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Editorial

The End of The Digital Generation Gap

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Bullet points:

* The idea that the more recent Information and Communication Technology (ICT) is for young people is increasingly questionable.
* User-centered design methods are increasingly used in companies.
* ICT tends to be more and more user-friendly.
* Digital natives (or millennials) are not outdated by the next generations in terms of digital skills.
* The digital generation gap may have been a parenthesis in history related to the democratization of the first and com plicated computers in the 80s.

Abstract

It is commonly accepted that the more an Information and Communication Technology (ICT) is recent the more it is suitable for young people and unsuitable for older people. However, several facts suggest that this idea is no longer valid and will not be in the future. User-centered design methods are increasingly used in companies, ICT tends to be more and more user-friendly, and it seems that digital natives (or millennials) are not really outdated by the next generations in terms of digital skills. These elements lead us to assume that the digital generation gap may have been a parenthesis in history related to the democratization of the first and complicated computers in the 80s. If generation is no longer a factor of ICT adoption, old age however is still related to sensory and motor impairments. Thus, the issue that is becoming increasingly important for technology designers should be better consideration of accessibility.

Keywords: Generation Gap; User Centered Design; Accessibility; Usability; Information and Communication Technology; Digital Native

Introduction

Nowadays, it is commonly accepted that the more an Information and Communication Technology (ICT) is recent the more it is suitable for young people and unsuitable for older people. For years, older adults are often portrayed in public discourse as a homogeneous group of technophobic, digital illiteracy and non-user of technology [34]. This idea of generation gap is also related to a frequent situation where children help their parents to use and to adopt ICT [3].

Generation gaps refer to the differences between generations in terms of values, skills or behaviors. Nowadays, six generations are usually mentioned: Silent Generation (1930-1945), Baby Boomers (1946-1964), generation X (1965-1977), generation Y or Millennials (1977-1994), generation Z or Post-Millennials (1994-2010); [48] and alpha generation or "Screenagers" (after 2010)[12]. Generation differences have been studied on different aspects, such as consumption [25] or political behaviors [1]. For years, one common manifestation of the generation gap is the help provided by children to their parents about the usage of the internet [13].

Not all generations have the same relationship with digital technologies. For instance, expectations about on-demand radio are not exactly the same for Baby Boomers, generation X and generation Y [28]. Concerning the uses of ICT, generation X tend to use it with only utilitary purposes, as information research, compared to generation Y who use it also for entertainment and hedonic purposes [9]. Generation Y is also called "digital native", because this is the first generation who grew up with available digital technologies. Therefore the main generational gap is between generation Y and generation X.

The idea mentioned earlier that ICTs are by nature reserved for young people and that later generations will always be more comfortable using ICTs than earlier ones is questionable for two main reasons: because this implies 1) that the technologies currently designed have the same level of complexity as previous ones 2) and because there are several other identified factors determining the adoption of technologies. In the present article, the main concepts regarding technology adoption are firstly detailed. Then, arguments concerning an evolution of technological complexity are provided, followed by the next crucial issues with regard to ICT adoption.

Conceptual framework

We mentioned the so-called difficulties of older generations in using ICT, is it a question of usability, learnability, intuitiveness, naturalness, affordance, discoverability or User eXperience (UX)? The nuances between some of these concepts are subtle, but necessary to understand why some types of interface are more satisfying than others.

Usability is the degree to which a system "can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." (ISO, 2010, P.2).

Learnability is the degree to which the system "supports discovery of its capabilities and how to use them, allows exploration of the interactive system, minimizes the need for learning and provides support when learning is needed." (ISO, 2010, P.4).

Intuitiveness is when an interaction comes "naturally without excessive deliberation" [19]. An interface or a feature is intuitive if the user did not need instruction or learning to use it.

Naturalness regards the interactions that are "marked by spontaneity" [19]. Natural interfaces are systems of which interactions are similar to actions people would do in their everyday life with physical environments, such as speaking natural language or taking an object with a hand.

Affordance, in the field of design, is "the design aspect of an object which suggests how the object should be used" [35,33]. Norman distinguishes real affordance that is all the things the user can do with the object, and perceived affordance that impacts usability (1993). This separation leads [18] to differentiate perceptible affordance, hidden affordance, false affordance and correct rejection. Perceived affordance is related to the concept of discoverability of a function.

UX corresponds to a holistic perspective of product quality based on both utilitarian characteristics and hedonic qualities. In the view of [31], the way the human-computer interaction occurs depends on system properties, user characteristics and context parameters. From this interaction, an UX emerges, composed of perception of instrumental qualities (utility, usability, etc.), perception of non-instrumental qualities (aesthetic, symbolic and motivational aspects) and the emotional user reaction (subjective feeling, motor expression, physiology reactions, cognitive appraisals, behavioral tendencies) generated by the two previous components. The overall judgments concerning the system, choice between alternatives and usage behavior are mentioned as the consequences of UX.

User centered design

Since the 80s, User Centered Design (UCD) has been developing more and more [39]. Usually carried out in the fields of ergonomics, human factors and human-computer interaction, it consists in focusing on the user's needs by iterative cycles of evaluation/implementation.

In the same period, the design thinking models have been developed and spread in companies. Design thinking approaches are user centered, but they also emphasized with more details the steps before the iterations evaluation/implementation. These steps concern the identification of user's needs and constraints (empathy, definition) and the creativity step (ideation) of imagining what could be the solution to meet these needs. This type of UCD has been increasingly used in organizations [38].

This is also the period of appearance of new key competitive concepts for digital product design, such as usability and UX. The popularization of such concepts reveals the increasing importance of user satisfaction and comfort. These new concepts are accompanied by new standardized questionnaires to measure them efficiently. For instance, System Usability Scale [7] or User Experience Questionnaire [43] allow any designer to measure UX and usability in order to improve them. Acceptance is also considered in technology development. In the same way, theoretical models and questionnaires about technology acceptance have been developed, with for example the Technology Acceptance Model [14] or Unified Theory of Acceptance and Use of Technology [45,46].

Specific methods have been built to collect user data at the beginning of user centered design projects. This can be done for example by ethnographic research [40] or interviews [49]. Two main methods for the assessment of usability are commonly used: user testing and heuristic evaluation. User testing is a method in which users (or potential future users) are invited to do typical tasks with the product [16]. During user testing, behaviors are observed and questionnaires are often used as usability indicators [4], to identify specific usability problems. User testing can be carried out before having a finished product, with prototype or mock-up. Heuristic evaluation consists in identifying usability problems of an interface based on a usability heuristic, i.e. a list of criteria. For instance, the famous heuristic from [47], is commonly used in various industrial sectors, such as transport (on vehicles' dashboards) or e-commerce.

In academic research, scientific publications about UX design in Web of Science increased gradually from 136 in 1999 to 2224 in 2019 [29]. More and more UX designers are trained and hired by companies. The biggest tech companies such as Apple give a crucial importance to UX related to their products, and have recruited many specialists to ensure it. Nowadays, working on the usability of a product is considered as normal and obvious, and a lot of companies have the skills to do it, but also the tools and methods. The evolution of more user-centered design methods, the integration of these practices and UX specialists in companies are factors contributing to making ICT more usable and acceptable. Methods continue to be improved by researchers and this trend is likely to persist.

Evolution of interfaces

According to [23], for forty years, new digital technologies for a general audience tend to be more and more oriented towards the well-being of the users. This notably consists in considering hedonic qualities, which is one major component of UX.

Democratization of personal computers during the 80s has been accelerated when graphical interfaces replaced command-line interfaces. The particularity of command-line interface is that its use is only based on the users knowledge, without any possibility of discoverability and with very poor learnability. Graphical interfaces appear to be an important step toward better ergonomics. However, interaction with graphical interfaces are based on the use of a mouse which requires specific training.

In the 2000s, smartphone sales exploded, as well as tablets at the end of the decade. Tactile screens are more direct than mouse and keyboards in terms of interaction. It is more intuitive than desktop computer in the sense of being based on familiar features from the same domain (the habits from computers interfaces that the users usually use) and also physical affordances (drag and drop is the equivalent gesture of sliding a physical object with the hand, pressing a virtual button with the same gesture than when we press a physical button; [6], Tactile screens have the advantage of having a graphical interface allowing discoverable fonctions with buttons and visual guiding, and also interaction by gestures on the screen, less discoverable but more natural. Nevertheless, mobile interfaces raised new issues due to the screen sizes, often small, that constraint the interface organization.

At the end of the 2000s and beginning of the 2010s, gestural interaction based interfaces (mainly Kinect) and natural vocal interfaces (vocal assistants such as Google Home, Alexa or Siri) emerged. In parallel, gestural remote control (mainly Wiimote) were used as controllers in video games. This type of gamepad was easy to use and stimulating, hence it was often used in projects involving older people stimulation [26]. Vocal assistants are supposed to work correctly when the users command them with complete sentences in natural language, not with keywords. The main usual problem with natural interfaces (vocal or gestural) is the lack of affordance, generating a lack of discoverability [30] that makes intuitivity crucial. [30] classified three types of gestural interactions mapping : metaphoric (based on schemas, for example an arrow pointing up to increase a quantity of something), isomorphic (the user movement has one-to-one literal spatial relation with a virtual object, for instance, when a player directs a weapon by pointing to a direction with his/her arm) and conventional (mapping previously learnt by the users with other interfaces, for instance, the arrangement of letters on a keyboard).

During the 2010s, virtual reality began its democratization after Facebook acquired Oculus in 2014. Virtual reality technology using head-mounted displays with gamepads in hands seems to be particularly promising regarding the trade-off between discoverability and natural interactions (or metaphoric and isomorphic interactions), which make this technology promising to reduce the age-related digital divide [10]. Discoverability and affordance are possible because buttons or commands can be shown in the 3D environnements or on tangible gamepads, and interactions can be based on real and natural gestures (walk, take an object with the hand, etc.). The feeling of presence can also facilitate the intuitiveness of the use, because users can spontaneously try to reproduce actions they would do in equivalent real situations.

Eye tracking and Brain-Computer Interface (BCI) are mainly used as research tools for analyzing the user behavior and cognition during ICT use. It seems to be plausible that their usages for interaction with ICT will be developed, not only for people with disabilities, but for the general public. Some experiments have been conducted using BCI as a modality of interaction with software. For example, [44] make participants use BCI to model 3D shapes with Google SketchUp. The participants showed signs of fatigue, but the learning curve is high, and the performance is strongly related to the robustness of the algorithm, which suggests a large potential to increase. BCI or eye tracking can be considered as voluntary interaction tools, but it can be tiring to interact using the gaze or the mind. These technologies can also be considered as elements that have the potential to enrich and facilitate interaction by using signals from the user's natural behavior, in addition to other voluntary interaction modalities (buttons, gestures, etc.). For example, a gesture command could be interpreted differently depending on where the user is looking. In the same logic, the development of artificial intelligence has the potential to make interactions more and more personalized to take into account the specificities of each individual and thus facilitate interactions (see for example [41]).

As schematized on Figure 1, the digital interfaces available for the general public have been significantly transformed over the last four decades and these transformations are not over. The tendency seems to make the ICT interfaces more and more intuitive and learnable. In this picture, the curve representing the evolution usability is to be considered as conceptual and representing a very large trend, but not as the result of a formal quantitative measure. The last three items, artificial intelligence, eye tracking in headset and BCI are at the top because we believe that their main interest in terms of interaction is to serve as an aid to improve the usability of another interaction mode (BCI in virtual reality, artificial intelligence to personalized the experience on a software, etc.).

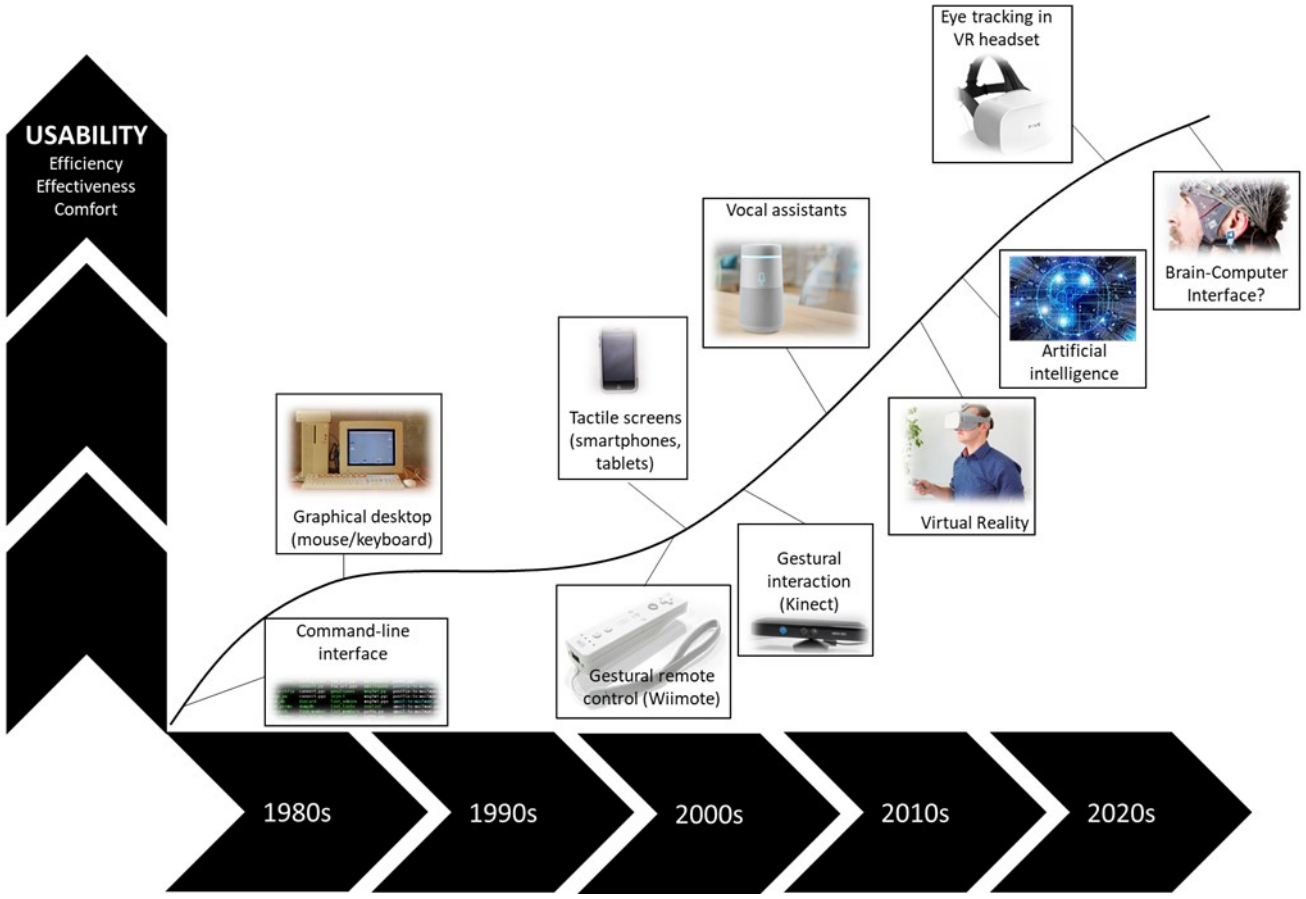

Figure 1: Schematic history of digital command's interfaces democratization and evolution of usability of consumer ICT

The other factors of ICT adoption

Usability is a crucial determinant of technology adoption, but it is not the only one. Several models based on users' attitudes and perceptions of technologies aim to predict the technology adoption. Technology Acceptance Model (TAM – [14]) is one of the most influential of them. According to this model, intentions to use a technology are determined by perceived usability, but also by perceived usefulness ("the degree to which a person believes that using a particular system would enhance his/her job performance", [14], P.320) and attitude towards use ("individual's positive or negative feelings about performing the target behavior", Fishbein & Ajzen, 1975, p. 216).

The Unified Theory of Acceptance and Use of Technology [45] and its extended version [46] include others variables to predict the intention to use a technology: social influence ("the extent to which consumers perceive that important others believe they should use a particular technology", p.159), facilitating conditions ("consumers' perceptions of the resources and support available to perform a behavior", p.159), hedonic motivation (e.g. enjoyment), price value (in relation with monetary constraints) and habits. Technology acceptance is also related to gender which is a moderated variable, as well as previous experience with technology and age.

Differences in the use of ICT by age groups are not only related to differences in perceived usability. For example, teenagers use social networks more frequently than older people but this may be related to socialization and identity needs that can be different during the teenage years [5].

Conclusion

Nowadays, the evolution of interfaces allows us to reconsider the generational gap. Regarding the uses of digital technology, recent studies revealed that generational differences tend to be overstated [32]. ICT usage varies between generations, and generational differences are not necessarily the reason for these differences. Age can lead to differences in usage because it corresponds to different social needs [5], or different life stages (finding a job, getting married, etc, [21]. Even concerning the digital skills, some studies question the idea that new generations are better than previous ones. For instance, [24] compared in Finland the digital skills of people of generations X, Y, Z and baby boomers and showed that the more skilled was generation Y whereas generation Z was the less skilled. Research in Russia showed a consistent reverse trend about the digital divide: middle-aged people are more likely to use the Internet than younger ones [20]. [37] found analog results in five European countries. Even on cybersecurity, generation Y are more skilled than generation Z regarding basic knowledge such as security on social media, antivirus use, etc [15]. These elements lead us to the assumption that the digital generation gap may have been a parenthesis in history only related to generations X and Y. Maybe interfaces will continue to simplify, with a trend to be more and more based on natural behaviors of the users. In parallel, design processes become more and more user centered, more participative.

The current state is the result of many dynamics playing out at the same time: generational habits, no doubt, since the boomers and the silents have lived without ICT, but also constraints linked to lifestyle (rural or urban, professional, student or retired) which determine usage, and finally ageing and the disabilities which may be linked to it. If the digital generation gap is narrowing as we think it will, the age-related disabilities will not disappear.

There is an overall trend towards an ageing world population which means that age-related issues will become increasingly important [8]. Beside, cognitive functioning (particularly short-term and long term memory, and visuospatial skills), that declines with age, is one of the most important predictors of internet use by older adults [47]. Sensory and motor impairments frequency increase also in the elderly and this can be a barrier to the use of ICT. Thus, the major issue today and in the future for technology designers should be better consideration of accessibility. The accessibility of the Internet is a long-term task, which started a long time ago, but which is now subject to precise standards [17]. Virtual reality devices and software are types of technology with strong challenges about accessibility, because they are about to be within everyone's reach. For now, although there are some initiatives (e.g.[50]), virtual reality lacks features to customize settings to improve visual, auditory and motor accessibility. Even the interpupillary distance, which is already adjustable, is not movable to a sufficient extent on the most popular headsets [11].

Among the technologies to come, Metaverse is likely to have a significant influence on our lives. Some researchers are already mentioning the Metaverse as a way to attract young people to a particular activity [27]. We do not subscribe to this vision. We are convinced that current and future trends will make ICT and particularly the Metaverse intergenerational tool.

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