A Study of Aging Effect on Cognitive Decline

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Abstract: - ***In the present study, adults of three different age groups, i.e., young, middle-aged and old were selected and assessed for their cognitive status in terms of PASS Processes as well as immediate and delayed memory. The results showed deterioration not only in the PASS Processes, but also in immediate and delayed memory with increasing age. PASS Processes are mutable and remedial programmes based on PASS theory have brought about remarkable changes in the skills of reading and mathematics in children. We hope that the findings of the present study regarding the age-related changes in the PASS Processes will enable the researchers to develop suitable training programme that may help preserve the strength of these processes over time. Cognitive decline accompanying age affects not only the person concerned, but also his/her family and the community in general demanding an array of health, social and psychological supports. Preserving cognitive strength amidst the gradual process of ageing, therefore, may be considered as a challenge for us that ultimately will lead to a healthier and happier old age.***

Key words: - Cognitive, Thinking, Reasoning, Memory, Retention and perception.

INTRODUCTION

Ageing is a normal and natural process of development. As people age, they change in diverse ways both biologically and psychologically. Cognitive ageing that results out of an ageing brain refers to changes in a host of abilities, namely, attention, perception and learning, memory, thinking reasoning, problem solving and language that constitute the different domains of cognition. But these changes are not uniform. Some cognitive abilities remain robust throughout life, whereas, others decline from middle age onwards or even earlier. For example, attention, some types of memory and reasoning are more affected by ageing compared to vocabulary, some numerical abilities and general knowledge. People also differ greatly with respect to the degree to which their brain functions decline with age. In general, it has been found that rapid information processing and dividing attention effectively in between tasks are the cognitive abilities that reach peak in young adulthood. Similarly, the ability to keep multiple pieces of information in mind simultaneously peaks around ages 18 to 20 years. These abilities are maintained for some years and then start declining. Memory ability also declines with age. But the exact nature of the declines varies with the types of memory. The ability to learn and recall new information reaches its peak early but becomes challenging generally after age 40. Linguistic skills also develop rapidly throughout childhood. But recalling the name of familiar persons/ objects/ places or a particular word during conversation generally becomes harder for adults after age 70. Yet, the vocabulary gets less affected compared to the comprehension skill with increasing age. Visual perceptual abilities, mostly, the ability to understand spatial relationship as well as the visual scanning ability diminishes in the process of ageing. Similarly, executive functioning which demands higher level cognitive activities, such as, conceptualizing a problem, making appropriate decisions and carrying out effective actions also get affected with increasing age. Older adults are found to be slower in conceptualizing problems and taking appropriate course of actions to solve the problems, especially when the situation is unfamiliar. Their thought process is characterized by rigidity and impulsivity. Such problems arise mainly because of decline in working memory capacity among elderly.

Working memory involves a composite of cognitive operations including maintenance of information over a brief delay, manipulation and monitoring of this information and executive functioning needed for problem solving and reasoning. Yet, very often in familiar situations, the prior experiences and

knowledge of older adults help them interpret the behaviour of others more accurately and take better decisions with feelings and emotions in comparison to young adults.

Several studies, especially, in the field of cognitive neuroscience have established that brain volume changes with increasing age and such changes are steeper in old age (Raz, 2005).

In the field of cognitive psychology, particularly, theories and measuring devices have been developed within the information processing paradigm in an attempt to explain the intellectual functioning in terms of cognitive processes. One such theory is PASS (Planning-Attention-Simultaneous-Successive) theory of intelligence advocated by Naglieri and Das (1988, 1990). Basing upon the neuropsychological evidences of Luria's clinical observations (Luria,1966, 73, 80) and the factor analytic results of subsequent studies in the field of cognitive psychology, this theory explains human intelligence in terms of four different but interrelated cognitive processes, namely, planning, attention, simultaneous coding and successive coding. The four processes are carried out in three different blocks of the brain. Thus, attention-arousal which refers to the waking state of cortex and is required for optimal cortical activity is carried out in the first block of the brain that includes the brain stem, the diencephalon and the medial regions of the hemispheres.

The second block which includes the occipital, temporal and parietal lobes carries out the processes of information coding that refer to storage and processing of information. Luria distinguishes between two different types of information coding namely, simultaneous and successive that underlie all types of mental activities.

Ageing and Brain Changes

In normal and healthy older adults changes in the brain are generally modest and make little difference in functioning (Kemper, 1994). After age 30, the brain loses weight, at first slightly, then more rapidly and by age 90, it usually loses up to 10 per cent of its weight. This Weight loss is the consequence of loss of neurons in the cerebral cortex that is the seat and centre of all cognitive functions. Modern researchers view that this is mainly due to the shrinkage in neural size resulting from loss of axons, dendrites, and synapses. This shrinkage seems to begin earliest and to advance most rapidly in the frontal cortex, which is important to memory and higher order cognitive functioning (West, 1996; Wlikelgren, 1996).

Cognitive Decline with Ageing

Neither all cognitive domains are affected equally by age, nor do all cognitive processes show age-related decline. Mostly older people experience problems in paying attention to relevant information ignoring irrelevant ones in their environment, word finding difficulties, problems in remembering the context in which information was learnt. Researches within the field of cognitive ageing have been carried out in an attempt to explain the pattern of age-related cognitive decline in terms of domain general ("Core") or domain specific theories. These have been discussed below.

Domain-General Theories of Cognitive Ageing

The domain-general theories involve "Core" deficits in speed of information processing, working memory, inhibitory ability and sensory functions. The sensory deficit hypothesis of ageing proposes that each of these mechanisms is said to be a cognitive or processing resource and some researchers also view that a combination of these mechanisms may even act as a better cognitive resource than any single mechanism (Salthouse, 1991). Variations among individuals with respect to their performances on cognitive tasks may be due to a number of causes, like their education, experience on the particular tasks and age. But theories of cognitive ageing explain only the variability in performance that occurs due to age.

Processing Speed: - A well-developed theory of Salthouse (1991, 1996) based on earlier work of Birren (1965) suggests that the basic mechanism that accounts for age-related variance is speed of performing mental operations. In fact, Salthouse's findings (1996) suggest that almost all age-related variance on any kind of cognitive task, ranging from memory to reasoning, can be explained to be due to the rate at which the individual makes speeded comparisons on perceptual speed tasks.

Working Memory: Working memory can be conceptualized as the amount of cognitive resources available at any given moment to process information and can involve storage, retrieval and transformation of information. In other words, it is the total amount of

mental energy that a person has to perform mental operations at any moment (Baddeley, 1986). For example, one may be asked to multiply someone digit numbers and remember the second digits of each product. But although there is found age-related deficiency with regard to such type of cognitive operation termed as working memory.

Inhibition: - The third mechanism of cognitive ageing is inhibition. Hasher & Zacks (1988) view that with aged people face difficulty in focussing on target information inhibiting the tendency to focus on irrelevant information. Their attention gets diffused between relevant and irrelevant information. According to Hasher and Zacks, inefficient inhibitory processes permit "the initial entrance into working memory of information that is off the goal path.

Sensory Functions: - Another important mechanism underlying cognitive ageing comes from Berlin Ageing study (Lindenberger & Baltes, 1994). Adults within the age range of 70 to 103 years were tested for all the cognitive abilities including speed of processing, reasoning, memory, world knowledge and Verbal fluency.

Results indicated that nearly all of the age-related variance in 14 tests of cognitive ability was mediated by sensory functioning as measured by simple tests of visual and auditory acuity. This suggests that sensory function appears to be fundamental to all cognitive functions and therefore, a powerful mediator of all cognitive abilities.

METHODOLOGY

Sample

The sample consisted of 150 adults from both the gender groups chosen from different age groups residing in four different districts in the state of Bihar, namely Patna, Muzaffarpur, Daarbhanga, East Champaran. Purposive random sampling method was adopted for sample selection. The first group consisted of 50 young adults within the age range of 20-35 years. The second group consisted of 50 middle- aged adults within the age range of 40-55 years. The third group consisted of 50 older adults within the age range of 60-70 years.

Cognitive Assessment System and Hopkins Verbal Learning Test-Revised were applied in the present study. CAS Basic Battery was used that incorporated eight subtests; two from each of the four PASS processes.

RESULTS AND CONCLUSIONS

Normal adults of three different age groups, i.e. young (20-35years), middle-aged (40-55 years) and old (60-75 years) groups matched for their educational qualification and carrying no record of any serious physical or mental illness were tested for their competence in the processes of planning, attention, simultaneous coding and successive coding within the frame work of PASS model of intelligence and the processes of immediate and delayed memory. The purpose was to examine the changes in these processes with increasing age.

Ageing and PASS Processes

The young, middle-aged and old groups of adults were tested for their competence in the PASS processes using the Basic Battery of Cognitive Assessment System (CAS). Along with this was used Crack the Code test which is a special test of planning designed to measure one's competence in executive functioning. The means, standard deviations, summary of ANOVA results and results of post-hoc comparisons with respect to each of the tests used are presented in separate tables in this section.

The young, middle-aged and old groups differed significantly from one another with respect to their strength in the processes of planning, attention, simultaneous coding and successive coding, the strength being maximum for the young group; minimum for the old group and in-between for the middle aged group in each of the processes. This indicates a decline in the PASS processes with increasing age. The decline starts in mid-forties and continues till one reaches the old age, or late adulthood, i.e., 60-75 yrs. This trend was noticed with respect to the accuracy score of the three groups on each of the PASS tests, except crack the code which measures planning and complex problem solving skill suggesting that strategic thinking and complex problem solving ability decline maximally by the time one reaches the middle-age, i.e., between 40-55 years and slows down thereafter till one reaches the old age or late adulthood, i.e., between 60 to 75 years. In fact, the post-hoc comparison showed that the young group differed significantly from the middle-aged group and

both the groups differed significantly from the old group with respect to their performance on each of the PASS measures except crack the code.

With respect to speed of performance the three groups differed significantly from one another with the speed being the maximum for the young group, minimum for the old group and in between for the middle-aged group. Results of Post-hoc comparison at the same time showed that the young group differed significantly from the middle- age group and both the groups differed significantly from the old group suggesting a progressive decline in the speed of performance with increasing age.

In respect of immediate and delayed memory, the three groups were found to differ from one another which suggest that the ability for both immediate and delayed memory decline with age. Results of post-hoc analysis, on the other hand, showed significant difference between the performance of young and middle-aged group and that between young and old group but not between middle-aged and old group in both immediate and delayed memory. This suggests that maximum impairment in these two types of memory occur till one reaches the middle-age, (40-55 yrs) but the rate becomes slower thereafter till one reaches the old age (60-75 yrs).

Children develop into young adults and finally into older adults. Cognitive development in them starts as they arrive in this world, continues up to a certain age, reaches its peak, is maintained for a certain period of time and then starts declining although there is a noticed inter-individual and intra-individual difference with respect to these developmental changes.

Research findings also suggest that nutritional diets that are particularly important for brain health or neuronal function reduce or repair the neurological as well as biological decline and thus, moderate age-related memory loss.

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