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SPECIAL SECTION ON POSITIVE NEUROPSYCHOLOGY

Positive neuropsychology: The science and practice of promoting cognitive health

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ABSTRACT

Positive psychology has influenced multiple subfields within psychology and areas outside of psychology. While positive psychology's focus on positive mental health and character strengths did not appear to meaningfully impact neuropsychology in its earlier stages, more recent indications suggest that the neuropsychological literature, and perhaps the field as a whole, has begun to embrace related research and practice applications. In this context, positive neuropsychology has emerged as a neuropsychological orientation focused on the study and practice of promoting cognitive health. The present review discusses the origins of positive neuropsychology and elaborates on its six key evidence-based domains: compensatory strategy use, activity engagement, prevention of cognitive impairment, public education, exceptional cognition, and positive cognitive outcomes in neuropsychiatric populations. This broad perspective on cognitive wellness can easily be embraced by both clinicians and researchers and offers multiple directions for future growth. Ultimately, consideration of various methods to promote cognitive health can inform our understanding of optimal brain function, maximize functioning in individuals with cognitive limitations, and enhance quality of life among populations served by neuropsychologists.

KEYWORDS

Activity engagement; cognitive health; lifestyle factors; positive psychology

Twenty years ago, Dr. Martin Seligman emphasized the need for the broader field of psychology to increase its efforts on promoting positive human qualities, psychological health in the broader population, and character strengths. During his American Psychological Association President's Address, he stated that one of his presidential initiatives sought "to utilize quality scientific research and scholarship to reorient our science and practice toward human strength. In this way, we can learn to identify and understand the traits and underpinnings of preventive psychological health and, most importantly, learn how to foster such traits in young people" (Seligman, 1999, p. 561). In the ensuing decades, positive psychology gained international prominence as an emerging scientific and practice-oriented focus that impacted clinical psychology, military psychology, and the business world, among others (Randolph, 2013).

In 2003, Dr. Ronald Ruff, then president of the National Academy of Neuropsychology, stated in his presidential address, "Patients' needs are not met by merely diagnosing cognitive deficits. There is a growing need to advance services that maintain cognitive health … the time has come for neuropsychologists to identify as caretakers for cognitive health" (Ruff, 2003, p. 847). While his comments in some ways echoed those of Dr. Seligman (1999), has the field of neuropsychology responded in kind, as was the case with the broader psychology community? In particular, has neuropsychology embraced ideas related to personal growth and development vis-à-vis cognitive health?

To consider this possibility empirically, meta-literature reviews of multiple prominent neuropsychological journals (*Archives of Clinical Neuropsychology*, *Journal of the International Neuropsychological Society*, *Neuropsychology*) were conducted at three points in time over a 10-year period (1999–2009). Key study aims were derived based on manuscript titles and abstracts, and studies were then categorized based on primary research questions being addressed. Findings from these reviews indicated that across journals and sampled years, 52% of studies focused on documenting cognitive deficits in neuropsychiatric populations, 13% considered normal cognitive functioning, 10% validated novel measures, and 8% involved neuroimaging. Few studies examined correlates of cognitive health or resilience; 2% of papers evaluated positive cognitive outcomes in neuropsychiatric conditions, and 1% of studies involved cognitive rehabilitation (Randolph, 2013). While these findings may have differed if other years

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had been sampled or if other journals had been considered, a pattern nevertheless emerged that indicated minimal focus on research investigating cognitive health factors.

An updated review of manuscripts published in 2014 in *Archives of Clinical Neuropsychology* and *Journal of the International Neuropsychological Society* indicated that while the majority of published manuscripts showed a continued focus on cognitive dysfunction or validating new or existing measures, approximately 10% of studies evaluated effects of lifestyle factors on cognition or cognitive rehabilitation (Randolph, 2015a, 2015b). Related research examined the role of lifestyle engagement on executive function trajectories in older adults (De Frias & Dixon, 2014), positive effects of exercise on inhibitory control in ADHD (Chang, Hung, Huang, Hatfield, & Hung, 2014), and the moderating role of coping strategy on fatigue and cognition in MS (Ukueberuwa & Arnett, 2014). Although this was a much less comprehensive literature review than the previous one, it was encouraging to see movement toward published studies examining contributors to cognitive health.

In sum, despite earlier evidence to the contrary, there is emerging evidence that perspectives from positive psychology have begun to impact the neuropsychological literature. Anecdotally, there also appears to be an increased emphasis on factors associated with cognitive health in the field based on seminar offerings at recent neuropsychological meetings, not to mention an entire conference recently devoted to this topic (Cleveland Clinic's 2015 "SuperBrains" conference).

Positive neuropsychology: Definition and domains

As an emerging orientation within the field, positive neuropsychology is conceptualized as the study and promotion of cognitive health. There are six key evidence-based subdomains of positive neuropsychology that relate to clinical and scientific aspects of promoting cognition through various means: compensatory strategies, activity engagement, prevention of cognitive problems, public education, understanding positive outcomes in neuropsychiatric populations, and studying individuals with robust cognition.

Compensatory strategies

Compensatory cognitive and emotional strategies are important components of cognitive health promotion. Regarding cognitive strategies, two broad categories can be considered: external and internal (Sohlberg & Mateer, 2001). Both types of strategies are particularly useful for promoting attention, memory, and executive functioning. External strategies are techniques that relate to the environment or use of a physical aid. A wide variety of external strategies are available to promote cognition in daily life, including appointment books, targeted lists, paper or electronic calendars, auto-payment for bills, and timers. There has also been increased focus on use of technology for maintaining functional status in older adults, including use of "smart environments" that monitor and prompt individuals' instrumental activities of daily living and may allow for longer periods of independent functioning (Schmitter-Edgecombe, Seelye, & Cook, 2013).

Internal strategies are self-generated and serve to improve focus on and learning and organization of new material. One well-researched strategy in this regard is self-instructional training, which involves verbalizing one's task approach and process, often leading to improved focus on the task at hand. This approach has been applied effectively for many years in populations including brain injury patients, individuals with schizophrenia, and impulsive children (Cicerone & Giacino, 1992; Meichenbaum & Goodman, 1971; Perry, Potterat, & Braff, 2001). Another internal strategy well known to the neuropsychologist is clustering or chunking information into categories to aid later retrieval. Some neuropsychological measures explicitly quantify such strategies to clarify spontaneous organizational abilities and can provide important information to review with patients during evaluation feedback sessions. As many clinicians can relate anecdotally, some research has found that individuals with neuropsychiatric conditions who spontaneously use such strategies perform better on memory tasks (Woods et al., 2010). It is also important to note that some strategies are better to avoid; despite some popularity in mainstream culture, "multitasking" is associated with increased errors, reduced task completion speed, and poorer overall performance (Ophir, Nass, & Wagner, 2009).

Emotional compensation also impacts cognitive health, both in neuropsychiatric populations and in healthy individuals. Some research indicates that individuals with multiple sclerosis who use active coping strategies (e.g., intently focusing one's efforts on managing an issue of concern) are less likely to experience depression related to cognitive deficits than those who use avoidant strategies (Rabinowitz & Arnett, 2009). Moreover, mindfulness meditation has been found to be an effective stress management strategy that also increases hippocampal, prefrontal, and cingulate cortex volume (Fox et al., 2014; Holzel et al., 2011).

Activity engagement

Another important factor involved in promoting cognitive health is activity engagement. There are three types of effortful activity that are clearly linked to cognitive wellness: physical activity, social engagement, and intellectual activity. Of these three domains, physical fitness and aerobic activity have been most widely researched to date. Multiple studies have demonstrated positive effects on cognition in those who exercise regularly, with particular improvement in executive functioning (Hertzog, Kramer, Wilson, & Lindenberger, 2009). In a related vein, exercise promotes neurophysiological functioning on molecular and structural levels. Increases in BDNF have been observed after single exercise sessions and as a function of consistent exercise (Szuhany, Bugatti, & Otto, 2015). Physical activity is also associated with increased brain volume in controls and in those with cognitive impairment, including in the anterior hippocampus (Erickson et al., 2011) and bilateral frontal regions (Reiter et al., 2015). Across studies, approximately 20 minutes of moderate physical activity per day appears to be the minimum threshold for positively impacting cognition and brain function. Exercise also appears to show brain-related benefits throughout life, including being associated with microstructural integrity in adults in their 80s (Tian et al., 2014) and cognitive improvement in dementia (Cheng et al., 2014). A dose-response effect vis-à-vis exercise and cognition has been observed across studies, including in a recent multinational sample with over 100,000 participants (De Souto Barreto, Delrieu, Andrieu, Vellas, & Rolland, 2016).

An additional activity that is critical for promoting cognition is social engagement. Some work has found that higher frequency of social activity has been associated with less cognitive decline over a five-year period across multiple cognitive abilities including episodic memory, processing speed, and visuospatial functioning. Participants most socially engaged were 70% less likely to show cognitive decline (James, Wilson, Barnes, & Bennett, 2011). The size of one's social network also plays an important role in cognitive health. Some research has found that having a larger network of social contacts (children, family, and friends) can moderate the impact of Alzheimer's disease pathology on cognition, particularly regarding semantic memory and working memory (Bennett, Schneider, Tang, Arnold, & Wilson, 2006). Higher perceived social support is associated with better working memory, processing speed, and visuospatial functioning (Krueger, Wilson, Barnes, Bienias, & Bennett, 2009). Conversely, poor support and adverse interactions in one's social network can detrimentally impact executive functioning (Liao et al., 2014). Effects of social support on cognition have also been found to differ over time by gender and relationship type (Liao & Scholes, 2017).

Further, consistent intellectual stimulation can maintain and enhance cognition throughout life, particularly in older adults. Such activity comes in many forms, including reading, photography, painting, playing (or learning/relearning) a musical instrument, learning a foreign language, doing crossword puzzles, or going to museums. An early study found that older adults who were most intellectually engaged were about 50% less likely to develop Alzheimer's disease than those who were less active; common activities included reading the newspaper, visiting museums, doing puzzles, and playing cards (Wilson et al., 2002). More recent work has found that doing crossword puzzles has a strong buffering effect on memory decline, delaying onset of decline by 2.5 years (Pillai et al., 2011). Increased job complexity, another aspect of intellectual stimulation, appears to moderate the relationship between whole brain and hippocampal atrophy on cognition (Boots et al., 2015).

Prevention of cognitive dysfunction

Efforts to promote cognitive health can also focus on prevention of cognitive impairment, which can take many forms. Regarding diet and nutrition, regular consumption of a Mediterranean-style diet is associated with a number of cognitive and brain-related benefits, including slower cognitive decline and a 34–40% reduced risk of Alzheimer's disease as noted in a recent systematic review (Lourida et al., 2013). While this dietary style may have a number of specific benefits, omega-3 polyunsaturated fatty acids (PUFAs) may play a particularly important role in maintaining cognitive health (Dyall, 2015). In a related vein, omega-3 PUFAs have been found to moderate the effect of physical activity on cognition; individuals with higher levels of omega-3 fatty acids show fewer negative cognitive effects of sedentary tendencies (Leckie et al., 2014). Additionally, regular consumption (at least once per week) of fish has been linked to increased brain volume, including in the right anterior hippocampus and posterior cingulate (Raji et al., 2014). More generally, effectively managing cardiovascular risk factors such as hypertension, diabetes, and obesity can reduce the risk of Mild Cognitive Impairment or dementia (O'Connor & Kraft, 2013).

Other preventative strategies include treating secondary factors such as sleep disturbance, depression,

chronic pain, and fatigue, all of which can have detrimental effects on cognition (Arnett, 2013). In addition to sleep apnea, which has well-known negative effects on cognition, sleep duration of less than or greater than 7–8 hours is associated with multiple cognitive deficits, although cognitive gains usually occur when sleep patterns normalize (Banks, Van Dongen, Maislin, & Dinges, 2010; Waters & Bucks, 2011). There is also evidence that ongoing activity engagement can moderate the impact of depression on cognition (Opdebeeck et al., 2017).

While smoking receives a relatively minimal amount of attention in the neuropsychological literature, this habit increases risk of dementia, is associated with cognitive impairment across the lifespan, and can cause volumetric decline in multiple cortical regions and in the corpus callosum (Randolph & Randolph, 2013). In contrast, smoking cessation is associated with cognitive improvement, potentially within a short period of time (Sabia et al., 2012). Another avenue of prevention relates to sports concussion. Conservative management of concussed athletes, rule changes in contact sports that penalize overly aggressive play, and legislative efforts leading to increased concussion awareness all serve to reduce acute and ongoing concussion sequelae (Echemendia, 2013).

Public education

Public education in neuropsychology is critically important. Relatively few individuals in the general public—not to mention some colleagues in allied fields—understand our extensive training and expertise in brain-behavior relationships, benefits from the services we provide, or the myriad roles in which we serve across clinical, forensic, military, academic, and other settings. Many people continue to be unsure of differences between psychologists and psychiatrists, let alone how neuropsychologists differ from clinical, counseling, or other psychologists. In this context, we all serve as ambassadors for the field, and our ability to communicate who we are and what we do has considerable implications for the long-term viability of neuropsychology.

Borrowing a term from Anthony Jorm (2012) as related to mental health, the general public tends to have fairly poor "cognitive health literacy." For example, a recent public survey of cognitive health beliefs found that few participants endorsed aging, stroke, hypertension, brain injury, depression, or environmental toxins as having adverse effects on cognition (Hosking, Sargent-Cox, & Anstey, 2015). Research across multiple studies has shown little change over time in the general public's understanding of brain injury factors or sequelae (Guilmette & Paglia, 2004). Common misconceptions include the belief that a second blow to the head improves memory functioning, and that most people with severe brain injuries will return to their pre-injury occupations. A recent study found that those with prior concussions or with formal concussion information training paradoxically showed more misconceptions than others in the general population, but that misconceptions were common across all participants (Merz, Van Patten, & Lace, 2017). Inaccurate beliefs about dementia are also common, including among healthcare providers (Annear, 2018; Tan, Hong, Luo, Lo, & Yap, 2012).

Public education efforts take many forms, including public presentations, writing articles for websites and newspapers, writing letters to the editor of local papers, media interviews, participation in psychological and neuropsychological organizations at state and national levels, and social media presence. Regarding the latter, it is encouraging to note that multiple neuropsychological organizations are regularly involved in posting content related to brain-behavior relationships on social media sites. Ultimately, public education can benefit individual patients, providers, and the broader health care system.

Exceptional cognition

While neuropsychology has a rich history of case studies related to cognitive dysfunction, much less is known about individuals with robust cognition. An early example of the latter was Luria's case study of "S." S had what appeared to be a nearly limitless memory, and he ultimately became a successful mnemonist. While his ability to remember details was remarkable, this skill became burdensome for him, as he had to force himself to forget less desired memories (Luria, 1968). More recently, Hu and Ericsson (2012) studied Chao Lu, the world record holder for recall of digits of pi. Lu was able to recall 67,890 digits of pi by using multi-level strategies, including segmenting 2-digit number groups, encoding these groups as words, and then creating related stories. Curiously, years after establishing his world record, he was only able to spontaneously recall 39 digits, suggesting that his earlier feat related more to effective encoding and working memory strategies than episodic memory storage per se.

Another ongoing line of research relates to "SuperAgers," a cohort of older adults (age 80+) with exceptional cognition and brain morphology for their age. The SuperAgers show objective memory performance and cortical thickness similar to healthy

individuals aged 50–65, with thicker anterior cingulate cortex than the same group (Gefen et al., 2015; Harrison, Weintraub, Mesulam, & Rogalski, 2012). Demographically, a perhaps unexpected finding (i.e., in light of cognitive reserve theory) was that only four of the 12 individuals in the initial SuperAgers sample were college graduates, suggesting that other factors contribute to highly successful cognitive aging beyond educational status. Other research on SuperAgers has indicated that relative to young and elderly controls, SuperAgers have an atypically high density of von Economo neurons in anterior cingulate cortex (Gefen et al., 2018). The same group has found that SuperAgers also report experiencing more positive social relationships than healthy age peers, which the authors have speculated could be linked to SuperAgers' abundant von Economo neurons (Maher et al., 2017).

Ultimately, understanding individuals and groups with impressive cognition may have important implications for rehabilitation and "pre-habilitation" (i.e., training in cognitive strategies prior to onset of cognitive dysfunction) of individuals with neuropsychiatric conditions and the general population. Neuropsychologists conducting related research are well poised to further this science and translate it into actionable practice-oriented principles and strategies.

Positive cognitive outcomes in neuropsychiatric populations

Academic and clinical neuropsychologists have clarified cognitive dysfunction across multiple neuropsychiatric populations over many years. We now have a solid working knowledge of expected sequelae secondary to multiple sclerosis, stroke, epilepsy, Parkinson's disease, brain injuries of all severity levels, and various forms of dementia. However, we know much less about individuals with conditions that impact neuropsychological functioning who show positive outcomes. For example, roughly 50% of those with multiple sclerosis will exhibit cognitive changes; much less is known about the other 50% who remain cognitively intact. Some patients may be particularly cognitively resilient due to lifestyle, genetic, dispositional, or other factors. For example, we recently found that individuals with MS who have no objective cognitive impairment, no subjective cognitive complaints, and informant-confirmed lack of daily cognitive dysfunction showed fewer symptoms of fatigue and subclinical mood lability than other MS patients (Randolph, Randolph, & Wishart, 2018). Other work has begun to clarify factors (e.g., lifestyle activity engagement, positive affect) that may reduce the likelihood of converting from Mild Cognitive Impairment (MCI) to dementia (Dolcos, MacDonald, Braslavsky, Camicioli, & Dixon, 2012).

A related line of inquiry revolves around attitudinal factors that improve outcomes. Much of this work has examined the role of variables such as determination, dispositional optimism, positive attitudes, and perspective changes in brain injury patients with good recovery (Hawley & Joseph, 2008; Peleg, Barak, Harel, Rochberg, & Hoofien, 2009; Todis & Glang, 2008). Symptom attributions and knowledge about brain injury may also play critical roles in recovery (Belanger, Barwick, Kip, Kretzmer, & Vanderploeg, 2013). Other research has investigated one's sense of life purpose as a potentially protective factor against cognitive decline or neurologic disease. Indeed, a stronger sense of purpose is associated with reduced chance of macroscopic lacunar infarcts or stroke (Kim, Sun, Park, & Peterson, 2013; Yu et al., 2015) and lower risk of developing MCI or dementia (Boyle, Buchman, Barnes, & Bennett, 2010). This factor has also been found to moderate the impact of Alzheimer's disease pathology on cognition (Boyle et al., 2012). In addition, there is evidence that some personality traits, such as conscientiousness and openness to experience, confer reduced risk for cognitive decline in older adults (Wilson & Bennett, 2017).

In summary, positive neuropsychology is a clinical and research orientation that emphasizes the study and promotion of cognitive health through various means. Here, I have discussed related ideas including compensatory cognitive and emotional strategies, activity engagement in daily life, prevention of cognitive limitations, public education related to neuropsychology, understanding robust cognition, and positive cognitive outcomes in neuropsychiatric populations. Neuropsychology appears to be moving toward a better understanding of cognitive health factors, although the field remains primarily focused on documenting cognitive dysfunction. Considering the six key elements of cognitive promotion, as noted above, can further advance and expand this area in the years ahead both in terms of scientific aspects of cognitive health and practical clinical applications. More generally, neuropsychologists who embrace a cognitive wellness perspective can help maximize quality of life and cognitive functioning in those with whom they work in community, medical, academic, military, consulting, and other settings.

Declaration of interest

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