, present, and future self-locations revealed a network common for both faces and events, consisting of the right anteromedial temporal lobe, posterior parietal cortex bilaterally, left inferior frontal cortex, insula bilaterally, and right temporo-parietal junction. In a subset of these brain regions, the percent of fMRI signal change showed higher activation for the past and future self-locations than for the present self-location.

Finally, several studies reported changes in brain correlates associated with processing of present and past self-faces (Apps et al., 2012; Butler et al., 2013). Neural circuits involved in the recognition of childhood and current (adult) faces were examined using fMRI (Apps et al., 2012). Participants viewed images of either their own present face morphed with the face of a familiar other or their childhood face morphed with the childhood face of a familiar other. Morphed images of adult self-faces activated different neural networks than morphed images of self-faces in childhood. Specifically, activity in the inferior occipital gyrus, the superior parietal lobule and the inferior temporal gyrus varied with the amount of current self in an image whereas activity in the hippocampus, the posterior cingulate gyrus, the temporo-parietal junction and the inferior parietal lobule varied with the amount of childhood self in an image (Apps et al., 2012).

In a recent study, ERP responses to past and present images of participants' faces were investigated in a group of dizygotic twins (Butler et al., 2013). Photographs were taken when they were 5–15, 16–25 and 26–45 years old. The former two time periods referred to the past (more-distant and less-distant past, respectively) whereas the latter corresponded to the present, i.e., the period of time in which the experiments were done. Control stimuli consisted of the participant's twin and unfamiliar other's photographs of faces, coming from the same time periods. The results of this study clearly showed that amplitudes of N400 (a late negative ERP component in the 400–600 ms time window) differed as a function of time period, but only for images of self and not for twin. Processing of both the present self-face and the less-distant-past self-face resulted in greater N400 than identification of the self-face in the early period of life.

All in all, some of the aforementioned studies reported differences between neural underpinnings of the past and present selves (Arzy et al., 2009; D'Argembeau et al., 2008; D'Argembeau et al., 2010) whereas others did not (Luo et al., 2010). In two cases, such differences were found for the current self compared to the very-distant-past self, i.e., the self in childhood (Apps et al., 2012; Butler et al., 2013) but they were absent if the current self was compared to the less-distant-past self, i.e., the self in adolescence and early adulthood (Butler et al., 2013).

As far as relation between the past self and the other is concerned, not much evidence exists—at the neural level—supporting the notion that the past self is processed like the other. Only one study reported that neural circuits associated with evaluation of psychological traits in respect to the past self and the other (friend) did not differ (D'Argembeau et al., 2008). Other studies either did not include 'the other' as a control condition (D'Argembeau et al., 2010; Luo et al., 2010), or did not compare the past self vs. the other (Apps et al., 2012; Butler et al., 2013). Therefore, one may wonder whether the neural underpinnings associated with the past self and the close-other (friend, mother, etc.) are similar when processing of information other than personality traits is required.

For this reason, in the current study ERP responses to present and past self-faces and self-names were compared to ERP responses to faces and names of the close-other, famous, and unknown people. There is no doubt that one's own present and past faces are appropriate to capture time-related changes in the self (Butler et al., 2013). However, we propose that one's own name is also suitable to refer to the past and present selves if it has been changed at some point in life. Examples of such changes include protected witnesses and women who take their husband's name after marriage. It is worth noting that the latter is much more common than the former. Thus only married women who voluntarily changed their names participated in our study, and subject's family name was considered to be the past self-name, whereas the subject's marital name was the present self-name. In contrast to previous studies on past and present self-face processing that used a series of past self-face images (Arzy et al., 2009; Butler et al., 2013), only one image of the past self-face was presented to participants. It was taken just before the name-change (i.e., before marriage) and the image of the present self-face was taken just before participation in our study.

Similarly to our previous ERP studies on name and face processing, we used here written full names (Cygan, Tacikowski, Chojnicka, Ostaszewski, & Nowicka, 2014; Tacikowski & Nowicka, 2010; Tacikowski et al., 2011). Thus, these two different types of stimuli were presented within the same (visual) modality. This was done to reduce—as much as possible—the number of factors that could potentially differentiate ERPs to names and faces.

ERP studies within the framework of the person-recognition models (Bruce & Young, 1986; Burton et al., 1990; Valentine, Moore, & Brédart, 1995) identified several correlates of face and name processing. The occipito-temporal N170 (a negative deflection occurring around 170 ms after the stimulus onset) was shown to be sensitive to face inversion, but it was rather unaffected by the familiarity of a face (e.g., Bentin, Allison, Puce, Perez, & McCarthy, 1996). N170 is often larger for names than for faces in the left hemisphere (Schweinberger, Ramsay, & Kaufmann, 2006; Tacikowski et al., 2011) and larger for faces than for names in the right hemisphere (Rossion & Jacques, 2008). Moreover, N170 is rather unaffected