Senescence, Enaction and Technology: On the Need for Movement and Questions in Interaction Design

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Abstract

This paper attends to the intimate history of the design of digital technologies with knowledge from the cognitive sciences, particularly when dealing with the subject of human ageing. The short history of Human Computer Interaction (HCI) and design research is filled with attempts to bring people and technology closer together—designers trying to predetermine the ‘fit’ between interfaces and those people who will be using them. The paper argues that the limitations of these approaches are brought to particular attention when the ageing body and mind are reconceived from an embodied-enactive ‘senescent’ perspective. The philosophy and pragmatics underpinning Warburg’s *Mnemosyne Atlas* is used in two ways. Firstly, it highlights the limitations of designed ‘fit’ in the context of human senescence. Secondly, it provides insight into finding a way forward for future design practice that explores the experiences senescent beings have with technology, which are incoherent, unpredictable and deny attempts to be predetermined by the designer.

For much of the latter 20th and early 21st century, the study of human ageing has focused on the declines and deteriorations of human experience. In particular, the literature surrounding the study of human cognition has overwhelmingly focused on how perception, attention and memory all falter in later life. This may not be a problem when this knowledge is kept within the confines of the discipline of cognitive psychology, but becomes problematic when researchers and practitioners from other disciplines draw upon these claims uncritically to inform their own activities. As has been noted elsewhere at length (Vines 2011; 2009) this can be the case when designers of new technologies targeted towards older people include cognitive psychology research to inform the design of new products, services and systems. The reasoning for using cognitive psychology research so explicitly is often based upon the vast body of evidence that suggests as people age, deteriorations to the human mind make it highly difficult for people to learn to use new, abstract, technologies. Therefore, as is typical of most user- and people-centred approaches to design, here designers focus upon gathering as much knowledge about the cognition of the user as is possible and attempt to ‘fit’ the design of a technology to a predetermined mental model of a group of people.

This paper proceeds from the perspective that in order to eliminate these problems in design it is first useful to reframe the problem that needs attending to. To achieve this, two questions are posed. Firstly, how might it be possible to consider the ageing process, in terms of its effects on cognition, as anything other than a process of deterioration? Secondly, if it is possible to transcend the paradigm of deterioration, what might this mean to designer’s of new technologies?
In exploring these questions, the paper will establish an alternative perspective on the cognitive changes occurring as people age, and will use the term ‘senescence’ to distinguish itself from the prevailing literature on ‘ageing’. It will be noted that whilst most cognitive psychology research into ageing treats the body as unrelated to mental phenomena, there are subtle connections between the body and cognition that when disrupted throws into question the human ability to enact with technology. The significance of the body in cognition is emphasised all the more by the work of Aby Warburg, who, through Robert Vescher’s theory of the optical sense of form, suggested the empathetic engagement of the whole body in the ‘looking’ at works of art. This is particularly notable within Warburg’s Mnemosyne Atlas, where seemingly disparate imagery is juxtaposed with one another and engenders an effortful process on the behalf of the beholder in order to enact the invisible traces in between. The paper will close by arguing that attempts at designing a close fit between people and technology inevitably fails due to a cognitive necessity for people to actively engage and reflect upon interactions with technology. By introducing the concept of senescent cognition, grounded in the incoherent experience of the temporal body and supplemented by the philosophical implications of Warburg’s work, helps identify a failure within design practice that has traditionally focused on constructing a ‘fit’ between people and technology, and ends rather than means.

The Body and Incoherent Enaction

For the most part, the scientific study of cognition finds the active, moving human body as a source of noise or blur that needs to be isolated and controlled. The notable exceptions that do imply the significance of the body in the development of human cognition (including, but not restricted to, the work of Humberto Maturana, Francisco Varela, James Gibson, Esther Thelan and Andy Clark) present the body as fundamental in bringing coherency to the world. For example, Varela et al. (1991) introduce their enactive approach to cognition as comprised of two main points; ‘(1) perception consists in perceptually guided action and (2) cognitive structures emerge from the recurrent sensorimotor patterns that enable action to be perceptually guided’ (Varela et al., 1991, p.173). What Varela et al. are referring to here is that human cognition (perception, thought, memory and more) is fundamentally grounded in the movement of the body contextualised in a world. It is this embodiment, so the argument goes, that enables patterns of experience to form that bring forth a coherent ‘reality’.

The problem with this focus on the coherency of embodied and enacted cognition is that cognitive experience might not, always, be coherent. The research of Shaun Gallagher (2005), informed by the phenomenology of Merleau-Ponty (such as Merleau-Ponty (1962 [2002])), is useful here, providing explanations as to how human cognitive experience is grounded in the human body, and how subtle changes to this grounding have profound consequences on an individual’s perception and cognition. A significant contribution of Gallagher’s research has been the study of interactions between two bodily systems related to the coherency of perception and action; the body schema and body image. Gallagher, developing and synthesising notions developed by Head (1920) and Merleau-Ponty (1962 [2002]), defines the body schema as ‘a sys-
tem of sensory-motor functions that operate below the level of self-referential intentionality’ (Gallagher, 2005, p.26). The body schema operates in a close-to-automatic manner to aid the positioning of the body in relation to the environment. A correctly functioning body schema affords a situation where aspects of bodily movement are not required to be under conscious control when engrossed in interactions with objects and other people. As Gallagher defines it, the body schema is a prenoetic performance of the human body, suggesting that ‘the body acquires a certain organisation or style in its relations with its environment’ before an individual is consciously aware of it occurring (Gallagher, 2005, p.32). It is not, therefore, just a case that the body schema coordinates the sensorimotor system of the human being in order to engage in a certain activity, but that it is in a constant exchange with the environment. Gallagher (2005) suggests that at times the body schema can expand beyond the flesh of the human and incorporate aspects of environment.

The body schema allows the body actively to integrate its own positions and responses and to deal with its environment without the requirement of a reflexive conscious monitoring directed at the body. It is a dynamic, operative performance of the body, rather than a consciousness, image, or conceptual model of it. (Gallagher, 2005, p.32)

The body image, on the other hand, is ‘a system of perceptions, attitudes, and beliefs pertaining to one’s own body’ (Gallagher, 2005, p.24). The body image frequently appears in conscious experience and is not equal to the body schema (Gallagher, 2005). An extreme example of the difference between a body image and body schema is that at times one’s body image can be brought to conscious attention, whilst the body schema always stays outside of consciousness. The body image is an explicit understanding of what constitutes an individual’s own body, rather than the tacit performances of that body. Gallagher (2005) argues that in terms of perceptual experience, the body image distinguishes itself from the environment. If an individual is required to consciously attend their perception to the performance of their body in a task, then the body would be brought forth as the focal point of attention. If people were required to utilise their body image for sensorimotor control, as opposed to the body schema, then action would be ‘inexact and awkward’ (Gallagher, 2005, p.33). As such, human beings have the sensorimotor abilities to free up cognition to attend to intentional activities, rather than the control of the body in relation to the environment.

The sense of proprioception is a significant sub-system coupled to the body schema. The notion of proprioception is often traced to the work of Charles Sherrington, who described it as a person’s sense of movement from the muscles, tendons and joints of the body (Sherrington, 1907). James Gibson, during his formulation of the theory of affordances, argued that proprioception was a form of ‘egoperception’, as sensitivity to the self, not as one special channel of perceptions or as several of them’ (Gibson, 1986, p.115). He went on to argue that all the perceptual systems are in some way proprioceptive as well as exterosensitive, ‘for they all provide information in their various ways about the observer’s activities’ (Gibson, 1986, p.115). He stated that:

[i]t was bodily movement, not the particular organs involved, that was essential. The organs were merely the means of producing movement, not the end in itself. The end was the movement itself. 

[Gibson, 1986, p.115]
information that is specific to the self is picked up as such, no matter what sensory nerve is delivering impulses to the brain. [...] An individual not only sees himself, he hears his footsteps and his voice, he touches the floor and his tools, and when he touches his own skin he feels both his hand and his skin at the same time. He feels his head turning, his muscles flexing, and his joints bending. He has his own aches, the pressures of his own clothing, the look of his own eyeglasses—in fact, he lives within his own skin. (Gibson, 1986, p.115)

Proprioception then, for Gibson, was a form of continuous feedback from the environment felt through the body. In engaging with the environment, a person discovers as much about their own abilities and embodiment as they do the world. In order to explore the world—to develop the perception of new affordances—then it is also necessary to have an understanding of one’s own body, its capabilities and an unconscious awareness of what to do with this body in relation to the world.

It appears that the body schema, informed through the various senses of proprioception, is a necessary function of human embodiment that integrates the environment to support enactment; it is crucial to the coherency of experience. As such, an individual with imbalances related to the coupling of these systems would likely have significant issues organising their body in relation to the environment. Gallagher (2005) discusses a clinical study of a patient called Ian Waterman, which presents an extreme example of such a situation (originally described by Cole (1995)). Ian Waterman had no sense of touch or proprioception below his neck as a result of an illness in his late teenage years. His sense of continuous feedback as to the position of his body was void and, as a result, he was effectively paralysed. This is not to say his body was not capable of movement, however. The possibilities for action were still fundamentally the same as before, but the necessary sensorimotor coordination to make them happen was lost. Gallagher (2005) notes that over time, Ian Waterman was able to regain movement. This was only possible through emphasising the role of vision in controlling his body. Without visual perception:

[Ian] does not know [...] where his limbs are or what posture he maintains. In order to maintain motor control he must conceptualize his movements and keep certain parts of his body in his visual field. His movement requires constant visual and mental concentration. In darkness he is unable to control movement; when he walks he cannot daydream but must concentrate on his movement constantly. (Gallagher, 2005, p.44)

Gallagher (2005) and Cole (1995) argue Ian Waterman has replaced his missing body schematic capabilities with his body image. When interacting with the environment, it is impossible for Ian’s body to disappear into the background of his intentional activity; he always has to include his body in his conscious awareness. To look at Ian years after his illness, it would be difficult to observe him acting any differently to most healthy adults. His actions are only possible, however, through his extreme effort and hard work to regain control of his body; medically, Ian Waterman’s proprioceptive system never recovered from his illness. Gallagher (2005) implicates the body schematic systems of the human body, of which proprioception fulfils a substantial role, as necessary for the seamless enactment of experience. In the following section, Gallagher’s claims will be relocated in the context of ageing and temporal change.
Senescence, Cognition and the Body

According to Chemero’s (2009) proposal of dynamic affordances an affordance is understood to be a relation between the abilities of a particular embodied agent and the features of the environment, which are in continual fluctuation and change. Abilities are, however, not purely a consequence of physical embodiment but also require an individual to hold the knowledge as to how to make use of this embodiment. As was highlighted by Gallagher (2005), implicit capabilities of the sensorimotor system often intervene silently in experience to ensure that human beings do not have to consciously attend to a variety of embodied abilities. When these fundamental bodily systems begin to falter, however, one’s body comes to the fore in relation to affordances and, consequently, the perception of affordances becomes somewhat incoherent. It will be argued here that it is this continual juxtaposition of expectations and actualities that should form our understanding of senescent cognition.

In the discipline of ecological psychology and research examining human locomotion and kinaesthesia it has been acknowledged for some time that the ageing process results in changes to the perception of affordances within an individual’s Umwelt. Usually, however, these relationships are understood in rather mechanical terms. So, for example, whilst extensive literature has been amassed on how the ageing of the body affect the perception of ‘stair-climbability’ (as in Warren 1984, Konczak et al 1992, and Cesari et al. 2003) these primarily focus on changes anthropometric data (such as the length of the leg from a specific point to a specific point) and biomechanical data (the elasticity of muscles and tendons, and the flexibility of certain joints). In the cognitive psychology of ageing, however, efforts have been made in recent years to examine the relationship between changes to human cognitive functioning occurring in old age and changes to sensory and motor systems such as those described above. Ulmar Lindenberger and colleagues noted strong correlations between deteriorations in cognitive and sensory abilities in later life (Baltes & Lindenberger, 1997; Lindenberger & Baltes, 1994). Subsequently, these researchers have performed a number of studies of people performing ‘dual-task’ operations. A dual-task is the completion of a cognitive task (for example, trying to memorise a sequence of words) at the same time as a sensorimotor or physically taxing task (such as walking around obstacles). In one such study, Lindenberger et al. (2000) observed that in dual-task situations older people showed significant reductions in both their cognitive and sensorimotor accuracy when compared to younger people. Huxhold et al. (2006) suggest that as older people exert a greater amount of cognitive information-processing, they suffer from lapses in the coherency of their sensorimotor system (notably their posture), suggesting that cognition, particularly in later life, is significantly implicated in sensation and action.

Although the work within ecological and cognitive psychology is highly functionalist in its approach, the claims made about the relationship between cognitive and sensory change have synergies with the phenomenological argument developed by Gallagher (2005). Despite these synergies, however, these considerations come from rather discrete and separated discussions within cognitive science. Whilst Lindenberger et al. come from a traditional, cognitivist-informed,
approach to understanding ageing cognition, their studies begin to invoke the important role the body and its relations to the world play in temporal changes to cognitive functioning. Problematically, however, being situated within a discourse where the body is often considered as noise or blur, Lindenberger et al. might be prevented from moving these ideas further. Contrastingly, Gallagher presents evidence of how the human body and its relations with the world are essential to human beings coping with temporal changes to cognition and subsequent interactions within the Umwelt. This discussion, however, is completely isolated from the cognitive study of human ageing. It is useful therefore to proceed with strengthening the synergies between these disparate bodies of knowledge.

In terms of the embodied senescent human being, the correlations between cognitive and sensory decline observed by Lindenberger et al. (2000) can be viewed as the result of changes to the prenoetic performances of human body and the contingencies these provide to guide perceptions and enactments of affordances in the Umwelt. Returning to Gallagher's (2005) discussion of the body schema, it was established that the proprioceptive systems play a pivotal role in configuring the implicit bodily relations and extension into the environment. An alternative reading of the issues highlighted by Lindenberger et al. (2000) then is that the cause of the combined sensory and cognitive decline may be related to the proprioceptive and body schematic systems. This interpretation appears to have weight due to observations of reductions in the acuity of proprioceptive feedback in older people compared to younger adults. (Camicioli et al., 1997; Teasdale et al., 1991) The lowered acuity of proprioception with age is not necessarily severe and in habitual activities may not surface; however, in moments where sudden and unexpected reconfigurations of the Umwelt occur, proprioception is implicated as a crucial sub-system of human embodiment (Peterka, 2002). Peterka and Loughlin (2004) observed that the reduced accuracy of proprioceptive feedback leads to under and over compensations in certain movements, which are particular evident in older people. It has been suggested that the decreased accuracy in proprioceptive feedback results in an increased risk of trips and falls for older people (Peterka & Loughlin, 2004). This increased risk is not necessarily as a result of misperceiving, but as a result of over or under compensating within dynamic interactions with the environment through conscious, rather than automated, sensorimotor action.

These reductionist studies of the ageing proprioceptive system can be both strengthened and strengthening by being considered within the work of Gallagher (2005). Bringing these discrete discussions together highlights how reduced proprioceptive feedback as a result of the process of senescence can lead to, first, an emphasis of conscious perceptual control of the body through the individual's body image and, second, a certain level of ongoing ‘experiential blindness’ (Noe, 2004). As people proceed through senescence, one of the key features of their embodied cognitive capabilities, that of proprioceptive sensorimotor integration, provides less acute streams of continuous feedback regarding the interactions between body and world. This alteration in the ability to integrate the Umwelt into a coherent whole, and the resulting increased necessity for conscious perceptual action, presents a situation where conscious mental activity is divided. It can no longer be placed primarily into an intentional activity, and the body is perceived in op-
position to the environment rather than as situated and extending within it. The sensorimotor contingencies of the senescent human, based upon a certain level of proprioceptive and implicit knowledge that no longer coheres to the physiology of the body, are somewhat misplaced. Instead of there being a coherence between the integration of ‘sensory stimulation with patterns of movement or thought’ (Noë, 2004, p.4), there is a mild yet continuous experiential blindness. This is not to say this process of senescence is one of deterministic deterioration; rather, it is a state of continuous and desynchrony of the body. Whilst the studies discussed above suggest that proprioception and sensorimotor integration reduces as a result of senescence, there are also suggestions that proprioception in later life is relatively plastic and can be re-integrated (Gauchard et al., 2003; Hay et al., 1996; Li et al., 2008). This suggests that although human senescence leads to problems in integrating the dynamics of the Umwelt, these integrative systems do not so much deteriorate in ability but are rather just misaligned with the changing embodiment of later life.

To proceed from the basis of senescent cognition provides a rather different perspective on the cognitive disconnections supposedly experienced by older people, particularly in terms of engagements with new and abstract technologies. Senescent cognitive disconnect, as argued here, occurs as a result of a misalignment between the interactions of the physiological basis of the organism and the unconscious sensorimotor knowledge an older person applies to know what is possible with their embodiment. Abilities, in relation to affordances, are not just to be understood as purely cognitive (as in traditional cognitive psychology), or as physical (as in certain ecological psychology studies) but as the resulting combination of potential couplings a particular embodied being is capable of and, at the same time, what couplings this being actually perceives as possible. To design the space to allow for the enactment of affordances in this situation is to provide the space for the individual to explore not only the possibilities for action in features of the environment, but to reintegrate their knowledge of their embodied capabilities. It is no longer plausible to design a fit between people and technology—rather, the senescent cogniser must find their own ‘fitness’ with technology. These are themes that were explored by Aby Warburg, particularly in the Mnemosyne Atlas, where an empathetic engagement that invokes the expressive movement of human embodiment in an active process of perceptual engagement with the world. Not only do the ideas and philosophy implicated by Warburg provide valuable new insight on the issue of senescence but his work also highlights the fundamental limitations of user- and people-centred design in this context. These will be explored further in the following section.

The Body, Movement and Distance

As should be clear by now, both in this text and in the other texts that form this volume, Aby Warburg’s work was about more than just the history of art in specific moments of time in specific locales. Rather, as Rampley (1997) and Blassnigg (2009) have noted, his work had as much to do with understanding human consciousness, perception and imagination as it was about making sense of supposedly concrete artefacts. It is in understanding Warburg’s work as a broader philosophical investigation that makes it valuable in the context of understanding the implications senescent cognition has on design. Firstly, as with much of post-Gibsonian design and technology
research, the *Mnemosyne Atlas* was more about the relationships inbetween the images than the images on the various boards themselves. Secondly, a necessary component of Warburg’s work was movement, and developing an intimate understanding of the distance between what would often appear to be highly discrete imagery. The point to elaborate here is that in reference to human cognition, although Warburg’s work is highly centred on the image and symbol, the entire body (in both its material and immaterial connotations) is invoked throughout. On a second level, the process of relationship forming and knowledge creation exploited by Warburg in his *Mnemosyne Atlas* makes transparent some limitations of much contemporary design practice in reference to the senescent cogniser. Before elaborating on these points, it is useful to overview the some synergies Warburg’s work has with the discussion earlier in the paper.

Rampley (1997) discusses at length the connection between Warburg’s various writings and lectures and Robert Vischer’s (1873) work *On the Optical Sense of Form*. A key distinction made by Vischer was a differentiation between the concept of ‘seeing’ (sehen) and ‘looking’ (schauen). Rampley (1997, p.45) notes that:

> This distinction rests on an opposition between simple passive ‘seeing’ as a physiological process of stimulus reception, where the “impression received is still undifferentiated” and ‘looking.’ The latter ... “sets out to analyse the form dialectically” where “the impression of seeing is repeated on a higher level”.

Whilst Vischer undoubtedly proceeds from a highly materialistic and mechanistic view of the human body and an overly simplistic view of human visual perception, his perspective is useful in this context as it distinguishes between a passive interpretation of the world with an active and effortful engagement with it. The consequence of such an active engagement with the world is that the world (for the beholder) becomes invested with value (Rampley 1997). Along with the more contemporary work of Varela et al., Noe and Gallagher and ecological psychologists, Vischer emphasised the role of bodily engagement in the world as a key prerequisite for richer knowledge creation. Vischer’s suggestion that “the child learns to see by touching”, which is highly analogous with the contemporary cognitive science work of Esther Thelen, Anothony Chemero and Francisco Varela, emphasises the role of the human body in perception. Vischer deviates from the more contemporary work of cognitive science, however, by arguing that the process of ‘looking’, through embodied perception, leads to the establishment of harmonies between objects and subjects. These harmonies, Vischer (p.101) argued, lay in the “concept of similarity” which permits the beholder, through their subjective, embodied experience of the world, to mimetically enter into the object. Rampley (1997, p.48) notes that:

> central to this mimetic process is the body, which functions as a common measure of comparison by which the object is invested with the qualities of subjective embodied experience. Furthermore, this comparison through the medium of the body is possible on the basis of the subjective imaginative capacity to symbolize; it is by virtue of the symbol that two or more heterogeneous elements can be literally thrown together on the basis of some perceived similarity.
Rampley (1997) argues that Warburg extended Vischer’s theory of empathy in two ways. Firstly, in giving a more profound role to symbolism as the basis for identifying unconscious similarities, and secondly as providing a historisiation of the phenomenon of empathy. For Warburg then, following Vischer, the understanding of the object does not come from its material form but rather from the empathetic projection of one’s own experiences into the object, or the symbols forum in art works, itself.

The above interpretation of Warburg’s work is of value to the debate surrounding senescence, cognition and technology as it supports a way of rethinking the issue of cognitive deterioration in old age. It could also, however, be interpreted as contradictory to the previous discussion. It suggests that symbols equal meaning; that cognitive experience is communicable through time and space through such symbols; and that the human body, in material or immaterial form, acts as a coherent meeting place for this communication to be enacted. To read Warburg’s work (as informed by Vischer) as contradictory to senescent enaction would be to ignore certain synergies however. Particularly valuable in this context is the implications this has on the way memory is conceived by Warburg, and how memory is contingent on elements of movement and distance. Traditional models of human memory within cognitive psychology for much of the 20th century have a tendency to conceive of memory mostly as a storehouse of knowledge (Pfeifer & Bongard, 2006). In traditional studies of ageing memory, the prevailing claims are that as access to memory slows, the creation of new memories is more difficult and there is a greater reliance on the long-term ‘storehouse’ of knowledge. Warburg instead provokes a sense that memory persists in a distributed manner over time and space that is reawakened in an individual’s holistic, embodied experience of works of art and religious symbolism. In order for these memories to be reawaken (or re-enacted) it is necessary to perceive what is looked at as a mobile entity. As Michaud (2004), translating Warburg, notes, “to attribute motion to a figure that is not moving, it is necessary to reawaken in oneself a series of experienced images following on from the other – not a single image.” Therefore, it is not primarily a case that symbols and works of art embody the empathetic engagement of its creator (although this was undoubtedly of interest to Warburg, as Rampley (1997, 2004) discusses at length) but that the actively engaged viewer makes sense of the work through the internalisation and imaginative re-enactment of their own past embodied experiences.

It is in Warburg’s Mnemosyne Atlas where this aspect of re-enactment becomes most evident. Each panel that formed the Mnemosyne traced a history of symbols and movements, where imagery was used regardless of its cultural, temporal and geographical provenance. Rather than treating the images as individual artefacts to be diagnosed and imagined, they are juxtaposed with one another in order to make novel and esoteric relationships. Punt (2006, p.101), noting the synergies between Warburg’s work and early cinema, notes how it ‘relied on the agility of the human mind to apprehend worlds, and to give sensible meaning to events even if they contradict the flow of dominant reality.’ That the connections between the images on a panel are not immediately clear is somewhat the point. There is a requirement for distance in the panels on the Mnemosyne. The viewer must actively engage, they must ‘look’ and not just ‘see’, in order to make apparent
the ghostly traces. Dillon (2000) notes that the Mnemosyne Atlas:

was ‘a ghost story for adults': it invents a kind of phantomic science of the image, a ghost dance in which the most resonant gestures and expressions its creator had discovered in the course of his career return with a spooky insistence, suddenly cast into wholly new relationships.

There is the suggestion here that within the objects of art history there is something of the works creator left behind in the object as a trace. As Dillon suggests, however, this is not to be understood in terms of a material and visible connection, but rather as a ghostly trace that becomes enacted when juxtaposed with other imagery. It was these ghost-like traces inbetween the imagery that were the focus Warburg’s keen interest, not the images themselves. It is perhaps the continual strive to make new connections, or find the most suitable connections, in the distances between the images that lead Warburg to continually move and reform each panel and never settle on a finalised system—much in the same way he continually reorganised his collection of (amount) books.

As Warburg’s continual effort to position and reposition his images in order to reawaken memories highlights, memory is of the moment and not necessarily perfect; it is connected with and extended into the body and the world and dispersed over space and time. In line with the theories of enactive cognition and perception, the Mnemosyne highlights how movement is a required element of making sense of one’s engagement with the world. It is only by moving entities and readjusting perspectives that one can actively engage and ‘look’ at what is before them. It is this active engagement of looking that allows some form of coherency to be formed from the incoherency of senescence. Despite this, contemporary design work surround ageing and technology attempts to limit such engagements, and actively discourages challenging the user. The following section closes the paper in reference to alternative design strategies for the senescent cogniser.

**Design for Senescent Enaction**

Thus far in this paper it has been established that; 1) the body is heavily interconnected with cognitive experience but does not necessarily provide coherency to this experience; and 2) it is possible to reconceptualise the changes occurring to cognition in older age as a continual incoherency in experience as perceptual, sensory and bodily systems change temporally at differing rates. The brief visit to the work of Aby Warburg allows us to add another step to this line of thought, that; 3) movement and distance are a prerequisite for seeing as much of ourselves as making sense of abstract others. In this final section, the paper will visit design literature and scholarship related to enaction and ageing, in order to identify synergies and implications for future work.

Thompson (2008) has contrasted the opposing views of cognitivism and enactivism in terms of the design of anoetic technologies, using the useful question and answer framework provided by Varela et al. (1991).
Question 1: What does design do when it humanises technology?

Cognitivist Implication: Design manipulates symbolic images by which people read the world so that they can make sense of and give value to technologies (semiotics).

Enactivist Implication: Design enables people to enact in the world by enabling potentiality of whole human as a distributed soma ...

Question 2: How does design work?

Cognitivist Implication: Designers create the means to project simple or multiple and complex symbolic meanings. These symbols are primarily experienced by people in reference to a codified cultural understanding of referents.

Enactivist Implication: Designers intervene in the complex processes by which people form an experience of their world. Their task is to enable people to experience the world ‘naturally’ without necessarily needing to attach meaning to individualised interactions.

Question 3: How do I know when design is functioning adequately?

Cognitivist Implication: When people understand the symbols they encounter and react appropriately.

Enactivist Implication: When people incorporate the designed world seamlessly as part of their experience of being. (Thompson, 2008, p.245)

Here, Thompson (2008) highlights the disparateness of the cognitivist and enactivist positions once translated into designing technologies for human beings. Whereas in taking a cognitivist position the designer is provided with a backdrop of knowledge from the domain of cognitive psychology to distinguish what is and what is not suitable to certain groups of human beings, enaction eschews closure in the design process. In taking an enactivist perspective, the designer takes the human being into account in the fullest range of experience rather than proceeding through a reductive-scientific model. The enactivist designer understands the interaction process as the unravelling exploration of complex interrelationships, which exist on multiple levels between human beings and the world. Instead of attempting to design a closed product in reference to the closed cognitive system of the user, designers are lead to speculate open-ended technological systems that augment the enaction of cognitive experience. Therefore, interaction is understood in an open-ended, or uncertain, manner.

Thompson’s argument lays the useful foundations for understanding what enactment might mean to the designer of technologies, at least at a highly conceptual level. He highlights how it is not sustainable to think of design as an explicit communication of meaning and use to the ‘user’ but rather that designers instead provide the space with which users form their own meanings, or couplings, with technology. At the same time, there are limitations to Thompson's (2008) claims if we are to take senescence as a subject seriously, as there will always be circumstances where people find it impossible to ‘incorporate the design world seamlessly’ into experience. It still suggests, at some level, that enactment is a desirable end of mutuality between people and
technology, rather than a means of continual movement, adjustment and becoming. This is not intended to be a meta-argument over the interpretation of enaction in design, however. Rather, the continual distance (be that large or small) between perception, action and cognition that occurs during senescence actively requires an emphasis on means rather than ends; to conceive of a possible end point defeats the purpose.

Thompson is not alone in his critique of design practice and theory that claims to directly communicate actions and meanings to the people who use technologies (such as Suchman, Dourish, Coyne, and Almquist and Lupton). What is rarer, however, is the identification of alternative, and practical, strategies for designers to proceed down that avoid the pitfalls of fitting people to technology. Redström (2005), in his critique of such approaches, highlights that critical design practice provides a potential route out of the continuous striving towards a fit between people and technology by actively provoking the user to question their use of a product. An oft-cited example of critical design is the work of Anthony Dunne and Fiona Raby, who have established critical design as a provocative aspect of designing which ‘uses speculative design proposals to challenge narrow assumptions, preconceptions and givens about the role products play in everyday life’ (Dunne & Raby, 2010). Their approach is still concerned with technologies becoming incorporated into the everyday lives of people, but actively considers how design can transform and change certain societal assumptions rather than be submissive to them. Similarly, the ‘droog’ collective of designers provide an extreme example of a critical design response, emphasising a design stance that attempts to combine functionality, fun, humour and critique.

The droog mentality could be summarized as ‘dry’. ‘Dry’ as in dry wit, unadorned informality, ascetic irony. ‘Dry’ as that essentially Dutch inclination to ‘do normal’ and at the same time critically investigate what you’re doing and the way you do it. (Droog Design, 2010)

Droog are an example of a design practice that ignores any formal conception of what constitutes the human being in reference to the object. For example, the works that formed the ‘Bootleg Objects’ (Fig. 1) collection by Marcus Bader and Max Wolf could represent, at a glance, a materialisation of the ideas of contemporary cognitively inclusive design. Rebraun, Re-Bo, and Re-SP (Fig. 20) are home music system ‘classics’ that have been altered in such a way that their functionality is changed to varying degrees of subtlety.

In “ReBraun”, recombination is paramount – while most features remained present, they slide along the surface, into new meanings. At the ReBo, nothing has been moved. Instead, an alien object – the touch screen – has slyly integrated himself. Lastly, the record player object Re-SP has not changed at all (apart from three clownish minimanipulations). Rather, its whole usage context has been taken. All of its working functions are completely different than it might seem, and all of its previous controls are now dead. (Bader & Wolf, 2003, p.1)

Externally, the Bootleg Objects are manifestations of an earlier period from the history of technology. Further exploration of the functions (or lack thereof) of these objects reveals, however, an element of subversion in their design. Rather than offering the functions that the external aesthetic appears to state, the Bootleg Objects have features that appear to contradict, defamil-
Fig. 1. Bootleg Objects. Taken from Bader and Wolf (2003).
iarise and invite a certain amount of reflection on the part of their user—and the designer—in order to discover as to what they are and why certain changes may have been made.

Similarly, with the field of HCI, Gaver and Martin (2000) developed a number of information appliance concepts that social and cultural certain boundaries regarding what are normally acceptable applications of technology. In the description of one information appliance concept, ‘Dawn Chorus’ (Fig. 21), Gaver and Martin (2000, p.210) deceptively claim that ‘[i]t is pleasant to be awakened by the sound of local songbirds, but how much more enjoyable it would be if they knew our favourite music’. In order to implement this possibility, the Dawn Chorus birdfeeder applies behaviourist principles of stimulus-response in providing food to the birds when it senses they can mimic the same song. In using Dawn Chorus, its owner may enjoy the pleasurable experiences of waking up to birds chirping their favourite song; however, it can also be read as an intervention upon the human tendency to tame nature (Gaver & Martin, 2000).

![Dunne and Raby’s (2004) huggable atomic mushroom.](image)

A stance on design that suggests products can be designed as critical arguments or questions projected to the user are relevant to the discussion of creating the space for affordances to emerge. Problematically, however, the above design approaches still require a certain level of closure to the designed outcomes. The products are created in a manner to invoke very specific questions from very specific users; Gaver and Martin’s bird feeder appears to be directed towards those people who may be concerned with the questions of man’s dominance on the environment; Dunne and Raby’s (2004) ‘huggable atomic mushroom’ (Fig. 2) assumes a user who is constructed
in such a manner that they can recognise the purpose of the societal questions being asked of them; the droog works suppose the ‘user’ is able to recognise the original uses of the objects in order to engage with the intended humour of the missing or changed components. There is still an underlying narrative in the design of these products and objects that focuses on completeness in the engagement between the designer, the designed object and the person experiencing it through use. The symbolic aspects of the objects emphasise very specific questions to groups of people who come from a specific cultural and social milieu—coherency in the user is assumed; the ‘critical’ reflection on the part of the user becomes one of perceiving the correct symbols designed into the artefact. Critical reflection, here, does not appear to be about actively engaging with design to find out more about oneself and the reality we perceive—rather, it is about answering the specific questions asked by the designer. Senescent enaction suggests that such questions—made from specific a priori constructions of the people intended to interact with the object—are as limited as the people-centred approaches they appear to critique.

Rather than thinking about design as a way of settling questions of use (be this for practical aspects of usability, or for critically engaging designs such as those described in this section), in the context of understanding the process of senescence, it is more appropriate to think of ways of continuously asking new questions. If the formerly static target of design is now mobile and inexplicable, then we require approaches to designing technologies that afford an equal amount of movement. It is here that the Mnemososyne Atlas is of great importance; rather than taking the object before us as a complete story that we (the viewer) are able to decipher and answer, instead we placed in a situation where we are actively engaged in a process of making new stories through the gaps and inconsistencies in the juxtaposition of contrasting ideas, symbols and contexts. This type of incoherency, requiring great effort on the part of the user to make sense of the objects, interfaces and systems they use, is discouraged in design; for the senescent human being, continuously experiencing incoherencies in their perceptual-action of ‘reality’, asking new questions of their body, the world, and the relationships inbetween are a necessary constituent of their continued enaction. Designers of interactive technologies might be best placed to facilitate this through the systems they design, rather than settling on a singular question with a singular answer.

**Conclusion**

This paper could be understood as making two significant moves. Firstly, it highlights a way of creatively rethinking the problem of ageing and cognition as it relates to the design of technology to highlight how the ageing, or senescent, mind is not necessarily in a state of deterioration but rather in an oscillating process of desynchronisation. Warburg’s work, in particular the methods he employed in constructing and reconstructing the panels in his *Mnemosyne Atlas*, highlight how movement and distance are a prerequisite factor in engaging in an active process of ‘looking’ where a subject is able to make empathetic sense of the abstractness before them yet reciprocally inform their knowledge of their own embodiment. In terms of the senescence, it is perhaps this sense of continual active engagement that is needed to bring coherency to the
incoherency of bodily experience. Secondly, this provides a basis for understanding the limitations of contemporary design literature that focuses on the end of communicating specific meanings rather than focusing on a process of ceaseless becoming through interaction.

This paper began with two questions. Firstly, how might it be possible to consider the ageing process, in terms of its effects on cognition, as anything other than a process of deterioration? Secondly, if it is possible to transcend the paradigm of deterioration, what might this mean to designer’s of new technologies? Whilst this paper has offered a possible answer to the first—which is just one answer of endless possibilities—the second is left wanting. As with most design scholarship critiquing user- and people-centred design, there is still a chasm between theory and the return to practice. One obvious route towards practice would be to use the Mnemosyne as a model for interaction with technology itself; however, caution should be directed towards such an idea. As highlighted by Woodward (2011) in this volume, to return to Warburg’s method so explicitly would be to return to a period where symbolism and visual imagery preside over other dimensions of sensory experience. Rather, as he also highlights, it is perhaps better to use the ideas that Warburg implied in the Mnemosyne, rather than revisiting the material embodiment of these ideas—stressing, once again, that it is the process of interaction here that is of crucial importance, not necessarily what is interacted with.

Notes

1 The literature in this area is available in abundance. For an overview of such literature, see Stuart-Hamilton (2006), Charness (2008), an Craik and Salthouse (2000).

2 Noetic, or noesis, is an Ancient Greek word referring to understand or to know something, often immediately. In terms of Gallagher’s (2005) usage, prenoetic is understood as a process of the body that means it is aware of certain relations with the world prior to the beholder’s conscious understanding or knowledge of it occurring.

3 By using the term Umwelt, I am directly referring to the work of biologist Jakob von Uexküll (1957). Von Uexküll (1957, p.11) stated that the first principle of the Umwelt is that ‘all animals, from the simplest to the most complex, are fitted into their unique worlds with equal completeness. A simple world corresponds to a simple animal, a well-articulated world to a complex one.’ By using his terminology in this paper, however, it is noted that there are occasions when this completeness is diminished or disrupted.

4 Experiential blindness is a term used by Noë (2004) to describe periods of incoherence in perception and action. In the enactive view of perception put forward by Noë there are two different types of blindness. “First, there is blindness due to damage or disruption of the sensitive apparatus. This is the familiar sort of blindness. It would include blindness caused by cataracts, by retinal disease or injury, or by brain lesion in the visual cortex. Second, there is blindness due not to the absence of sensation or sensitivity, but rather to the person’s [...] inability to integrate sensory stimulation with patterns of movement or thought.”(Noë, 2004, p.4) This second form of blindness is termed “experiential blindness” (Noë, 2004, p.4). Experiential blindness occurs when an individual’s sensorimotor contingencies do not match the sensations and actions
that their body is capable of performing. In a similar vein to Gallagher, Noë (2004) uses clinical examples to support the notion of experiential blindness. Noë takes as an example attempts to restore sight in people blinded as a result of cataracts. The “surgery restores visual sensation, at least to a significant degree, but [...] does not restore sight. In the period immediately after the operation, patients suffer blindness despite rich visual sensations” (Noë, 2004, p.5). The relationship between Gallagher’s work, experiential blindness and senescent cognition is discussed in greater detail in Vines (2011).

References


