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AGING MEMORY IS *NOT* A LIMITING FACTOR FOR LIFELONG LEARNING

Abstract

Efficient memory is one of the necessary cognitive potentials required for virtually every form of lifelong learning. In this contribution we first briefly review and summarize state of the art of knowledge on memory and related cognitive functions in normal aging. Then we critically discuss a relatively short inventory of clinical, psychometric, and everyday memory instruments usually employed in healthy older population memory assessment. In final section, some of new approaches and promising methods in this area will be outlined and proposed as alternative methods for elderly memory and cognition screening. We conclude that normal memory aging is by no means a limiting factor for successful lifelong learning and that we are currently in need of new approaches to memory assessment, valid yet not laborious for older adults enrolling in lifelong learning programs.

Key words: memory, cognitive aging, memory assessment, lifelong learning

Memory in aging: a very brief overview

Common and regretfully popular notion of memory decline with age represents sort of knowledge not warranted by scientific literature on cognitive aging. Objective memory lapses and subjective complaints on memory are in fact relatively seldom reported by healthy older adults. Estimates of elderly population experiencing objectively measured memory problems vary with subject samples and diagnostic instruments employed. For instance, in Plassman et al. study conducted in USA representative sample of subjects aged 71 years and older (N = 856) a total of 13,9% subjects suffering from dementia of some form was established. Notably, only less than 5% subjects in cohort 71-79 were diagnosed with dementia, the percentage rising up to 37,4% in those aged 90 plus (Plassman et al., 2007). Other forms of memory impairments, such as those seen in mild cognitive impairment (MCI), are diagnosed more often but not at a dramatic rate, MCI incidence ranging from 17-34% in various studies (Petersen et al., 2001). Subjective memory complaints are reported by 22-37% of elderly, according to one large sample studies meta-analysis (Jonker et al., 2000). Taken together, such data suggest memory problems of various etiologies to be expected by no means in majority of elderly.

When analyzing the trajectory of memory in aging, it is essential to specify function/s referred to. Memory registers and functions can be classified with respect to memorized information duration (brief sensory iconic and echoic, short-term, and long-term memory), to information modality (verbal, visuo-spatial, motor) or to retrieval task and retrieval conditions (recognition vs. reproduction, free, serial or cued). Arguably, the dominant model of short-term memory is the Baddeley's and Hitch's Working memory model, which posits this memory register to consist of three "slave" systems (phonological loop, visuospatial sketchpad, and episodic buffer) coordinated by super ordinate system called central executive (Baddeley, 2003). Squire's long-term memory model with the dichotomy between declarative (explicit) and non-declarative (implicit) memory and further division of declarative into semantic and episodic memory provides a good framework for aging memory studying (Squire, 1992). Finally, distinction of retrospective and prospective memory bears special significance for aging memory understanding, as the latter refers to the cases of remembering to do something some time in future.

Certain memory functions appear to be moderately affected by normal aging. Most pronounced is the episodic declarative memory decline. Cross sectional and to somewhat lesser extent longitudinal studies show gradually poorer efficiency of stories heard/read remembering, lists of unrelated words and word pairs recalling, and familiar faces recognizing with age (Salthouse, 2003). Normal aging affects short-term memory in a specific way. While standard short-term memory measures, like simple digit- or word-span, do not show marked decline with age, more elaborate complex span tasks show clear decreasing trend (Oberauer et al., 2003). Complex span tasks require simultaneous cognitive processing (e.g. simple arithmetic problems solving) *and* short-term memorizing (digits-solutions to the problems) thus taxing subject's potentials for focusing and shifting attention between the two processes. Adding concurrent task to simple memorizing diminishes results of elderly (e.g. Li, 1999). In addition, cognitive performance of elderly is more disrupted by incongruent distraction, i.e. by stimuli not related to the task, compared to young subjects performance (Weeks & Hasher, 2014). Such findings suggest executive attention to be inversely related to aging, executive attention being the function of central executive. Autobiographical memory shows specific but not steep decline with age (Fromholt et al., 2003). Elderly subjects also seem more prone to retrieval errors, both in laboratory, and in ecologically more relevant tasks of eye witnessing (Jacoby & Rhodes, 2006). Finally, general cognitive speed decrease with aging is considered well established fact (Salthouse, 1996).

By contrast, large areas of memory functioning seem to be spared and even improved in aging. Despite general senses weakening, sensory memory seems to remain intact in elderly. Laboratory tasks with brief auditory or visual word fragments presentation show that older subjects are equally successful at integrating fragments into words when fragments presented either auditory (Parkinson & Perry, 1980) or visually. Experiments with brief visual presentation of the kind suggest iconic memory in elderly to be even of somewhat longer duration than in younger (Kline & Orme-Rogers, 1978). It is safe to conclude with this respect that content that can be perceived also can be learned by elderly. Semantic memory also seems to be little affected by normal aging, as opposed to episodic memory. This declarative long-term memory domain contains conceptual knowledge acquired in one or in number of learning episodes. Typical indices of semantic memory, like word or general information knowledge at their worst do not display decline but mild improvement until mid sixties of age (Dixon et al., 2004), while in most of studies they show stable improvement during whole life (Park et al., 2002). Prospective memory in elderly appears to decline, but to a much lesser extent than episodic and working memory. Such decline is detectable mostly in laboratory tasks (e.g. Craik, 1986). Naturalistic prospective memory studies placed in everyday setting (e.g. sending a postcard or making a phone call) demonstrate that elderly subjects constantly perform better than younger ones (Rendell & Craik, 2000).

Finally, meta-analysis of 33 implicit memory researches showed very mild or no decline of this type of memory in aging (Light & La Voie, 1993).

Memory assessment in normal aging: in need of new paradigms

Memory assessment in elderly is generally aimed at detecting subjects with memory impairments or identifying those at risk of dementia in older adult's population. Objective methods for memory assessment broadly fall into three categories: psychometric, clinical, and behavioural, testing so-called everyday memory (Christensen, 1991). Subjective complaints of poor memory display no or weak correlation with objective test performance in elderly (Sunderland et al., 1986).

As much as ascertaining normal memory functioning in elderly is important when including them into some form of lifelong learning, standard methods are tiring and laborious even for subjects with completely preserved memory. Widely accepted psychometric battery, Wechsler Memory Scale (Wechsler, 1987), for instance, takes 45-60 minutes for completing. Administration of Rivermead Behavioural Memory Test (RBMT; Wilson et al., 1999) may well take more than 30 minutes with elderly. Besides that the very experience of being tested can be frustrating, it is worth noting that the most of established instruments for memory assessment may prove difficult for elderly because of time pressure, leaving them little sense of accomplishment upon testing.

Recently, a novel approach to older adults memory screening, Semantic Interference Test (SIT), was validated on a large scale community sample (Snitz et al., 2010). SIT builds upon the fact that Alzheimer's patients and people with MCI suffer from specific long-term memory deficits preventing them of effective semantic retrieval cues use (Loewenstein et al., 2003). Subjects from the groups mentioned are prone to semantic intrusions, substituting the target item in a word recall task for a semantically similar exemplar ("glass" for "mug"), but also to the two types of retrieval interference, proactive inhibition (PI) and retroactive inhibition (RI). Both PI, i.e. newly learned material retrieval inhibited by competing effects of the old one, and RI, i.e. recall of previously learned material inhibited by a new one, appear to be caused by ineffective use of cues distinguishing material originally learned from the one formerly or later learned. SIT materials consist of two sets of 10 common household objects. Sets are chosen to consist of objects belonging to the same semantic categories (e.g. "ring" in set 1 corresponds to "bracelet" in set 2), thus making two sets recalling difficult. SIT starts with set 1 objects learning (by identifying objects hidden in an opaque bag by touch). Success in list 1 learning provides measure of episodic learning. Next, subjects learn objects from the set 2, interfering with set 1. Shortly delayed recall of set 2 items provides a measure of PI (from set 1 previously learned). Recall of set 1 that follows afterwards provides a measure of RI (from set 2, learned after the set 1). Finally, after a 20-minute delay subjects are asked to recall set 1 items. Intrusions provide a measure of RI in long-delayed recall.

All the SIT scores, PI score most prominently, discriminated in a large cohort of healthy older adults (age range 65-99; average 77,51) groups of those with intact cognition from those with mild cognitive difficulties affecting daily functioning (Snitz et al., 2010). Obviously, the latter group would require special attention when enrolling in any of lifelong learning programs. Unlike standard memory tests, SIT apparently has the appeal for subjects with refusal rate less than 2% in Snitz et al. (2010) survey. It requires no reading and does not resemble standard paper and pencil, school exams – alike tests. SIT can be administered to illiterate persons and requires no translation and back-translation. Finally, SIT measures are less influenced by subjects' educational attainment than standard memory tests, as revealed by low correlations of SIT measures and reading ability, taken as a proxy for quality of education by Snitz et al. (2010). SIT was therefore proven to be a useful tool in general elderly population screening.

With similar motivation, we have revisited validity of verbal fluency tasks in verbal ability and memory in elderly assessment. Interestingly enough, verbal fluency was established to be the first measurable indicator of pathological cognitive aging, as revealed by 14-year longitudinal study of large scale population based elderly sample (N = 3777; Amieva et al., 2008). In our research of verbal ability and memory tasks validity in discriminating samples (N = 32) of healthy young (mean age 21,56) and elderly (68,88) subjects matched by gender and education Wechler's vocabulary, phonemic fluency (phonemes: K, L, and S; PF), semantic fluency (categories: animals, fruit, vegetables; SF) and semantic fluency with categories switching (clothing-vehicles, names-toponyms, food-furniture; SFCS) were administered, fluency tasks asking subjects to provide as many instances of the criterion as possible within one minute. Results suggest differences in vocabulary, as a marker of general language development and crystallized intelligence, PF, SF and SFCS to go in expected direction, younger participants accomplishing somewhat larger scores in all of measures. But, stepwise discriminant analysis with the age group as grouping variable has shown SFCS number correct items (F to remove = 10,78; standardized canonical coefficient = 0,640) and vocabulary subtest score (F to remove = 6,78; standardized canonical coefficient = 0,522) to be the only variables contributing to the single discriminant function (canonical correlation coefficient 0,690; Lalović & Jovović, 2013). Such outcome, bearing in mind the nature of SFCS task requiring executive functioning over and above verbal ability points out to potential benefits of adding SFCS task to the list of standard memory and cognitive tests for older adults. SCFS administration is easy and quick, subjects do not find it difficult or laborious. It may serve as a practical marker of executive functioning, working memory, and even crystallized lexical knowledge, as it moderately correlates with vocabulary (Pearson's r = 0,42; Lalović & Jovović, 2013).

Conclusions

Contrary to the widespread belief, serious memory decline need not be a part of normal cognitive aging. Normal aging seems to be the vital condition for successful and enjoyable participating in lifelong learning programs. Literature review suggests decline in episodic memory, and working memory followed by general cognitive slowing in older adults. Working memory somewhat poorer performance should be attributed primarily to executive functions in aging decline. Cognitive slowing is not the memory function per se, but it affects all the cognitive processes, memory included. In contrast, sensory, semantic, nondeclarative and prospective memory appear to remain intact or even getting better with age. Most of current methods for memory assessment are aimed at detecting people with memory problems in elderly population and those at risk of developing such problems. In context of lifelong learning those instruments seem unnecessery long, laborious and tiring for elderly, making their use questionable. Currently, we are in need of valid but not that extensive and detailed alternative ways of providing insights into aging memory and cognition functioning. Two of attempts in that direction were outlined, both of them showing promise in memory and related cognitive abilities of prospective lifelong learners brief screening. In light of the existing evidence, tentative conclusion of normal memory aging in most cases being not the obstacle for comfortable everyday living seems warranted. At the same time, memory in normal aging seems capable of supporting various forms of lifelong learning.

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