

# Keep It Simple! Assisting Older People with Mental and Physical Training

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**Abstract.** The demographic change is having a strong impact upon Europe's societies and upon our financial and social security systems. To avoid cost intensive retirement homes, one main goal for European governments is to build up and maintain a socio-technological infrastructure that allows elderly people to stay in their familiar surroundings and cultivate their social networks as long as possible, with support of assistive technologies. However, when deployed in real-life settings, i.e. "in the wild", it has been shown that these will only be accepted and therefore effective, when integrated into an environment that aims at enhancing people's health and well-being in general. Although it is well known that moderate physical training as well as mental exercising are crucial for maintaining health and well-being, lack of motivation frequently prevents individuals from exercising regularly. We introduce a simple way to motivate elderly people for mental jogging and physical training with assistive indoor and outdoor technology.

**Keywords:** demographic change, social interaction, social network, social technology, mental jogging, physical training, elderly care, AAL, ambient assisted living, Near Field Communication, NFC, senior playground.

## 1 Introduction

Most elderly people in Europe and elsewhere aspire to live in their own four walls and familiar surroundings in an independent and self determined way as long as possible. In comparison to the United States, resident areas exclusively for senior citizens are less common in Europe. The goal of senior areas is to provide living conditions in a secure and comfortable environment, frequently with several generations living together, so that tight social bonding can be combined with individual independency.

However, moving to a senior citizen home can become a necessity despite all individual and collective efforts, usually if an individual loses the ability to organize his or her independent living. Due to the demographic change and the continuously increasing live expectancy, Western societies are progressively forced to develop and maintain concepts, technologies and infrastructure that enable autonomy of senior

citizens in their homes, especially if high costs for elderly care in nursing homes are to be avoided.

The concept of salutogenesis developed by the American-Israelian sociologist Aaron Antonovsky (1923–1994) postulates that the experience of well-being is associated with a Sense of Coherence (SOC). Antonovsky considered SOC to consist of the three following core subcomponents [1]:

- **Comprehensibility:** The perception of the world as being structured, predictable, and explicable that allows an individual to understand his or her environment.
- **Manageability:** The conviction that resources that are necessary for an individual in order to meet the demands and requirements are available or can be made accessible.
- **Meaningfulness:** The profound experience of the individual life as being meaningful.

If Antonovsky's theory is linked to the needs and demands of elderly populations, it is clear that in order to maintain the first two dimensions "comprehensibility" and "manageability" it seems to be essential to maintain physical and mental fitness, as well as mobility and communication as long as possible. Technology may thereby serve as a powerful tool for building and enriching infrastructure that aims at preserving, enhancing, protecting and maintaining mental and physical fitness. Mental and physical fitness is influenced by external and internal factors, such as possibilities to exercise the mind and the body alike (inside and outside) as well as developing, upholding and improving the motivation to do so. Meaningfulness however seems to be an existential dimension that bestows purpose to one's individual life that can only partially be substituted by means of technology.

## **2 A Biopsychophysiological Approach to Health and Well-Being**

Let us first of all take a closer look at the consequences of regular mental training on the brain. In short, this relationship can be described as "use it or lose it", because the brain is actually very similar to a muscle that can be systematically trained by regular exercise and as we all know muscles gradually involute as a consequence of lack of exercise. Research has shown that lifelong learning is crucial for retaining mental fitness. However, systematic mental exercise has to start as early as possible, preferably even as early as the beginning of one's professional career. It is thereby important to highlight that the ability for lifelong learning is not restricted to improving cognitive and metacognitive functions but that it may also have consequences on the social environment; one has only to recall that social isolation may occur due to the degrading possibility to develop new or adapt old forms of behavior as well as establish new contacts, for example when moving to a new setting (e.g. senior nursing home).

In addition to mental training for keeping the brain active, we see a strong synergistic effect for maintaining and improving important brain functions by means of physical training. As we know from brain research, the activation of the motor cortex while exercising bodily functions not only strengthens the peripheral muscles but also leads to an enhancement of cognitive functions. This effect is likely due to the increased blood flow in motor areas that results in a co-stimulating effect in related cognitive areas of the cortex. A recent study with eleven young test persons for

example examined the effects of aerobic training on brain functions over 12 weeks. After the training program, participants scored significantly better in a memory task and a higher blood flow was detected in neuro-imaging of the Gyrus dentatus, an important region of the brain associated with memory and cognitive functions [2].

Another study found that walking showed a positive outcome for the prevention of dementia. A daily walk of more than 3000 meters leads to a better metabolism and heart and circulation parameters. Additionally, cognitive functions are less deteriorating as a consequence of aging. In a prospective trial with 2.257 healthy male individuals in the age of 71 to 93 a daily waking distance of less than 400 meters showed a 1.8 fold higher risk to develop dementia [3]. Unfortunately, lifestyle and dietary preferences were not considered in this study.

Women also benefit from extended walking. A survey in the Nurses Health Study evaluated 18,766 women between 70 and 81. A 20 percent risk reduction was found in the population with higher physical activity [4].

Examples like these show that the salutogenetic effects of physical and mental exercise go hand in hand. This means that retaining both a socially and existentially meaningful and stimulating atmosphere for the elderly is important, particularly for those with mobility constraints. One important stimulating factor is thereby the existential and spiritual anchoring, which may occur completely independent from denomination or religious affiliation. Empirical studies point to the fact that spirituality may act as a specific health resource, although it may sometimes also induce distress. Particularly some spiritual and meditative consciousness practices have not only been associated with an increased amount of resilience against stress but also proven to increase quality of life and well-being, even under difficult health and deteriorating life conditions.

However, although the pathways mediating the spirituality health connection remain largely unclear for the time being, some recent studies point to the fact that some aspects of spirituality such as the ability of self-transcendence may be associated with the configuration of important neurotransmitter subsystems in the brain such as the serotonin system. Since the serotonin system also plays a key role in mediating important psychophysiological, one might speculate that the ability to have spiritual experiences may also be associated with the ability to self-induce automatic healing responses of the body. In other words, since spiritually inclined or practicing individuals might be able to trigger so called "unspecific healing effects" by means of particular mind-body techniques, they might respond to medical treatment and intervention in a better way because they are able to exploit the psychologically induced unspecific effects in a more efficient way. Put simply, these individuals might be better responders to unspecific than specific effects. The holistic effect of a drug therapy therefore may not depend upon the active agent.

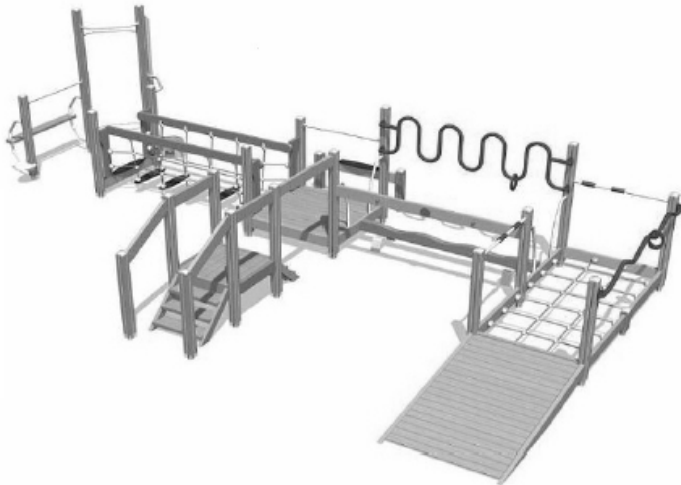
Kirsch et al. for example found in a recent metaanalysis that in mild depressive disorders placebo pills that simply consisted of sugar, have proven to be as effective as real drugs such as selective serotonin re-uptake inhibitors SSRI [5]. Thus the positive impact of the psychological mindset of an individual as it is mediated by psychological constructs such as expectancy or mindfulness can be considered to be a strongly underestimated field in health care and medicine. Ambient Assisted Living in the Wild might benefit a great deal from this approach.

### 3 Assisting Older People with Physical Training

Although details of the pathways from physical training to supporting and improving cognitive functions are not known for the time being, their existence cannot be questioned any longer in the light of the evidence. Thus, the question remains, how this insight may best be harnessed for improving and maintaining the well-being and health of elderly populations.

To begin with, let us take a look at state of the art in the indoor and outdoor home training systems. Apart from the traditional home exercisers with mostly mechanical parts, newer more sophisticated fitness devices that are also available for the elderly are computer programmable and monitor physiological parameters such as heart rate or blood pressure. The possibility of measurement of physiologic parameters allows individualizing the training in accordance with the actual fitness and strength level; an inbuilt-training history function systematically allows to analyse the effects of this training. However, technical functions like these are frequently not used by seniors due to a design that is not suitable for them e.g. haptic problems with plastic foil keypad and complicated menu navigation.

Newer concepts in Europe try to assist outdoor physical activity for seniors and kids by means of shared playgrounds that have been designed to fulfil both the needs and demands of kids and seniors. “Young at heart” or “moving seniors” is the new playground concept inspired by fitness parks in China. The first playground for seniors was opened in Berlin 2007. The idea was to encourage old people to keep themselves both fit and also allow them to socialize. This seems to work in the Berlin case, with the drawback that using the playground is only allowed for persons taller than 1.5 meters (5 feet). Unfortunately, this excludes the very young.



**Fig. 1.** The picture illustrates the concept “Moving Seniors” with easy to learn calisthenics and concentration training. Future concepts could integrate wireless sensors for documentation and visualization of training results (history function). The data transmission is realized over mobile phone with near field communication (NFC). User information direct or over a home based TV-application (Source: Sportkreativwerkstatt Munich).

A pilot project of the Peter-Schilffarth-Institute is to combine wireless sensors (near field communication) with outdoor and indoor training devices for visualization, documentation (history function) and a neuronal network feedback. It is simple to use, because the user just has to point with the mobile phone at the training gear and the stored parameters can be seen after the training in a TV-based health application at home with the possibility of receiving individualized feedback. Together with the parameters of mental training and change of nutritional behavior, a feedback for an individually optimized fitness program is possible.

## 4 Assisting Older People with Mental Training

It is common knowledge that brain jogging for patients suffering from dementia has positive effects [6]. Scientifically not yet proven is the effect of brain jogging programs for the maintenance and enhancement of the normal mental competence of healthy persons. One drawback in scientific studies is the selectivity of tasks in testing conditions, such as mental arithmetic or pattern recognition, where an improvement is obvious [7, 8].

In real life, however, we have to cope with multiple and complex tasks and activities of daily living (ADL). Research has not found evidence for the amelioration of ADL through selective training. However, there is a growing body of evidence that so called mind-body techniques are associated with improved mental capacities and enhanced resilience against stress. These techniques have become increasingly popular among the public and researchers alike and can be considered to be a hall-mark of Integrative Medicine (IM), as the integration of psychological, medical, mental and physical approaches becomes most clearly visible. Mind-body practices embrace different methods that have one thing in common: they all use some sort of mental-behavioral training and involve modulating states of consciousness in order to influence bodily processes towards greater health and well-being and better functioning.

Possibly the best investigated Mind-Body technique is the „Mindfulness Based Stress Reduction Program” (MBSR) that was developed by Professor Jon Kabat-Zinn at the MIT more than twenty years ago in order to improve the compliance and stress resilience of chronic patients [16]. While the original mindfulness practice has its roots in Buddhist philosophy and correspondingly a religious connotation, the modern versions have to be considered as secular mind-body-techniques that frequently utilize only the meditation technique without the religious and philosophical background. Regular practice of mindfulness meditation should lead to a mindful awareness of one’s mental activity and on the long run also to a non-judgmental attitude towards one’s own mind and other people’s actions. Systematic training of this state of mindfulness apparently allows an individual to develop a certain attitude of acceptance that seems to have salutogenetic effects [9]. MBSR programs have in common that they use principles of mindfulness and teach the patients formal mindfulness meditation, urging them to continue practicing at least within the 8 week program. In a meta-analysis of studies on MBSR we found that MBSR was effective in improving psychological and physical health outcomes across various diseases with an effect size of  $d = 0.53$ , which can be considered a medium effect that is remarkable when considering the chronicity of the diseases studied [10]. It is also noteworthy that a special

adaption for preventing depression relapse has also proven to be effective in patients with recurrent depression in controlled studies [11].

Assistive technical systems for mental training are available, but the interactive form [12] is usually only for use with a personal computer, or the training has to be conducted with paper and pencil [13]. The computerized training however may be a barrier for some elderly individuals, as they may not be familiar with using a computer. Nevertheless, since 2006 a small device is available from Nintendo [14], which offers Brain Jogging for adults. Although this device has a user friendly intuitive graphical user interface and a wireless functionality, it can be connected with other devices of the same type. TV based brain jogging applications are still missing.

To sum up, for preserving the physical and mental functions even at an advanced age, three aspects can be considered to be crucial: physical activity, brain jogging, relaxation and a reasonable diet (which is not addressed here). Optimal effects are supposed to occur when starting with this mix of prevention at an early age, possibly as integral part of a life philosophy. But still when starting at a later stage in life these three aspects –if observed not in an excessive but an adequate manner, with a sustainably high motivation - are quite effective for staying healthy both mentally and physically. Motivation can be enhanced and fostered by providing a suitable infrastructure.

## 5 NFC Technology to Keep It Simple

How can information technology assist in mental and physical training? Technology should offer functions that are similar to those that the human brain is accustomed to, for example control actions not only once but repeatedly. This is realized in brain by feedback loops and feedback-dependent reward systems. Using marketing as an analogy, in the same way that a product has to appear “sexy” in order to increase its chances to become a top seller, technology has to appear attractive to the brain. Adequate feedback helps generate “joy of use”, and consequently feedback systems should aim at rewarding mental and physical training. How can technology provide feedback systems in physical training devices?

Indoor and outdoor training devices are usually „Stand alone units“, i.e. they lack a standardized network connection with other training devices or with a central unit. NFC, or “near field communication” (NFC), is a new possibility to “virtually” connect remote devices (e.g. outdoor training devices) to a host for user feedback.. The principle has been derived from “radio frequency identification” (RFID) Technology. In short RFID is a technology that utilizes the use of electromagnetic or electrostatic coupling in the radio frequency (RF) portion of the electromagnetic spectrum in order to uniquely identify an object, place or organism. Using an additional chip in the mobile phone and a small software application, data from remote devices can be picked up from a physically extant electronic tag and sent to an internet based service. Implementing these tags in outdoor and indoor training gear could be a possibility to receive data from a device with self contained (low) energy supply. With usability optimized software for seniors the software application initiates a transfer of training parameters from the device to a host simply by touching the device with the mobile phone. This facilitates easy collection of outdoor training data for feedback.



**Fig. 2.** Near field communication (NFC) provides data transmission which is initiated simply by touching a surface with a integrated electronic tag. Applications with NFC for assisting seniors are now under development (Picture: [www.smartnfc.com](http://www.smartnfc.com)).

## 6 Assistive Technology with a Personal Touch

As with training devices, assistive systems for mental and physical training for seniors are nowadays only available as stand-alone components. The devices for physical training are electronically controllable and they have connections to transmit measured psychophysiological parameters. A central unit for collection and evaluation of the parameters (e.g. heart frequency, energy used) in connection with other parameters (e.g. calories intake) and with individualized user feedback has not been introduced to the market as yet.

Envisaging the ideal environment for mental and physical training, systems should visualize training data with a history function as well as evaluate data and provide feedback. The training should be possible outside and inside and the feedback device should work without barriers, maybe in the living room at home. Because all of the seniors can handle a TV Set, and a lot of time is spent watching TV, this medium seems to be almost ideal as a central unit for monitoring personal health activities. Moreover, brain jogging in a playful and exciting form could be realized comparatively easily by means of using the TV as a user interface. An individually configurable electronic “Wellness and Health Agent”, with optional connection to a service center, in connection with a personal health manager (real person) would be an advance for ambient assistive technology and training support.

A project that aims at the personalization of assistive technology is ALADIN (Ambient lighting assistance for an ageing population), a project co-financed by the European Union . It has developed a platform for relaxation and activation in connection with dynamic lighting. The system provides a monitoring of mental training, which consists of brain jogging and relaxation tasks, biofeedback and history function with user feedback over TV with graphical user interface (TV-GUI). With a Bluetooth



**Fig. 3.** Communication and information portal implemented on interactive TV and videophone with call center connection. (Source: Sophia GmbH, Germany)

sensor glove biofeedback training over TV-Screen is possible and a usability optimized interface can be easily operated by seniors. Field tests with 12 seniors (age over 65 years) in Austria, Germany and Italy showed a high acceptance of the mental training device and a good effect of dynamic lighting on activation and relaxation.

In addition to already available possibilities for seniors to communicate and interact over their TV-Set [15], the ALADIN System additionally allows to incorporate a biofeedback and mental jogging device. A history function with a neuronal network designed to compute target values provides individualized real-time feedback to the user for mental and physical training support. The combination of technology and personal service, health management and technical attendance creates added value not only for the manufacturer but also for the local service provider economy.

Like in a call center, a bundle of functionalities can be integrated, e.g. personalized health services such as advice for health and well-being, a professional service and social interaction by counseling patrons both face-to-face and by TV-phone communication.. Computer based programs via a TV-based graphical user interface aim at supporting mental and physical fitness at a comparably low cost rate as they can be efficiently be realized by local providers with the assistance of peer-group and call-center.

## 7 Summary

Specifically designed technological devices for elderly populations, which allow easy to handle mental and physical training support are currently only available as stand-alone gadgets such as home trainers or brain jogging devices and the like. However, these devices are frequently connected to a personal computer, which are sometimes difficult to operate for older individuals. Thus an easy to operate system that is able to facilitate mental and physical exercise, monitor and record progress as well as provide



feedback would be desirable. Possibly, one could also think of devices that are able to provide feedback concerning psychophysiological states associated with states of mindfulness or other relaxation states, so that the individual gets feedback at home, even if he or she is not instructed by a mindfulness trainer. Systems like these, although they are not able to substitute for a mind-body technique trainer, could prove to be helpful for upholding the motivation for regular mental and physical exercise.

For user acceptance it is essential to create graphical interfaces, which can be intuitively and effortlessly operated by older individuals. It is desirable that the system is linked with a communication device that allows individuals with mobility constraints to conduct videophone conferences with other people or call centres. This would turn the television not only into a platform for information, communication and interaction but actually into a personal assistant. Even data generated remotely, such as training data from outdoor training facilities could easily be fed into the home systems, for example an USB-stick or alternatively by near-field communication technology.

However, it has to be acknowledged that despite all the fascinating options that state-of-the-art technology can offer, technology cannot be used as a substitute for meaningfulness. Despite these reservations we believe that the prudent use of technology has much to offer for improving the health, well-being and quality of life of senior citizens. And from our field trials we know that the elderly do accept very complex technology, provided it is kept simple. This means that the technology has to provide easy access, effortless processing and efficient action.

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