



Defining aging in cyborgs: A bio-techno-social definition of aging

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ABSTRACT

Initially the aim of this article was to discuss and define aging at the intersection point between biology and sociology. However, recent biomedical and technological advances are changing the discourse on aging, and against this background the author of this article argues that current definitions of aging should be improved. The author emphasizes that there is a need to update current definitions of aging, or to formulate new multidisciplinary ones. The author suggests that (besides biology, psychology and sociology) the technological discipline should be included in the *integrative gerontology model*. Finally, in this article a new definition of aging is put forward. According to the author of this article, human *bio-techno-social aging* is characterized by: (a) a time-bound process of change including, (b) both reversible and irreversible biological processes, (c) social processes forming an irreversible chain of events, and (d) an increasing use of technological artifacts whose purpose is to support or replace damaged biological functions; and/or an increasing use of technological artifacts whose purpose is to facilitate or enable interaction.

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Introduction

This article discusses the definition of *aging* at the intersection point between biology and sociology. In this article, the integrative model presented by *Alkema and Alley (2006)* is used as a source of inspiration and as a framework for the understanding of age-related processes. The model integrates the concepts of *age*, *aging* and *the elderly* and scientific disciplines operating within the gerontological field (biology, psychology and sociology) in a broader social context. In this article it should be noted that the definition of aging (as understood by the integrative model) specifically refers to a dynamic passage of time; thus the model states that *time* and *aging* are associated with each other (*Alkema & Alley, 2006*, with reference to the *Treas & Passuth, 1988*). How then is aging defined within biology¹ and sociology²?

Within the biomedical field a distinction between primary and secondary aging is usually made. Secondary aging is

described as caused by ‘*age-related diseases*’ or ‘*behavioral factors*’, whereas primary aging instead is described as “*age-related biological alterations that occur in all individuals of a species, depend on factors in the individual's internal biological environment, are slow and progressive, and irreversible*” (*Wikby & Johansson, 1999*). The irreversibility of biological aging processes is also emphasized by other authors within the biomedical field (*Holliday, 2004; Larsson & Rundgren, 2003*). While the field of biomedicine sheds light on aging in humans, within microbiology aging is instead studied at a cellular level. Aging in this area is therefore defined as ‘*a time-dependent, progressive, breakdown of all cellular and bodily functions*’ (*Nyström, 2013*). The definition of aging within the field of social gerontology somehow implies processes of cumulative change (*Tornstam, 2011*, with reference to *Schroots, 1988*). Aging processes are therefore described in terms of *change* in one, or more, chain/s of events (*ibid.*). In the field of social gerontology, biological-, psychological-, social- and functional aging are discussed in relation to chronological age (*Tornstam, 2011*, with reference to *Erber, 2010*). The distinction between primary and secondary aging is also described within this field, with the latter meaning an amendment linked to the aging process without being a part of it, whereas the first is instead

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¹ Refers to the fields of *biomedicine*, *microbiology* and *bio-gerontology*.

² Refers to the field of *social gerontology*.

described as an 'inevitable, irreversible and cumulative' aging process (Tornstam, 2011). However, all the above definitions are highly restrictive and they have in common that aging processes are assumed to move in *one* single direction. In other words, current definitions only embrace one-sidedly an age-related *increase* in biological *degradation* and in a *time-bound process* that is considered to be of *irreversible character*. Thus definitions exclude alternative possibilities, such as reversible aging processes.

In order to broaden the perspective on how aging may be defined, two examples of contemporary rewording of other definitions are highlighted below. The first example refers to the concept of death. Historically, people have been considered to be dead after they have stopped breathing and no longer have any cardiac activity (Nationalencyklopedin, 2014). In Sweden until the 1980s the term 'cardiac death' was applied to describe a dead person. During the latter half of the 1980s in the legal sense it was instead formulated as 'a person is dead when all the brain's functions totally and irrevocably have fallen away' (SFS, 1987: 269). The change of the legal definition of the concept of the death should be understood as a consequence of new scientific knowledge that led to the acceptance of newer ways to understand and describe death. At the same time, it should be noted that both the previous concept of death (cardiac death) and the current concept of death (brain death) might be criticized in a strictly biological sense. This is because both the old and the new concepts of death are confined to the fact that *one* of the humans's organs has stopped working, while the concepts of death do not include 'life' (function) in each cell or in each organ of the human body. This has relevance because individual organs and/or cells can be observed to 'be alive' and functioning *after* legal death has occurred. The discussion of the concept of death is similar to the discussion about the aging process. Does aging solely concern cells, functions and/or people? The second example is taken from the Swedish *National Board of health and welfare*,³ which is the authority responsible for the definition of the terms used within health care. The Board's terminology council decided to clarify the definition of the terms 'disability' and 'impairment' (National Board of health and welfare, 2013). This constitutes evidence of how a modern *societal discourse*,⁴ today more often than in the past, requires a multidisciplinary approach. The distinction between the notion of impairment and the concept of disability is thus about what's what in terms of human biological (or psychological) functions in a social context. While impairment usually refers to individual biological (or psychological) functioning, disability instead is understood as socially conditioned. These two concepts have been specifically designed, resulting in the demarcation of a phenomenon in a complementary way and across disciplinary boundaries (i.e. natural sciences and social sciences). Similarly, future definitions of aging ought to be described in relation to other academic disciplines in order to reach a 'bridging' in our understanding of the concept of aging.

³ The National Board of Health and Welfare is a government agency in Sweden under the Ministry of Health and Social Affairs <http://www.socialstyrelsen.se>.

⁴ In this article the term *societal discourse* refers to discourse within aging and disease.

Aging vs. disease

The distinction between normal biological aging and disease has long been a subject of discussion (Blumenthal, 2003; Wikby & Johansson, 1999). In this section, an imaginary experiment concerning dementia is described. Dementia is common among the elderly and is associated with injuries or pathological changes in the blood vessels and/or in brain cells. However, in this section, degenerative dementia is discussed in terms of a *primary* aging process that might affect anyone achieving old (biological) age. Note, however, that this imaginary experiment is only offered to achieve a better understanding of what aging is, and this does not reflect the author's definition of dementia. The thesis is initially contradicted in relation to the biomedical definition of aging, because dementia cannot be claimed to occur in all individuals. Furthermore, the thesis can be criticized by sociologists as well as by biologists because dementia can be described in terms of a secondary aging (i.e. dementia seems to be avoidable). In the scientific literature sometimes it is also emphasized that environmental factors are of importance for the development of dementia, and some scientists believe that there is a correlation between lifestyle and dementia (Dahl, 2008; Sofi, Abbate, Gensini, & Casini, 2010).⁵ The thesis, that dementia can be understood as a form of natural biological aging process, is otherwise also based on the fact that the type of senile plaques (β -amyloid protein), that has long been considered to cause dementia, accumulates in the brain cells of Alzheimer's patients as well as in the brains of people who have a healthy aging brain (Forsknings & Framsteg, 2013; Stomrud, 2009; Swedish Dementia Center, 2013). Furthermore, recent research suggests that the connection between damage to the brain's blood vessels and dementia is stronger than the connection between plaque and dementia (Marchant et al., 2013). Is it possible that this type of damage is caused as a result of a natural aging process? Support for the imaginary thesis is also found in definitions of the aging process made by researchers who study aging processes at the cellular level. Microbiologist Nyström (2013), for example, defines aging as 'a time-dependent, progressive, breakdown of all cellular and bodily functions', stating that common forms of dementia at least satisfy two criteria relating to brain cells and functions (i.e. 1. it is *time-dependent* and 2. it is all about *the progressive degradation* of cellular functions in the brain). Although research suggests that the speed of aging may be manipulated (López-Otín, Blasco, Partridge, Serrano, & Kroemer, 2013; Nyström, 2013) all types of cells seem to die after a certain number of cell divisions. However, one unanswered question is whether this cell division process, that ultimately leads to cell death, should be understood as a process of disease (instead of an aging process). The thesis, described above, shows that the definition of aging still flows together with the definition of disease (dementia). However, as stated above, it seems to be possible to manipulate the speed of aging processes (i.e. aging processes can be slowed down). In my opinion, this implies that the aging process should no longer be defined in static terms, because the variability of aging processes is not embraced.

⁵ Some researchers suggest for example that people who eat a Mediterranean-style diet have a reduced risk of developing dementia (Sofi et al., 2010). An active way of life and control of blood pressure appears to have a protective effect against the risk of developing dementia (Dahl, 2008).

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