



# Gender identity better than sex explains individual differences in episodic and semantic components of autobiographical memory and future thinking

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## ABSTRACT

A recently tested hypothesis suggests that inter-individual differences in episodic autobiographical memory (EAM) are better explained by individual identification of typical features of a gender identity than by sex. This study aimed to test this hypothesis by investigating sex and gender related differences not only in EAM but also during retrieval of more abstract self-knowledge (i.e., semantic autobiographical memory, SAM, and conceptual self, CS), and considering past and future perspectives. No sex-related differences were identified, but regardless of the sex, feminine gender identity was associated with clear differences in emotional aspects that were expressed in both episodic and more abstract forms of AM, and in the past and future perspectives, while masculine gender identity was associated with limited effects. In conclusion, our results support the hypothesis that inter-individual differences in AM are better explained by gender identity than by sex, extending this assumption to both episodic and semantic forms of AM and future thinking.

## 1. Introduction

Today, beyond physical characteristics, growing evidence shows that women and men differ significantly in their cognitive and neurobiological mechanisms (Andreano & Cahill, 2009; Halpern, 2013; Sherwin, 1996; Wassell, Rogers, Felmingam, Bryant, & Pearson, 2015). For instance, many studies reported a male advantage in spatial processing and a feminine advantage in verbal tasks, although it appears that sex-related differences in cognition may well extend beyond this simple opposition, especially in the field of memory (for a review see Andreano & Cahill, 2009). From a biological perspective, sex-related hormonal differences are known to affect cognition and especially memory (Sherwin, 1996; Wassell et al., 2015). Being a man or a woman is an important part of who we are and who we will be in that belonging to one sex provides a legion of autobiographical and general information and expectations about our behavior, preferences and social roles (Garcia-Falgueras, 2014).

Autobiographical memory (AM) contributes to the sense of identity in that it contains a set of information about oneself, stored at different levels of abstraction, which allows self-definition: I was, I am and I will be (Conway, 2001; Klein & Gangi, 2010; Martinelli,

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Anssens, Sperduti, & Piolino, 2013a; Renoult, Davidson, Palombo, Moscovitch, & Levine, 2012; Singer, Rexhaj, & Baddeley, 2007). Thus, different components of AM, underpinned by different neural correlates (Martinelli, Sperduti, & Piolino, 2013c), are distinguished:

- *Episodic autobiographical memory (EAM)* that allows the recollection experience of a memory associated with autonoetic consciousness (Tulving, 2005), i.e., the feeling of traveling through time to relive or re-experience a unique personal event, lasting less than 24 h and recollecting details related to the context and the occurrence of this event (spatio-temporal context, perceptions, emotions, thoughts);
- *Semantic autobiographical memory (SAM)*, which refers to recalling factual information about oneself without the recollection of the encoding context, and gives rise to a sense of familiarity which is referred to as noetic consciousness (Tulving, 2005) or the recall of general events, i.e., repeated or extended in time including information about lifetime periods, which are not associated with a sense of reliving the occurrence of a specific event;
- *Conceptual self (CS)* corresponds to the most abstract and summarized representations of oneself including personality traits, beliefs, images and attitudes that define us and underlie our sense of identity. Its role is crucial in supervising generative search strategies of memories, e.g., EAMs via SAMs, generally in coherence with the current-self and a positive self-image, by means of facilitation and inhibition processes (Conway, 2005; Conway, Singer, & Tagini, 2004).

These different levels of representations are therefore intimately linked, and they are not only at stake to remember and know the remote and recent personal past, but also to pre-experience and conceive one's personal future (Abram, Picard, Navarro, & Piolino, 2014; Rathbone, Conway, & Moulin, 2011). Some memories of the past, especially those from adolescence and young adulthood, are particularly crucial for the construction and the maintenance of the sense of identity (Fitzgerald, 1996; Piolino, Desgranges, Benali, & Eustache, 2002; Piolino et al., 2006). Moreover, future-oriented thinking, including affective forecasting, episodic simulation and autobiographical planning, has a strong adaptive value in our daily life since it allows individuals to plan their future actions, helps them to foresee, set goals and represent what is yet to come (Szpunar, Spreng, & Schacter, 2014).

Several studies that have investigated sex-related differences in EAM showed a female advantage that extends not only to the amount of details recollected or speed or number of evocations, but also during the investigation of the content of autobiographical accounts of personal memories. Women seem to report more details (Grysmen & Hudson, 2013; Niedźwieńska, 2003), particularly emotional ones (Cross & Madson, 1997; Davis, 1999; Fujita, Diener, & Sandvik, 1991), remember more specific events than men in a limited testing time and recollect memories more quickly in response to cues (Canli, Desmond, Zhao, & Gabrieli, 2002; Davis, 1999). In the same vein, women also show greater specificity for imagined future events (Wang, Hou, Tang, & Wiprovnick, 2011). By analyzing the narratives' content, sex-related differences in the description of internal states were also evidenced in that women include more elaborations about mental states and especially about emotions in their stories than men (Fivush, Bohanek, Zaman, & Grapin, 2012). Women's memories have thus more meaning from a personal point of view, are endowed with more information about other people and reflect a greater sense of connexion with others (Grysmen & Hudson, 2013). They report events concurring with their self-images as closer to the present than men and dissonant events as more distant in the past (Grysmen, 2014). Nevertheless, Grysmen and Hudson (2013) also noted in their literature review that the expression of these differences could be context dependent in that some instructions such as encouraging recollection of highly relevant memories for oneself (e.g., self-defining memories or memories of decisive events in the participant's life) seem to eliminate sex differences in EAM. Moreover, it could explain the fact that several studies failed to find sex differences in EAM (Piefke, Weiss, Markowitsch, & Fink, 2005; St. Jacques, Conway, & Cabeza, 2011). In addition, no research has directly investigated sex-related differences in general and abstract forms of AM such as SAM (extended in time or repeated events) and CS (abstract self-knowledge). However, some authors (Fuentes & Desrocher, 2013; Grysmen, 2016) examined sex-related differences in the production of semantic and episodic details when recollecting EAMs, i.e., external details relative to the context of the event but which refer to general knowledge, e.g., names of friends present, and internal details specific to the episode, e.g., specific perceptual or emotional details of the event, respectively (for the detailed scoring procedure, see Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002). Their findings suggested a female advantage in the production of episodic details but not of semantic details.

In order to explain these sex-related differences, some research argues in favour of the *cognitive style hypothesis* (i.e., women differ from men in cognitive strategies how they encode, remember or think about their personal experiences, Seidlitz & Diener, 1998). For instance, Fuentes and Desrocher (2013) showed that women remembered more episodic information in comparison to men in the cued recall condition while no sex difference was observed in the free recall condition. These results were interpreted as sex differences in EAM that could originate at the time of encoding, in that women may encode more detailed representations of life events (Cahill & van Stegeren, 2003), thus allowing them to recall a larger amount of additional information when presented with cues in a high retrieval support condition. However, differences in retrieval strategies identified in laboratory tasks (with spatial processes favored in men and verbal ones in women, Halpern, 2013), could also explain these differences in EAM retrieval (Piefke et al., 2005; St. Jacques et al., 2011). According to the *affect intensity hypothesis* (i.e., women benefit from a mnemonic advantage in everyday life because they experience events more intensely and thus remember them more intensely and more often than men, Fujita et al., 1991), Bloise and Johnson (2007) have shown that sex-related differences regarding emotions were mediated by emotional sensitivity, which is particularly interesting in that this result suggests a possible link between the focus of women on emotion and their mnemonic advantage. The reported female advantage could be related not to sex but to their focus on emotion as a factor differentiating participant performances and that tends to be more prevalent among women than men. Thus, this hypothesis assumes that if women are more attentive to emotions than men, this means that attention processes toward emotion could explain their better recall

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