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Social impact of technology
on disabled people and elderly people
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AGING, HEALTH AND TECHNOLOGY

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Presented at the January 17, 1994 Workshop

**Social Impact of Technology on
Disabled People and Elderly People**

TOPICS

Secular changes in aging and technology
Aging and the environment
Five uses of technology for the aging and the aged
Recommendations regarding the pragmatics of fully utilizing technology for the aging and the disabled
Conclusions

ABSTRACT

Aging is universally expressed but is not uniformly expressed within or between persons. Genetic variation in tissue composition, repair and metabolism combines with intrinsic biological aging processes and extrinsic influences--including lifelong differences in patterns of disease, lifestyle, exposure to environmental pollutants and obstacles of the manmade environment--to create large individual differences among the aging and the aged. Disabilities and handicaps that occur during life create even greater heterogeneity among coevals. Technology helps compensate for loss of function and provides aids to caregivers, but it also plays a positive role in prevention of disease and disability, enhancement of quality of life and basic research.

SECULAR CHANGES IN AGING AND TECHNOLOGY

Thank you for the opportunity to participate in this European Union Conference on the Social Impact of Technology on Disabled People and Elderly People. As we have heard from Professor Knipscheer, the largest change ever in the composition of the age population is occurring now. It will continue well into the next century. At the same time the evolution of technology--both in terms of speed of change and complexity--is faster than ever before in human history. These trends are represented in fig. 1 that shows the projected changes in the number of elderly persons in the world, the changes in life expectancy of women, and some representative changes in technology. The resultant dynamics of these changes in the population and in the technical environment provide us with unprecedented opportunities and a mandate to use technology to improve the health and the quality of life for aging and elderly adults, including those who become disabled.

SECULAR CHANGES IN ELDERLY POPULATION, FEMALE LIFE EXPECTANCY AND TRANSPORTATION AND COMMUNICATION TECHNOLOGY (1900-2050)

	POPULATION 65+ (millions)	
< 100	**474**	**830**
	FEMALE LONGEVITY (years)	
48	**80**	**87**
	TRANSPORTATION/COMMUNICATIONS TECHNOLOGY	
car/plane	**spacetravel**	**?**
radio TV	**interactive TV/computers**	**?**
1900	**2000**	**2050**
	YEAR	

Fig. 1 Changes in number of elderly, life expectancy and technology

The ability and motivation to function of any person, whether or not he or she is elderly or disabled depends on the supports and challenges--both physical and psychological--presented by the environment. The environment has both a social and a physical component. Professor Knipscheer has just explained how successful functioning of an individual depends on the social component of the environment--mainly the families and friends of an individual. Indeed, government policy makers already recognize the importance of family members and friends along with professionals, and hired caregivers for providing the social supporting component of the environment because substantial amounts of public money are expended to encourage and assist this type of support.

The physical component of the environment also offers both challenges and supports to the successful functioning of an individual. The supporting potential of the environment is exemplified by recent improvements in access to public facilities and transportation for the physically handicapped. Great progress has been made in western Europe and other countries of the world to modify the physical environment so that mobility and access for the physically handicapped is less of a problem than in earlier times. One of the later sessions of this workshop will be devoted to further developments in this area.

AGING AND THE ENVIRONMENT

But to fully appreciate the social impact of technology on the elderly and the disabled, we must further examine the relationship between the environment and aging process itself. Technology is, of course, part of the environment. The conclusion of what I am about to discuss is that aging is a universal biological process but it is not a uniform one. The environment contributes to the uniqueness of the aging experience of each of us. Disabilities which are not universal and which may occur at any point in the aging of an individual further contribute to the uniqueness of the aging process of an individual.

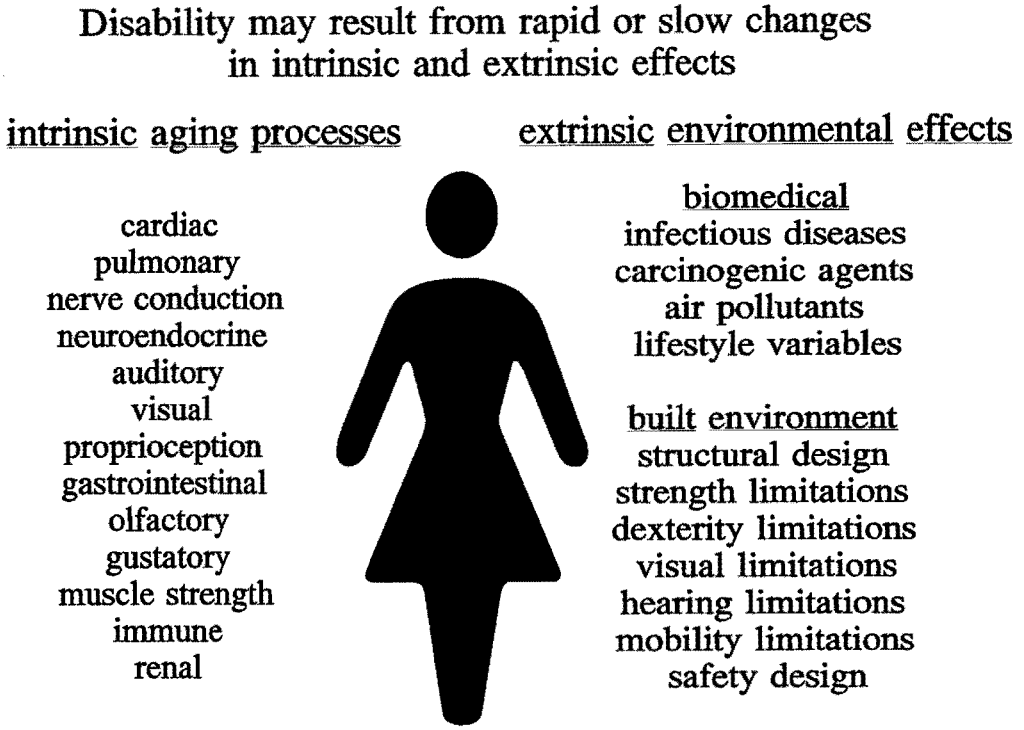

Fig. 2 Aging is universal but not uniform

The uniqueness of aging starts with genetic variations in the biological processes of tissue composition, repair and metabolism. It is convenient to distinguish between intrinsic and extrinsic influences on aging. Intrinsic aging includes measurable changes in a variety of physiological processes such as those indicated on the left of fig. 2. At present, the aging of the processes listed are thought to occur independently of disease processes although the distinctions between aging and disease are constantly changing as research continues. Intrinsic age changes reflect genetic and environmental influences.

The extrinsic influences on aging shown on the right side of fig. 2 are largely due to environmental factors, but some of the biomedical factors shown, especially diseases and lifestyle, reflect genetic factors as well. The potential for influencing human functioning is especially pronounced in the items shown under the built or constructed environment. Many of the environmental influences on aging are potentially modifiable or reversible by personal or environmental interventions, and this fact provides the starting point for deciding how to best use technology to improve human functioning. The use of technology should not be limited to modifying the environment after some limitation in function has occurred. The most effective use of technology for the aged and the disabled is in prevention. Just as the best medical treatment is based on prevention rather than cure, the best long range use of technology is to help prevent problems of functioning associated with old age or disability. To sum up, we argued first that aging is a very individual matter. Any two persons are less likely to be the same at age 70 as they were at age 7, whether they started life as identical twins or unrelated persons. Second, we argued that the degree to which they differ during the course of aging depends in part on when in history the aging occurred, for example in the 19th or 20th century. Third, we argued that the importance of environmental factors on determining the pattern of a person's aging is so important that it is no longer acceptable to attempt to understand aging without describing the environmental context in which it occurs.

The same arguments about environment and aging apply to technology and disability. Disability is not just a characteristic of a person carrying the disability label; it is a gap between personal capability and environmental demand (Verbrugge and Jette, 1994). Expectations and adaptation of an individual to a disability are profoundly affected by the degree to which the environment is supportive or challenging. The most effective long range use of technology are in primary prevention of the disability and secondary prevention of its sequelae.

The impact of a particular disability depends in part on the age of the person experiencing it; indeed, the relationships between aging and disability can be quite complicated. For example, many persons who have suffered from coronary heart disease have subsequently modified their lifestyle with respect to exercise, nutrition and use of recreational drugs such as tobacco and alcohol so much that their overall health is improved above the level prior to the coronary event. A person who ceases smoking may expect to regain pulmonary function, but only to the level of nonsmoking persons similar in age to a person sometime after the age he ceases smoking rather than the age that he started (See Fozard, et al 1992 for a summary). In old age, a positive association has been observed between the number of chronic medical problems and degree of limitations in functional ability; however the cause and effect relationships are unknown, and many of the chronic medical problems are preventable (Guralnik, et al, 1989).

The view of aging and disability presented above suggests a need for a different approach to the epidemiology of aging and disability than presently exists. Knowing the prevalence of limitations in functioning in various groupings of people will not by itself help us to use technology most effectively on behalf of the aged, the aging or the disabled. Without knowing how people adapt to limitations in functioning, or what correctable difficulties exist in particular environments we cannot take full advantage of technology to prevent disabling or handicapping processes or to compensate for limitations in abilities, whatever the cause. One approach to epidemiology of aging and disability that includes a consideration of the environment that we favor was described by Verbrugge and Jette (1994). Their model deals with both personal and environmental factors that contribute to disability. A second is based on the needs assessment approach developed by Cullen and Moran (1992).

Performance Demands for Select ADL Activities
(Percentages)

	Meal Preparation	Grocery	Bathing
Actions			
Lift, lower	37%	39%	28%
Push, pull	23	23	13
Hold, carry	11	10	11
Rotate	13	4	7
Side to side, hand to hand	8	5	23
Other	8	19	18
Postures			
Stand	64	58	44
Lean reach	26	16	14
Bend	7	9	14
Sit	-	9	9
High reach	3	5	15
Stoop	-	2	2
Grips			
No hand grip	40	45	29
Precision	49	28	44
Power	6	8	8
Palm	4	6	12
Cradle	1	2	5

Fig. 3 Table from Czaja et al, 1993

The third approach is based on task analyses of many everyday situations originated by Faletti (1984) and elaborated by Czaja and her colleagues, e.g., Czaja, et al (1993). They analyzed video recordings of elderly persons doing a variety of tasks ranging from bathing to meal preparation and shopping. They identified several postures, movements, and forces required in these activities that were difficult. An important finding was that many of the difficult actions observed were common to several different situations, e.g., bending, crouching, lifting. An example of their results is shown in fig. 3. The authors are using the findings to recommend ergonomic design principles for furnishings and utensils.

FIVE USES OF TECHNOLOGY FOR THE AGING AND AGED

The conceptual approach to aging and health that includes disability that we favor suggests five ways of using technology to improve the health and abilities of the aging and the aged. They are based on our conceptual approach to technology and aging that we call gerontechnology, a term coined by Jan Graafmans. The definition is "Gerontechnology is the study of technology and aging for the benefit of a preferred working and living environment and adapted medical care for the elderly".

The 5 uses of technology are shown in the next fig. 4.

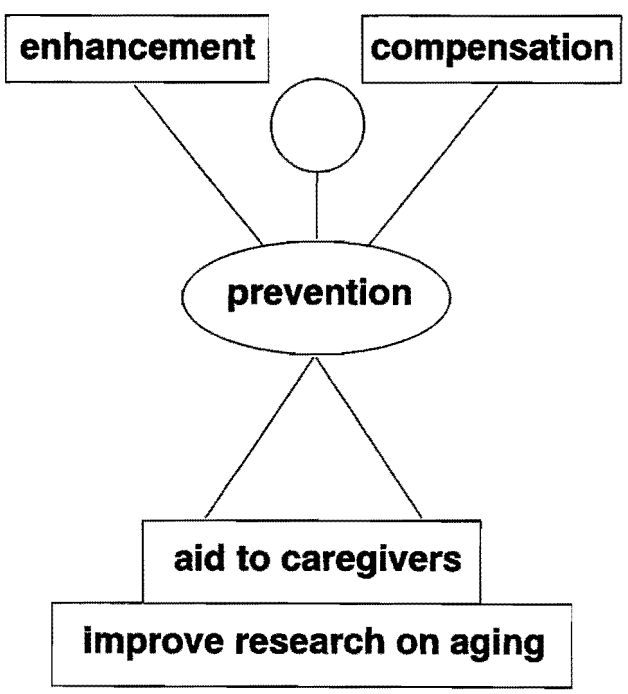

Fig. 4 The 5 uses of technology for the aging and the aged

As indicated earlier, we believe that the most effective use of technology is in prevention. Many problems of old age are modifiable through long-range, nonmedical interventions involving nutrition, physical activity, exposure to chronically dangerous environments such as noise, changes in life style regarding use of alcohol etc. Technology has an important role to play in task redesign, the design of monitoring equipment, warning equipment for persons using improper posture for work or improper use of dangerous tools, etc. Light switches activated by human approaches to dangerous stairs or passages is another example.

At the top left of the diagram is enhancement. Aging brings with it opportunities in the form of time for new social interactions and activities, time for new work, learning and leisure activities--self--fulfillment.
There has been virtually no attention paid to this aspect of aging and technology. The exception is the development of adaptable housing to suit the different needs of people during the life cycle of the family. The potential uses of technology for enhancement of activities is particularly intriguing. We are particularly pleased to see that one of the sessions in this workshop is devoted to leisure activities. We anticipate that user friendly communication technology will be of particular importance to facilitate remote contacts, to make new contacts and to participate in educational activities. Another area for development is computer systems for games artistic and creative activities through multi-media technology.

At the top right is compensation. This is the most fully developed aspect of technology adapted for the disabled, and to a lesser extent for the elderly. It requires little more attention now, except to say that the technology interface should be designed to give the person using it the perception that he or she is in control of the technology rather than the other way around. Troubled VCR users, unite!! might be the slogan for this sentiment.

At the bottom of the diagram is an indirect use of technology on behalf of the disabled of any age. The design of devices to lift and transfer people who cannot move themselves and devices that assist caregivers in providing assistive and medical care are included in this category. A lot of high tech effort in robotics and electrical stimulation of muscles etc. is currently being put into this area, a trend that will continue.

With respect to research on aging, it is a truism that technology is revolutionizing scientific research in physiology and biology, a trend that is reflected in gerontology, the scientific study of aging. We fully expect that the scientific applications of technology will influence the current concepts of aging and will have long range effects on consumer technology targeted toward the elderly and the disabled.

THE PRAGMATICS OF FULLY UTILIZING TECHNOLOGY FOR THE AGING AND THE DISABLED

We have four recommendations for consideration at the conference.
Developmental approach to design. To fully realize the uses of technology for the aging and disabled, industrial designers, architects, and planners need to adopt a developmental view of product design. For example, the uses of homes change over the life cycle of a family--from a home for newlyweds to a home for a family, to an empty nest for parents with grown children, to a shelter for elderly persons with limitations in mobility, perception and memory. We need both adaptability in form, e.g., movable partitions, and function, e.g., adaptable person-product interfaces in appliances to fit changes in strength and mobility. There is considerable knowledge about such approaches presented in architectural schools, but applications are very limited. Adopting a developmental approach entails small additional initial costs which will be offset by savings in renovating or retrofitting existing products or housing stock.

Consumer involvement. Involve the consumer in the design process of new technology and in the evaluation of the usefulness and usability of existing technology. Consideration of the preferences, needs and abilities of elderly and disabled consumers becomes relatively more important as the complexity and variety of technology increases. Today's technology is full of examples of products and services that are very difficult to use, e.g., the VCR and its control and the automatic bank teller devices. The time required to adapt to such devices discourages their use and limits their intended usefulness.

Development of scientific knowledge base for technology. Scientific information about peoples needs, abilities, desires, and economic status are needed to make the most effective use of technology for the aging, elderly and the handicapped. In the past quarter of a century a substantial knowledge base about aging and disability has been established. The knowledge needs translation to be effectively used by designers and manufacturers of technology, but a substantial start has been made.

Change technology infrastructure. The pragmatics of technology utilization call for changes in the infrastructure for technology development and dispersal. Let me illustrate this with the concept of market-pull vs. technology push, a concept developed by Bouma and colleagues (Bouma, 1991). The figure illustrates technology push.

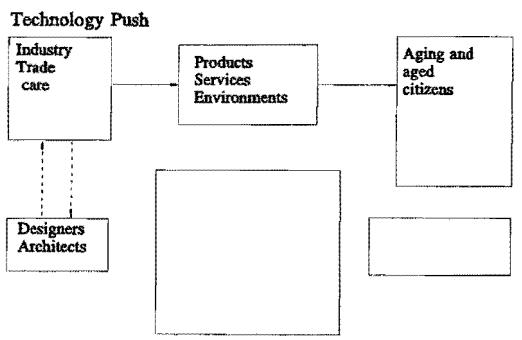

Fig. 5 Technology push

Industry and trade generate products, techniques, and services that are offered to potential consumers who have little to do except to accept the products offered or to reject them.

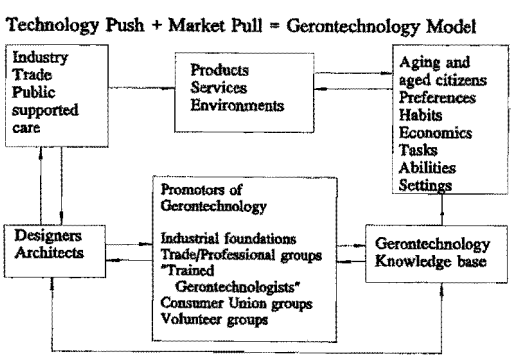

Fig. 6 Technology push and market pull

Fig. 6 illustrates market pull as applied to the aging and aged consumer. You see that the development of technology is influenced by the consumer in two ways--feedback about technology offered on the market, and scientifically based information about the consumers and their needs and preferences provided to the designer and manufacturer. The implications of market pull are many. For example a salon or studio approach to presenting lighting fixtures as opposed to a store with hundreds of fixtures on the ceiling, tables and floor, would allow the visually impaired customer to better identify the products available for his lighting needs. Training in the possible uses of technology would supplement or replace the current use of salespeople to explain their products.

CONCLUSIONS

In this brief presentation, we have presented a view of aging and disability that emphasizes the importance of the environment, including technology, for human functioning. We argued that a new approach to epidemiology of aging and disability is necessary to fully take advantage of technology. We argued that the truly effective use of technology requires a change in the infrastructure of development and distribution of technology. We are optimistic about the value of technology for improving the health and quality of life of all people who are aging or aged whether or not they have disabilities.

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