NAL NF Bd. 108, Nr. 372

Leopoldina
Nationale Akademie
der Wissenschaften

More Years, More Life

Recommendations of the Joint Academy Initiative on Aging

More Years, More Life

acatech
DEUTSCHE AKADEMIE DER
TECHNIKWISSENSCHAFTEN

JACOBS
FOUNDATION

Nova Acta Leopoldina Neue Folge Band 108, Nummer 372
Wissenschaftliche Verlagsgesellschaft mbH Stuttgart

ISSN 0369-5034
ISBN 978-3-8047-2778-6

Aging in Germany English Edition
More Years, More Life – Recommendations of the Joint Academy Initiative on Aging

Leopoldina
Nationale Akademie
der Wissenschaften

Translation
of the Recommendations of the Joint Academy Initiative on Aging
“Gewonnene Jahre”
(Altern in Deutschland Band 9,
Nova Acta Leopoldina Band 107, Nummer 371)

NOVA ACTA LEOPOLDINA

Abhandlungen der Deutschen Akademie der Naturforscher Leopoldina

Herausgegeben vom Präsidium der Akademie

NEUE FOLGE NUMMER 372 BAND 108

More Years, More Life

Recommendations of the Joint Academy Initiative on Aging

Appointed by the
German Academy of Sciences Leopoldina –
National Academy of Sciences
in collaboration with the
acatech – German Academy of Science and Engineering

Funded by the Jacobs Foundation

With 1 Illustration

**Deutsche Akademie der Naturforscher Leopoldina –
Nationale Akademie der Wissenschaften, Halle (Saale) 2010
Wissenschaftliche Verlagsgesellschaft mbH Stuttgart**

Redaktion: Dr. Michael Kaasch und Dr. Joachim Kaasch

Die Schriftenreihe Nova Acta Leopoldina erscheint bei der Wissenschaftlichen Verlagsgesellschaft mbH, Stuttgart, Birkenwaldstraße 44, 70191 Stuttgart, Bundesrepublik Deutschland.
Jedes Heft ist einzeln käuflich!

Die Schriftenreihe wird gefördert durch das Bundesministerium für Bildung und Forschung sowie das Kultusministerium des Landes Sachsen-Anhalt.

Bibliografische Information der Deutschen Nationalbibliothek
Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http//dnb.ddb.de abrufbar.

06019 Halle (Saale), Postfach 11 05 43, Tel. + 49 345 4723934
Hausadresse: 06108 Halle (Saale), Emil-Abderhalden-Straße 37
Herausgeber: Präsidium der Deutschen Akademie der Naturforscher Leopoldina – Nationale Akademie der Wissenschaften
Printed in Germany 2010
Gesamtherstellung: Druck-Zuck GmbH Halle (Saale)
ISBN: 978-3-8047-2778-6
ISSN: 0369-5034
Gedruckt auf chlorfrei gebleichtem Papier, hergestellt aus Holz aus ökologisch kontrollierter Forstwirtschaft

6. Aging and Technology

Summary and Recommendations

Technology is a friend in old age – this proposition may initially come as something of a surprise. The view that technological change in general, and modern information technology in particular, tends to place unreasonable demands on older people rather than providing support is widespread. In contrast, we believe that modern technology can and will make a significant contribution to aging successfully.

Sensory and cognitive abilities, such as hearing, vision, the sense of balance, attention, and memory, decline in the course of adult life and, to an increasing degree, in old age.[69] Restrictions of physical mobility raise the danger of social isolation. Modern information technology can *prevent*, *delay*, *even out*, and *mitigate* the impacts of these losses by (1) *training* abilities and skills, (2) *supporting* everyday skills and (3) *monitoring* vital functions. It can contribute to elders' being in a better position to continue to lead an independent life, often in their accustomed home surroundings.

In order for technology to satisfactorily perform the functions of training, support, and monitoring, three criteria need to be considered in its development and application: *First*, technology ought to release more cognitive resources than its application requires. *Second*, it ought to adapt to the changing characteristics, preferences, and needs of older individuals. *Third*, it ought to positively influence their cognitive and physical resources.

Technical innovations for successful aging rely on research collaboration between computer scientists, psychologists, engineers, interior designers, architects, area planners, and medical scientists. Most useful technical innovations will assert themselves on the market without any government intervention. However, government can contribute to tapping technological potentials in order to enhance everyday skills in old age more quickly, fairly, and sustainably. In this context, we recommend:

- Government support of longitudinal studies carried out under everyday conditions to enable comparisons of costs of investment in modern technologies with the long-term savings brought about by the maintenance of the ability to lead an independent life.
- Introduction of standards (particularly technical norms) for the employment of flexibly assistive technology in households, public facilities, and buildings.
- Consideration of technical infrastructure for assistive and communication systems in urban and regional planning to achieve aging-friendly and barrier-free environments.[70]

The Requirement for Support and Technology

Over the last few decades, very old age has become a normal part of life rather than an exception. The human life span has become longer and more predictable. This success story is mainly due to the reduction, avoidance, and delay of age-related losses and impairments. *Information technology* is continuing this success story with modern means and thereby assuming a *key role*. These technologies allow the development of devices and environments with

69 See also Chapter D.2.
70 See also Chapter D.5.

flexible assistance properties. They recognize, learn, and actively support their users' and occupants' behavior, activities, and habits. Devices of this kind can be portable and used like mobile telephones, but may also be fully integrated in the material environment and function automatically. The increasing equipping of everyday environments with assistive technology has already changed our everyday lives; take, for example, navigation systems in vehicles. All in all, the opportunities and risks these changes pose for old age are not yet in sharp focus. As will be shown in the following, it is important to consider these opportunities and risks early enough to be able to strengthen desired trends and avoid undesirable ones.

The interaction of thought, attention, and memory, of sensory perception, balance, and gait is subject to changes in the course of adult life. Younger adults only spend a fraction of their cognitive resources on their vision, hearing, or balance control. To a large degree, their perceptual and motor performance controls itself automatically, unless they happen to be engaged in activities with high sensory and physical demands, such as mountaineering. In contrast, older adults need to invest mental resources in vision, hearing, balance and gait when carrying out everyday activities such as crossing a busy road. But unfortunately, it is precisely those mental resources required here, namely controlled attention, working memory, and associative abilities, that diminish especially strongly with aging.[71] The biological process of aging thus makes things difficult because the resources increasingly needed are on the decline themselves. A chief objective of employing technology in old age is to reduce this conflict.

Criteria for the Assessment of Technologically Enhanced Environments

Aging individuals can continue to make gains, for example, in social status, material belongings, knowledge, and professional expertise. However, other, more biologically-based resources such as physical fitness, health, sensory acuity, and cognitive abilities decrease throughout adulthood, particularly in old age. Even so, many older adults can cope well with their everyday lives because they succeed in adapting their goals to the altered resource situation and in making good use of resources that have become scarcer. Assistive technologies can contribute provided that their application fulfills the following three criteria.

– *Criterion 1*: *Net resource release*. The operation of technology usually requires an investment of physical and mental resources. It follows that the use of technology is only adaptive if these operation costs are lower than the payoff associated with other changes in processing when using the technology. For example, if using a mobile phone as a diary requires reading complicated instructions, the resource balance of this application will be low, at least initially. Objective and subjective assessments of the resource balance may differ from one another. Both are relevant since perceived usefulness determines the use of the aid more strongly than its objectively demonstrable utility. At least in the medium and long term, the use of assistive technology should bring about improvements in the resource balance. Therefore, when developing and testing technical aids, the conditions under which behavior with such aids requires fewer resources than behavior without them should be observed from the outset. This requires the integration of technological and psychological knowledge.

71 See also Chapter D.2.

– *Criterion 2*: *Person specificity*. Technology can better fulfill its supportive role if it is adapted to the habits, abilities, and preferences of its users. Differences in performance and interests increase with aging. It is important for assistive technology to be adjusted to older users' idiosyncrasies. The earlier in life it is introduced, the easier this adjustment will be. Learning to deal with assistive technology will also be easier if it is introduced before the onset of physical frailty and mental limitations. A high degree of individualization and the early application of technical aids are two sides of the same coin.
– *Criterion 3*: *Retaining everyday skills and promoting developmental potential*. Comprehensive assessment and prediction of assistive technology's capacity to maintain mental performance and facilitate independent living is only possible if the entire life span is considered and historical change is taken into account. When they reach the age of 80, today's 30-year-olds will use multifunctional mobile devices differently than today's 80-year-olds use mobile phones. Moreover, a stocktaking of the use and risks of technical aids may yield different results depending on whether their effects are observed over a short or a long period. Thus the use of mobile navigation systems in automobiles can help people to reach their destination more efficiently, i.e., faster and with less mental effort, and allow them to make use of their freed-up mental resources to have a conversation or follow an audio book while driving. But it is at least conceivable, albeit not (yet) proven, that the constant use of a navigation system while driving will lead to chronic disuse of navigational and spatial orientation skills and, in the long run, cause a worsening of cognitive functioning. The Seattle Longitudinal Study, for example, showed that cohorts born later were not as good at mental arithmetic as those born earlier, in spite of the fact that generally, the later cohorts' cognitive functioning tended to be better than their predecessors'. Probably, the decline in mental arithmetic was connected to the introduction of pocket calculators in school.

Accordingly, the employment of technology may not only optimize the use of existing resources, but it can also influence the improvement or decline of cognitive functioning in the course of life. As is so often the case, it is crucial to strike the right balance between support and activation. Thus everyday life ought to place demands on learning, memory, and navigational skills and pose challenges that people can cope with. Assistive technologies can specifically tune the degree of support provided to individual users and lower or raise it according to their needs. In this manner, the degree of difficulty in coping with everyday life can be kept in a balance between mental underload and overload that favorably influences further cognitive development in old age. Future generations of older people will be confronted with new kinds of assistive technology. This technology will influence the aging of the brain and behavior in as yet unforeseeable ways. In order to promote performance and avoid decline due to underuse of a person's faculties, both the short-term *and* the long-term effects of employing technical aids should be further considered.

On the Way to Individualized Assistive Technology

At present, the impression often arises that older people have to adapt to the requirements of technology. As a rule, the opposite makes sense and is also technically feasible. Older people are "experts on their own lives," and they have a wealth of knowledge about their personal preferences, habits, and idiosyncrasies.[72] Sometimes, however, it is difficult for them to apply

72 See also Chapter D.2.

this knowledge adequately, for example when they are tired, distracted, have to pursue several goals at once, or their senses and body take up mental resources for the reasons explained above. In such situations, *flexibly assistive technologies ought to provide reliable cues* supporting people in keeping track of their goals and performing intended actions appropriately.

Which properties should reliable cues have? Two features are particularly important: appropriateness and distinctness. A cue has a high level of appropriateness if it signals characteristics of the contents to be memorized, or the action to be triggered, as directly as possible. For example, the STOP sign makes drivers stop because in the course of their life, the sign and the action have been firmly associated with one another. But not only should cues fit, they have to be clearly distinguishable as well, i.e., a certain cue should only activate the desired action and not simultaneously a string of competing actions. Also, the distinctness of cues will vary according to person and context. One contemporary example is the ringing of mobile telephones; a ring-tone that was only recently clearly distinguishable from that of other telephones may result in several people unnecessarily groping for their phones just a few days later.

If people create their own cues – intentionally or unintentionally through their prior actions – which are then acted upon by technology, there will be a good chance of high levels of appropriateness and distinctiveness because these cues perfectly correspond to their habits. Assistive technology should set out from the effectiveness of self-generated cues. It should learn its users' habits and preferences and subsequently support them by cues when required. And this has nothing to do with science fiction: The technical prerequisites for devices of this kind that are portable or can be integrated into objects of everyday life already exist.[73]

The supportive role of modern technology is supplemented by its monitoring function in phases of life characterized by special hazards and frailty, e.g., in very old age, in cases of dementia, or during rehabilitation following a serious illness. Examples include pressure-sensitive carpets that record falls, blood-pressure and pulse straps, or navigation gadgets that can register that the user has lost his way and offer assistance. The last of these examples also shows how monitoring and support can act in concert. Individually adapted combinations of support and monitoring can enable older people to live in their homes for longer than would be possible without modern technology.

Empirical surveys have demonstrated without exception that nearly all those interviewed prefer the installation of monitoring functions in their own homes to leaving the environment they are accustomed to. Nevertheless, we are aware that the monitoring function of modern technology in particular conjures up associations with George Orwell's "Big Brother." The installation and use of such technology represents an intrusion into private space and obviously requires the consent of those being monitored. Also, the corresponding data needs to be protected technically and legally. This requires a new and important field of data protection to be developed.

Opportunities and Risks of Modern Technologies for an Aging Population

The use of modern technology does not inevitably lead to social isolation and reduced social participation. In fact, precisely the reverse applies to people whose physical mobility is strongly impaired. For them at least, modern information technologies represent a "gateway

73 See also Vol. 6 of the findings, "Altern und Technik," Ulman Lindenberger, Jürgen Nehmer, Elisabeth Steinhagen-Thiessen, Julia Delius, and Michael Schellenbach (Eds.), on aging and technology.

to the world" and a forum for social exchange. This is already true for many older adults today; for example, Berlin's University clinic Charité has been very successful in using the internet for rehabilitation measures (e.g., following a stroke) and for self-help groups, especially among older adults with only limited mobility. Future generations of older people will have grown up with the internet, and they will understand how to use it for many different forms of communication. For these generations, modern information technologies will also represent a particularly important means of social participation.

Modern information technology can be used for cognitive training purposes, as well. However, in spite of the promises made by commercial providers, it has not been demonstrated so far that cognitive training programs can enhance mental *abilities* and thus contribute to retaining everyday skills in old age. (So far, it has only been shown that one becomes more proficient in solving the tasks one has practiced.) Examining the effectiveness of such programs via intervention studies with a subsequent monitoring of progress is an urgent research undertaking.[74] Via the internet, such training programs can be used by people in all age groups. If some of them prove effective, they can contribute to the enhancement and maintenance of cognitive abilities.[75] In addition, easier individualized access to the internet will also increase the benefit of general education programs. This expectation could above all apply to such programs that link cognitive training and communication. Individualized programs to promote physical fitness can be provided via the internet as well; some of these programs have already been shown to enhance cognitive functioning.[76]

The growing share of older people among the general population is also important in *market* terms. Currently, work is in progress in Asia, North America, and Europe on software, appliances, households, and environments with training, assistive, or monitoring functions. Science and industry in Germany ought to extend their research activities in these fields over the next few years.

The Joint Academy Initiative not only sees the opportunities that technology offers for successful aging, it also sees the risks. Modern technology generates new dependencies, and it can aggravate social discrepancies; not everyone will be able to afford every technological aid. Moreover, it is conceivable that the chronic use of technological aids creates a lack of independence by decreasing mental resources through disuse. These risks ought to be taken seriously and scientifically examined.

Technical innovations offer opportunities both for older people and for societies with growing numbers of old and very old people. Technology applied in a flexible and supportive manner can improve the balance between support and challenge in old age, enhance everyday skills, and strengthen participation in social life, with positive effects on performance, well-being, and self-esteem – and it thus has positive impacts on society's "social productivity."[77] It can also reduce costs in the health and social security system and create a potential for growth by improving and extending the ability to lead an independent life. Last but not least, the inventiveness of users of technical innovations who are themselves aging will help to ensure that the opportunities outweigh the risks.

---

74 cf. Chapter D.2.

75 See also Vol. 6 of the findings, "Altern und Technik," Ulman Lindenberger, Jürgen Nehmer, Elisabeth Steinhagen-Thiessen, Julia Delius, and Michael Schellenbach (Eds.), on aging and technology, and in particular, Florian Schmiedek et al.'s contribution on using the internet for cognitive training in old age.

76 cf. Chapter D.2.

77 cf. Chapter D.4.