Eur Rev Aging Phys Act
DOI 10.1007/s11556-012-0099-z

EDITORIAL

Assistive technologies at home and in the workplace—a field of research for exercise science and human movement science

Michael Brach · Oliver Korn

Since its existence, the European Review of Aging and Physical Activity (EURAPA) used different forms and contents of editorial articles. Beside referencing and summarizing the current issue, introductory overviews on research subjects are presented, thus drawing attention to fields considered in EURAPA, to stimulate potential research and submission of manuscripts to the journal. Such topics were, e.g. peak exercise [16], socioeconomic perspectives [14], or theory-driven evaluation [4].

The present editorial addresses technical assistance for elderly persons. During the last years, the term "ambient assisted living" (AAL) has been established for this field of research, mostly by national and European Union (EU) funding agencies, including science and technology [1, 19]. This field is of a highly interdisciplinary nature, oriented towards practical solutions, and it includes behavioural and technical aspects. This corresponds to the nature of exercise science and human movement science, which has been described to be "technological" from a theory of science view [3]. In addition, physical activity is an integral part of daily living. Therefore, AAL seems to be an interesting and stimulating field.

M. Brach (✉)
Institute of Sport and Exercise Sciences, University of Muenster,
Horstmarer Landweg 62b,
49149 Muenster, Germany
e-mail: michael.brach@uni-muenster.de

O. Korn
Labor HCI & Interactive Wizards,
Hochschule Esslingen - University of Applied Sciences,
Kanalstraße 33,
73728 Esslingen, Germany
e-mail: oliver.korn@hs-esslingen.de

Published online: 12 April 2012

In the following sections, firstly, the AAL concept is introduced. Secondly, a sketch on concepts to improve and prolong working life is presented, including examples for research questions from a sport and exercise science point of view. Some concluding remarks contain practical information on calls and research frameworks.

Ambient assisted living—an introduction

AAL is an "umbrella term" for products and services, designed to support and make daily activities easier for old or disabled people by technological means [7]. Several developments and goals in policy, society and in technology and economics have been combined to initiate progress. The research should:

1. Target the elder generation, yielding assistance for enjoying an active working life and living independently at home as long as possible
2. Improve interaction between technical and social systems
3. Create potential for economic benefits in the domain of micro-systems and information and communications technology (new markets and export)
4. Comprise networking between disciplinary and interdisciplinary partners along the value chain, including companies, research institutions, user organizations and the health care system

While motor control and learning, physical activity, mobility or exercise hardly appear in the focus of the current AAL-research frameworks, these and other topics of human movement and exercise sciences still are an implicit part of

many research projects. From a motor control and mobility point of view, aims as staying independent, preventing falls and the need of care are not imaginable without one's own movements and physical activity. Therefore, exercise and human movement science should consider joining the already existing and ongoing initiatives.

The ageing workforce

The demographic development obviously affects the occupational domain. While the percentage of older employees grows in European countries, the employment rate in the 55- to 64-year-old population was 41.7 % in 2003. The European Union has set a target rate at 50 % by 2013, which means an increase of 8.3 % within 10 years ([11], p. 362; numbers refer to the EU15 countries). Furthermore, the prolongation of working lifetime requires many people to work in older age.

From the point of view of human factors and ergonomics ([8], p. 381), the work environment should fit human needs. This relates both to the work performance and the well-being. The latter also is considered as an important influence on work performance. This is particularly true for older humans, who experience changes in the sensory and physiological status. The number of accidents at work is not higher as in younger age groups, while inactive periods due to accidents last longer. Certainly, there are decreases in several physical, visual and cognitive abilities like short-term memory. On the other hand, Dul et al. [8] list mental growth (strategic thinking, language skills, motivation, commitment, work expertise) and some aspects of social capabilities (ability to adjust their behaviour) on the positive side (see also [11]).

In order to solve the demographic challenge, Ilmarinen and colleagues ([11], p. 363) propose to target four directions: (1) to change the attitudes towards ageing, (2) to increase the knowledge level of managers in age-related issues, (3) to improve age-adjusted and flexible working life and (4) to adjust health care service in meeting the increasing needs of older workers. Consequently, a special ageing management on company level should be introduced, in order to analyse workstations, attitudes and other human factors. The aim is to prolong healthy and productive work life in face of regulations comprising later retirement in several countries.

Until now, the growing demand for such management activities is barely reflected in the literature. McDermott and colleagues [13] searched several databases (Web of Science, PsycInfo, PubMed, Ergonomic Abstracts) in order to compile a review on workplace interventions targeting the elderly workforce and published from the year 2000 on. Since only six papers were found (published between 2004 and 2007), they widened their search to interventions which were general in their audience but could be useful in particular for the elderly. Another 15 papers were found.

From an exercise science viewpoint, an interventional study of Granacher and colleagues [10] may be of interest. They conducted a fall prevention exercise programme for middle-aged workers (about 10 years before reaching the retirement age) in a sedentary office environment. Beyond transporting established paradigms (like fall prevention) to the workplace settings, the “ambient assisted living” paradigm introduced above could be useful. With regard to technical assistance, the Bridging Research in Ageing and ICT Development project (BRAID), a support action in the 7th EU framework programme, includes research on how technology can support the continuation of professional activities before and after retirement. The following aspects were listed ([6], figure at p. 20):

1. Ageing at work
    - Adjusted working space (tailored workstations, light, adapted environment, ergonomics, physical limitations, activity re-assignment)
    - Inter-generational relations (transferring knowledge, tacit and explicit knowledge, relationship management)
2. Extending professional life
    - Keeping links to former employers (relationship employer-senior, advice and support to younger employees)
    - Freelancing and entrepreneurship (promoting freelancing, monetary income, law and legislation, teleworking)
    - Professional communities (lifelong learning, community interactions, intermediary organizations, teams solving problems)

While technology may be used in all of these topics, we focus on adjusted working space with regard to movements and training in the following section.

Technical assistance in the workplace

Technology use could be classified according to the mode of assistance for the elderly:

- Training and education with regard to workplace activities
- Enhancement and/or takeover of workplace activities by technology

In production, the use of assistive systems has a long tradition since it has always been in the best interest of

companies to maximize the workers' performance. Combined with computer-based systems for Enterprise–Resource–Planning (ERP) or computer-aided process planning, they helped to make work in production more transparent, aiming to reach a "Digital Factory". However, the humans themselves have always been an obstacle for the Digital Factory, being neither programmable nor predictable in their actions. Since 2011 new motion sensors like the Kinect allow what, until recently, required costly multi-camera setups, wearable sensors and powerful hardware: human body tracking in real time and without markers [18].

While older employees often excel in knowledge and experience, they tend to suffer from a gradual reduction of short-term memory [2], resulting in a decrease of learning abilities [17] and an increase of human errors in manual production tasks. This requires workplace adjustments and the design of adequate user interactions [15]. When designing for elderly workers in production environments, human–computer interaction has to become more natural and user centred. Like the anti-lock braking system used in cars, the system should stay in the background most of the time and only intervene as soon as an error occurs. Process-oriented assistive systems for production environments use motion sensors to monitor the worker's task. However, they are not connected to the enterprise data networks like ERP—instead, the sensitive data are only used to discretely augment problems of senior workers like decreasing short-term memory by reacting immediately in the context where the error occurs.

From context-sensitive interaction, it is only one logical step to Natural Interaction (NI)—another upcoming trend in human–computer interaction (HCI). Instead of just watching or observing the user's actions, in NI, the user actively interacts with the system, e. g. by pointing towards a specific part or simply by nodding. By using the un-augmented human body as a controller, NI offers a simple and direct way of interaction that requires little training. From a user-centred approach, we felt a great potential in implementing NI for exercises, especially for older adults who need accessible interfaces. Designing for accessibility prevents the problem that "a badly designed interface might unnecessarily create a population of users who are 'disabled' with respect to that system so designers have a responsibility not to marginalize atypical users" [12]—and the use of basic body movements and gestures as a means of HCI probably allows the most intuitive form of interaction possible, "disabling" the least amount of potential users.

A possible interventional approach using NI in exercise science is the prevention of overweight and balance problems which reduce the overall performance and frequently cause accidents in working environments. Using only a motion tracking system and a monitor, the acting senior's body movements can be tracked and analysed in real time, also allowing real-time qualified feedback created by an evaluation software. While Kinect-based sport solutions already are available in the entertainment industry, they fail to address older users. However, if designed according to the restrictions and preferences of the elderly, a combination of elements from gaming like high scores and achievements with real-time feedback can become a powerful tool to motivate elderly users and protect them from accidents at the same time.

From an exercise science point of view, the systemic integration of NI into interventions for the elderly requires three main tasks [5]: first, a training target and physical exercises must be conceptualized. Second, volume and intensity of the training have to be determined, including adaptations for different performance levels and progression rules (scalability). Third, the criteria of movement quality have to be defined for monitoring and decision making.

Concluding remarks

The present introduction should give some hints for research demands and also invites submissions to EURAPA. New motion sensors allowing for human body tracking in real time and without markers should stimulate research on practical solutions for both the elderly at home and in working environments.

Practical information on this assistive approach can be found through the "Ambient Assisted Living Joint Programme (AAL JP)", which "is to enhance the quality of life of older people and strengthen the industrial base in Europe through the use of Information and Communication Technologies (ICT)" [1]. Another EU-based resource is the "European Innovation Partnership on Active and Healthy Ageing" [9].

As hitherto, in the first issue of the New Year, EURAPA's reviewers in 2010 are acknowledged:

Arzu Ari, Turkey
Klara Brixius, Germany
Ulrike Burrmann, Germany
Kelly Cotter, USA
Matthew J. Delmonico, USA
Patrick Rene Diel, Germany
Rosa Diketmueller, Austria
Paul Downward, UK
Mary J. Dyck, USA
Sabine Eichberg, Germany
Maria Märta Ekblom, Sweden
Dorothy Forbes, Canada
Trentham Furness, Australia
Sascha Härtel, Germany
Dave A. Harley, UK
Stefan Hey, Germany
Sylvia Kirchengast, Austria

References

1. Ambient Assisted Living Joint Programme (AAL JP). Retrieved on March 18th, 2012 from http://www.aal-europe.eu/
2. Anders TR, Fozard JL, Lillyquist TD (1972) Effects of age upon retrieval from short-term memory. Dev Psychol 6:214–7
3. Brach M (2009) Research on exercise programs—an approach of technological science. Eur Rev Aging Phys Activ 6(2):63–5. doi:10.1007/s11556-009-0053-x
4. Brach M (2011) Theory-driven evaluation of exercise programs: often recommended but still only a few hits in literature databases. European review of aging and physical activity 8:1–4
5. Brach M, Hauer K, Rotter L, Werres C, Korn O, Konrad R, Göbel S (2012) Modern principles of training in exergames for sedentary seniors: requirements and approaches for sport and exercise science. International Journal of Computer Science in Sport 11:86–99
6. Camarinha-Matos LM, Rosas J, Ferrada F., Oliveira AI, Afsarmanesh H, Brielmann M (2011) ICT & Ageing Scenarios. Technical Report (Bridging Research in Ageing and ICT Development BRAID, July 2011). Retrieved on March 18th, 2012 from www.braidproject.eu/sites/default/files/Ageing_scenarios.pdf
7. DKE German Commission for Electrical, Electronic & Information Technologies of DIN and VDE (2012). The German AAL Standardization Roadmap (= Ambient Assisted Living). Frankfurt: VDE Association for electrical, electronic & information technologies
8. Dul J, Bruder R, Buckle P, Carayon P, Falzon P, Marras WS, Wilson JR, van der Doelen B (2012) A strategy for human factors/ergonomics: developing the discipline and profession. Ergonomics 55(4):377–95. doi:10.1080/00140139.2012.661087
9. EC-EIP-AHA (European Innovation Partnership on Active and Healthy Ageing). Retrieved on March 18th, 2012 from ec.europa.eu/research/innovation-union/index_en.cfm?section=active-healthy-ageing
10. Granacher U, Wick C, Rueck C, Esposito C, Roth R, Zahner L (2010) Promoting balance and strength in the middle-aged workforce. International Journal of Sports Medicine 32:35–44. doi:10.1055/s-0030-1267214
11. Ilmarinen J (2006) Towards a longer worklife: ageing and the quality of worklife in the European Union. Finnish Institute of Occupational Health (FIOH). FIOH Bookstore, Helsinki
12. Mankoff J, Hayes GH, Kasnitz D (2010) Disability Studies as a Source of Critical Inquiry for the Field of Assistive Technology. In: Proceedings of the 12th International ACM SIGACCESS Conference on Computers and Accessibility, New York, pp 3–10
13. McDermott HJ, Kazi A, Munir F, Haslam C (2010) Developing occupational health services for active age management. Occupational Medicine 60:193–204. doi:10.1093/occmed/kqq026
14. Mechling H (2011) Special issue-socioeconomic perspective on physical activity and aging. European review of aging and physical activity 8:51, doi:10.1007/s11556-011-0088-7
15. Riman C, Ghusn H, Monacelli E (2011) A comparison of age difference reaction to computer interface. European review of aging and physical activity 7:117–25
16. Sagiv M, Goldhammer E, Ben-Sira D, Amir R (2010) Factors defining oxygen uptake and peak exercise in aged people. European review of aging and physical activity 7:1–2. doi:10.1007/s11556-010-0061-x
17. Satre, D.; Knight, B. G.; David, S. 2006: Cognitive behavioral interventions with older adults: Integrating clinical and gerontological research. In Professional Psychology: Research and Practice, (37):489–498, http://escholarship.org/uc/item/1qg446xk (Accessed at 2012-03-18)
18. Shotton J, Fitzgibbon A, Cook M, Sharp T, Finocchio M, Moore R, Kipman, A, Blake A (2011) Real-time human pose recognition in parts from single depth images. In CVPR, Proceedings of the IEEE Computer Vision and Pattern Recognition, doi:10.1109/CVPR.2011.5995316
19. Steg H, Strese H, Loroff C, Hull J, Schmidt S (2006) Europe is facing a demographic challenge. Ambient assisted living offers solutions. Report compiled within the Specific Support Action "Ambient Assisted Living—preparation of anarticle 169-initiative", Berlin, 2006. Retrieved on March 18th, 2012 from http://www.aal-europe.eu/Published/reports-etc/Final%20Version.pdf