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### **Do female and male brains age differently?**

Yes, it seems that the loss of grey matter in the frontal lobes is steeper in the aging male than in the aging female brain. This means that older women fare better in executive functions, i.e. planning, working memory et cetera. It is hypothesized that this is caused by different lifestyles. The brains of men are more affected because there is a higher incidence of smoking, hypertension, diabetes, etc. among men compared to women. These factors may also account for the fact that men are more likely to suffer from strokes than women.

### **Why does physical activity benefit cognitive brain capacity more than brain training computer games?**

Brain changes associated with physical training increase available cognitive resources, which are then used by the trained individual to take advantage of the brain changes to improve cognitive functioning. Cognitive training, by contrast, improves the way we use available cognitive resources. Most games only train specific cognitive tasks, hence we become experts in this particular task but cannot transfer this expertise to other areas of cognitive functioning. Mastering crossword puzzles does not help one to memorize people's telephone numbers or to become better at spatial orientation.

However, there is recent evidence that specific and highly intensive types of cognitive training make a difference for other areas of cognitive functioning. These types of training require individuals to continuously switch between rules governing different cognitive tasks. They do not use tasks typical of intelligence tests whose rules are mastered after a few repetitions. This type of training does make a difference for other areas of cognitive functioning. However, it has to be high intensity, that is, several times a week for at least an hour, over more than three months.

### **To what extent does the environment contribute to the plasticity of the aging brain?**

Human development and aging are the result of continuous interactions between genetic predispositions and socio-cultural influences. Depending on the area of functioning, that is, for instance, cognition or personality, the influence of the genetic make-up is above or below 50%, respectively. Genetic as well as contextual conditions determine the constraints within which we can develop. Therefore, the commonly observed trajectories of cognitive development, for example, should not be interpreted as natural laws but

rather as modifiable, given enough knowledge about the contextual conditions that facilitate rather than hamper, cognitive development and aging. The work environment is an important example. During adulthood we spend a lot of our waking time at work: those who have a stimulating job or switch between tasks during their working years undergo 'natural' brain training, while those whose jobs involve only routine tasks do not use their full cognitive potential and show faster cognitive declines. Another striking example for 'downward' plasticity is the effect of old-age images. Independent of other factors such as socioeconomic status, objective health and subjective well-being, negative convictions held about one's own old age have been found to reduce survival by seven years.

### **What are empirical examples of resilience and growth, two main forms of positive plasticity in human development, when it comes to older generations?**

Resilience refers to the ability to compensate for losses or to buffer stressors and thereby maintain normal levels of functioning. In the cognitive arena, for instance, rather early and steep declines in the cognitive mechanics (e.g. speed of processing new information) are compensated for by increases in and stability of the pragmatics of the mind (e.g. knowledge, experience). As a result, in everyday situations the decline is not noticeable. It only emerges under extreme conditions. In the personality realm, we get better at coping with life challenges such as the death of a loved one or illness and physical impairment. Subjective well-being does not decline until very late in life. There, life experience plays out: we learn to adjust aspirations and change our standards of comparison, or change our goals altogether, and thereby maintain our subjective well-being. This resilience is complemented and strengthened by the fact that as we grow older we become more agreeable, more conscientious, and emotionally stable. These are three characteristics that support everyday mastery tremendously.

When it comes to growth, the prototype is wisdom. Unfortunately, wisdom does not come automatically with age, as do the two examples just provided for resilience. Even though there is a higher likelihood, in principle, to achieve wisdom at older ages, a number of additional factors need to be realized before it actually happens. Such factors include: the type and frequency of critical life events, the mentorship that we obtain in dealing with such events, and the openness to new experiences, which usually declines after midlife. These factors are important ingredients for gaining wisdom from experiences.

### **What are the key differences in the research on aging in Germany and in the U.S.?**

For many years, the U.S. has invested more in aging research than Germany. The U.S. Congress established the National Institute on Aging in 1974. This institute as well as the National Science Foundation (NSF) have been supplying important funds for aging research for over 35 years. Only now are we, the European Union, starting to set up structures that allow the coordination of aging research in the member states. Fortunately, the exchange between U.S. and German researchers of human aging is very well developed and highly constructive. Particularly, the exchange of Postdoctoral Fellows works very well. The Alexander von Humboldt Foundation as well as the Fulbright Commission have been very active players in support of such cooperation and exchange. There is also very good cooperation in the aging field between our respective National Academies of Sciences.