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The relation between verbal and visuospatial memory and autobiographical memory

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ABSTRACT

The basic-systems approach (Rubin, 2005, 2006) states that autobiographical memory is supported by other cognitive systems and argues that autobiographical memories are constructed from interactions between cognitive systems, such as language, vision and emotion. Although deficiencies in one or more of the basic systems influence the properties of autobiographical memories, little is known about how these cognitive abilities and autobiographical memory are related. To assert whether participants with stronger cognitive abilities also perform better on autobiographical memory tests, participants who completed verbal and visuospatial memory tests also recorded one personal event, which they recalled after a certain interval. Participants who performed well on the verbal memory tests also had better retention for the personal event, providing support for the basic-systems approach to autobiographical memory and preliminary support for the view that people have more memories from adolescence and early adulthood because the memory system works optimally in these lifetime periods.

1. Introduction

1.1. Individual differences in memory

Autobiographical memory contains the memories people have of their own life experiences (Robinson, 1986). It not only consists of vivid memories of important and emotional events, such as what one's high school graduation was like, but it also contains memories of mundane events, such as what one ate for breakfast this morning, generic personal memories (or repeated memories), such as what it generally was like to take the train from Maastricht to Amsterdam, and autobiographical facts, such as the name of one's sixth grade teacher (Brewer, 1986; Conway, 1987).

Although autobiographical memory is taxonomically speaking a part of episodic memory (Squire, Knowlton, & Musen, 1993), autobiographical memories are far more complex than episodic memories (Brewer, 1986; Conway, 1987), suggesting that autobiographical memory is supported by different forms of memory. For example, if one cannot remember the face of a person, then that person's face will not be a part of the memory about an event that involved that person. The main goal of the present study is to examine whether autobiographical memory is related to other forms of memory. We will examine

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this relationship by looking at individual differences in autobiographical memory and other forms of memory (i.e., verbal and visuospatial memory).

Many studies on individual differences in different forms of memory have revealed large variations among individuals (e.g., Cowan, 2000; Engle, Kane, & Tuholski, 1999; Jevons, 1871; Miller, 1956; Vogel, Woodman, & Luck, 2001). Such individual differences have also been identified in autobiographical memory (Grysman & Hudson, 2013; Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002; Piolino, Desgranges, Benali, & Eustache, 2002). One important factor influencing individual differences in different forms of memory and other cognitive abilities is age (e.g., Cerella & Hale, 1994; Fiore, Borella, Mammarella, & De Beni, 2012; Li et al., 2004; Park et al., 2002; Salthouse, 2004). Several studies have shown the rise and fall of memory capabilities across the lifespan. A recent study by Murre, Janssen, Rouw, and Meeter (2013), for example, examined the results of more than 28,000 participants who took at least one of possibly ten verbal and visuospatial memory tests on the Internet. The results on the tests were affected by gender, education and age. Women outperformed men on the verbal memory tests, whereas men outperformed women on the visuospatial memory tests. Participants with high educational attainment performed better than participants with low educational attainment. Adolescents and young adults performed better on the verbal and visuospatial memory tests than middle-aged adults, who in turn performed better than older adults. The performance on the visuospatial memory tests showed a higher peak in adolescence and early adulthood and a stronger decrease in middle and late adulthood than the performance on the verbal memory tests.

Despite memory being defined as a collection of separate capabilities to retain information (Squire et al., 1993), different memory systems are often functionally related. For information to be stored in long-term memory, for example, it first has to be held in short-term memory. As information is kept in short-term memory longer, the probability that it will be transferred to long-term memory increases. People who are able to hold more information in short-term memory are therefore also able to transfer more information to long-term memory. Such interactions can cause individual differences in one type of cognitive abilities to be predictive of those in other types of cognitive abilities. For example, working memory capacity has been found to predict IQ (Deary, Penke, & Johnson, 2010) and mathematical skills (Raghubar, Barnes, & Hecht, 2010).

In the present study, we will examine whether there is a relation between verbal and visuospatial memory and the formation and retrieval of autobiographical memories. People who are generally less able to store or retrieve verbal and visuospatial information are assumed to have difficulties to store and retrieve such information about personal events. There were two reasons for choosing to examine autobiographical memory's relation to verbal and visuospatial memory. The first reason is that many studies have shown strong individual differences in verbal and visuospatial memory. The second reason is that these two forms of memory are easy to measure through the internet.

1.2. Basic-systems approach

One theory of autobiographical memory that builds on the idea that different memory systems are often functionally related is the basic-systems approach (Rubin, 2005, 2006). The approach states that autobiographical memory is supported by other cognitive systems, because autobiographical memories are multimodal entities. They can involve seeing, hearing, smelling, tasting, touching and language, and can vary greatly in spatial, temporal, emotional and narrative content. This approach argues that deficiencies in one of these cognitive systems will lead to deficiencies in the content or phenomenology of autobiographical memories.

These cognitive processes are reflected by the brain areas that are activated when people retrieve autobiographical memories (St. Jacques, 2012): lateral pre-frontal cortex (control processes), dorsal and ventral parietal cortex (top-down and bottom-up attention), medial pre-frontal cortex (self-referential processes), hippocampus and retrosplenial cortex (recollection), amygdala (emotion), and occipital, cuneus and precuneus regions (visual imagery). Although each basic system has its own functions, processes, and neural substrates, the systems interact to form autobiographical memories.

The approach has several similarities with other theories of autobiographical memory, such as Conway's Self-Memory System (Conway, 2005; Conway & Pleydell-Pearce, 2000). Both theories regard autobiographical memory as a reconstructive process with specific neural substrates. However, the theories differ on how the self is represented. In contrast to the Self-Memory System, the self is, according to the basic-systems approach, not a single entity but distributed among the individual systems.

On the basis of Rubin's basic-systems approach (Rubin, 2005, 2006), we hypothesize that cognitive abilities are related to autobiographical memory. Many of the basic systems are known to be affected by age (e.g., Cerella & Hale, 1994; Fiore et al., 2012; Li et al., 2004; Murre et al., 2013; Park et al., 2002; Salthouse, 2004). These age-related changes are expected to have an effect on autobiographical memory performance, because deficiencies in one or more of the basic systems influence the properties of autobiographical memories. Several individual difference studies have found strong relationships between cognitive abilities, such as processing speed and working memory, and episodic memory (e.g., Clarys, Bugaiska, Tapia, & Baudouin, 2009; Hertzog, Dixon, Hultsch, & MacDonald, 2003; Park et al., 1996). However, participants in these studies were required to recall or recognize word lists or short stories with no or only a short delay (e.g., 5 min). As these studies did not measure personally relevant information or over longer retention intervals (e.g., days, weeks, months, or even years and decades), they do not inform us about the relationship between cognitive abilities and autobiographical memory. To offer support for the basic-systems approach to autobiographical memory, we therefore examined the relationship between individual differences in verbal and visuospatial memory performance to the formation and retrieval of autobiographical memories. As far as we are aware, this study is the first one to investigate this relationship.