

Homo informaticus: Thinking and moral values of humans are shaped by human-computer-interaction

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Abstract

Human-computer-interaction (HCI) including social networking and gaming rose fast and is now part of the society. Besides the technological innovations initiated and implemented by humans, another impact, namely that HCI modifies the way of human thinking and changes human motivation and personality by a shift of moral values was proposed and was summarized in the concept of *Homo informaticus*. Experimental and theoretical evidence suggest that *Homo informaticus* can be described as characterized by (1) altered perception, (2) mental load and distorted memory formation, (3) altered thinking, (4) reduced sense of reality, (5) preference of hierarchy, (6) low conscientiousness, (7) a motivational shape by shifted moral values towards power and egoism, (8) altered social interaction, (9) risk of problematic technology usage or even technology addiction, (10) some technology competence, and (11) humans acting as an information technology (computer) subsystem.

At the moment “The VIENNA BIENNALE (2017) Robots. Work. Our Future focuses on the potential of art, design, and architecture to contribute to an environmentally and socially sustainable concept of the digital age that is also committed to a new humanism” [1]. This topic is driven by the view that digital utopic concepts – like autonomous driving, drone delivering, detailed analyses of Internet users and customers – have been realized faster than one would have imagined only a few years ago. Such technological changes are often seen as a manifestation of human progress, driven by needs and implemented through human creativity. However, the opposite view, namely that technological progress, in particular expressed in extensive human-computer-interaction (HCI) and connectedness (Internet), may shape human thinking and moral values, could also be considered.

The last view is supported by early experimental work investigating effects of HCI on higher cognitive functions. In those experiments, immediate effects of HCI as compared to paper/pencil tasks were observed. All test persons displayed less field dependency – a cognitive style related to the integration of the actual environment in the process of perception [2] – after HCI [3]. HCI also affected causal attribution (the kind of how persons explain the causes of events and actions [4,5]) in that way that test persons attributed less internally (meaning that they are less personally responsible) in the field of “intellectual thinking” but attributed more externally (in the sense of “luck or bad luck”) for human relationships after HCI compared to the control condition [6]. Other experimental effects were observed for interference tendency, the interference of different memory traces during the transition into the long-term memory [7], where non-computer-science-students had a higher interference tendency after HCI than computer-science-students [3], and also in communication style, where computer-science-students preferred a verbal expression of abstract concepts to a pantomimic expression contrary to non-computer-science-students [8]. Moreover, comparing computer-science-students with non-computer users (as had been possible in those days), comparable effects to the immediate experimental effects were observed and interpreted as

long-lasting effects of HCI [3,8]. Thus, there is some evidence that HCI immediately affects higher cognitive functions and persons with an extensive amount of HCI may display such characteristics in general.

In addition to effects of HCI on higher cognitive functions also a cardiovascular activation during HCI [9,10] and neurophysiological after-effects of HCI were observed [11]. The comparison of the P300 of event-related brain potentials [12] after HCI versus paper/pencil activity indicates less mental resources after HCI, as the P300 amplitude was generally reduced after HCI. Another indication that HCI affects human resources was demonstrated by an accelerated heart rate during prolonged response times of Internet search [10]. In this study, it was also shown that persons feeling high strain displayed a rather high mean heart rate of 114 bpm during long (~22 s) waiting times and a mean heart rate of 93 bpm for short waiting times (~2 s), contrary to persons without strain displaying a mean heart rate of 85 bpm independent of waiting time during an Internet search.

Through the rise of the Internet, HCI is now dominated by Internet activity with extensive activity in social networks and gaming. As already pointed out in the early rise of computer games, the problematic Internet usage arises in parallel [8,9]. This may be forced by the emotional engagement as indicated by the relative strong response in the cardiovascular system in general and cognitive-motivational factors in addition. In particular the flow-theory [13] gives a useful

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frame on the motivation and on the subjective experience of computer gaming [9,11]. Meanwhile this view was supported by recent data and interpreted as the “Janus-faced role of gambling flow” [14]. Moreover, numerous reports and different investigations on problematic Internet usage [15] and Internet addiction can be found in the literature, and seem of particular interest from a public health, social, and educational point of view, because there are concerns about the long-lasting consequences for society in general.

Thus, it seems reasonable to consider how HCI (including social networking and gaming) in general may affect human behavior by changing human thinking and changing human moral values which are essential elements of motivation and decision making. This was already considered by early observations on how behavior was altered due to HCI as described by Weizenbaum [16] and by integrating experimental results of that time (1998) to the construct of *Homo informaticus* [6]. An update was presented 2015 [17] with new supporting data, in particular considering aspects of personality and moral values from a cross sectional study of 396 persons (mean age 37 y, 213 females). According to personality, it was shown that Internet usage (as indicated by the Facebook intensity score, FBI [18]) is associated positively with extraversion, but negatively with conscientiousness [17]. The relationship of Internet usage (FBI) with moral values (portraits value questionnaire, PVQ [19]) indicates that FBI is correlated positively with hierarchy, mastery, affective autonomy, intellectual autonomy and negatively correlated with harmony. Although some relationships as intellectual autonomy and social value may be considered as a positive progress, others, in particular hierarchy and less harmony may be considered as less positive for society and the future.

These data support earlier observations that HCI and Internet activity may affect higher cognitive functions and by this personality and motivation and, at last, behavior. Although there are contributions underpinning positive effects of Internet usage, most often expressed in the sense of competence or social values, analyses of the impact on thinking and of moral values seem to support a critical view of the *Homo informaticus* – a summarizing conception on how humans and society in general are shaped by the use of modern information technology – with the proposed cognitive, motivational, and behavioral features: (1) altered perception, (2) mental load and memory formation distortion, (3) altered thinking, (4) reduced sense of reality, (5) preference of hierarchy, (6) low conscientiousness, (7) a motivational shape by shifted moral values towards power and egoism, (8) altered social interaction, (9) risk of problematic technology usage or even technology addiction, (10) some technology competence, and (11) humans acting as an information technology (computer) subsystem.

These characteristics of the proposed *Homo informaticus* are further supported by (other) empirical evidence and theoretical issues:

(1) Altered perception. As pointed out in an early work [3], HCI reduces the impact of the actual social and physical environment in the process of perception as indicated by a reduced field dependency. One may speculate that this is caused by attention processes to avoid information overload as already described for noise environments [20], in which environmental information is filtered out by attention switching.

(2) Mental load and a distorted memory consolidation may also be caused by a high information processing load and attentional affordances (as described above). Early observations of memory consolidation were indicated by a high interference tendency as an expression of a reduced memory consolidation to represent information

in the longterm memory, after HCI [3]. Moreover, as indicated by a reduced P300 amplitude of the event-related brain potential [12], mental resources are reduced after HCI [11]. In addition to that observations a highly “synchronized” P300-latency across recording locations was observed; such a timely synchronized mental activity at various brain areas may speculatively be interpreted as an expression of a “less modular activity of mind” [21] caused by HCI and the associated mental demands. Another source of emotional load is predominant in social networking sites by reason of maintaining existing relationships, developing of new contacts [22-25] and depends on how self-presentation is perceived individually, for which personality aspects of narcissism and self-esteem are important moderators [26,27].

(3) Altered thinking was already indicated by early observations of causal effects of HCI on attribution style, that is the way how real-world causalities are interpreted by a person [5]. The enhanced internal attribution for the fields of work and of computer [3] are in line with an aspect driven by egoism in the information technology [17]. But this aspect is not independent from other (motivational) aspects like preference of hierarchy and motives towards power and egoism (see below).

(4) Preference of hierarchy is indicated by the positive correlation of FBI with a preference of hierarchy (as indicated by the PVQ [19]).

(5) A reduced sense of reality was observed by analysing the content of stories written after HCI contrary to stories written after comparable paper/pencil tasks [28].

(6) The association with low values of conscientiousness is supported by the inverse correlations of FBI with conscientiousness (as indicated by the PVQ [19]) and is also found in recent studies [29,30] and furthermore supported by a negative correlation with harmony [17].

(7) An enhanced motivation towards power and egoism as indicated by the correlation of FBI with the PVQ [19] is closely related to the aspects mentioned above, namely preferring hierarchy and displaying low conscientiousness.

(8) Altered social interaction is indicated by a number of observations. Early causal effects were observed for a reduced conversation style of pantomimic expression of an abstract concept after HCI. This may speculatively be interpreted as a reduced preference of an “analogous” contrary to a “digital” communication style as in the case of a verbal description. Another aspect of social interaction is often reported by the association of Internet usage, in particular social network activities, with extraversion and introversion, whereby extraverts use social network sites for social enhancement and introverts use it for social compensation [29]. Moreover, for persons with high social network usage high values in narcissism associated with a decreased real life social community participation and relational problems were reported [29] and their behavior is sometimes associated with problematic Internet usage including cyberbullying [31].

(9) The risk of “information technology addiction”, which includes social network activity and gaming, has been described since the early years. One aspect of information technology is the aspect of a very high interactivity, which may be perceived as a human-to-human interaction as has already been described in 1976 by Weizenbaum [16] and later [6]. Such a highly interactive communication may be perceived like a communication with an idealized partner, and would therefore have a high potential to prolong this (digital) “interaction”

with no risk of being confronted with “real life”. Another mechanism often described as a highly motivating aspect is the conception of “flow” [13]. In particular in the context of computer gaming, but also for other activities on the computer/Internet, the characteristic trait is that the specific claims can be user-adjusted and therefore be determined in a close match to the capability of the person, thus provoking the experience of flow as suggested [6,9] which was also described for Facebook [32]. However, for problematic Internet usage and Internet addiction neither the high interactivity nor flow experience could satisfactorily explain this problem, but life satisfaction was identified as a moderating background variable [33] and psychopathological variables including personality traits like autistic fantasy and non-adaptive coping strategies and depressive symptoms are discussed as underlying mechanisms [34]. One of the rising problems of excessive Internet usage is that such a behavior is also prevalent in children, of which 20% displayed a risk for psychosocial problems [35], moreover, it was shown that for smartphone addiction traditional interventions failed [36]. For massive multiplayer online role-playing games players maladaptive personality traits like schizotypal personality traits were identified [37].

(10) Some technology competences are described as positive effects of (extensive) HCI or of social network usage. Investigating the relationship of Facebook use and the social capital it was found that intensity of Facebook was related to life satisfaction, social trust, civic engagement, political participation [38], higher motivation [39], and also to psychological well-being [18], whereas others found contradictory results on the association of social networking with individual welfare [40]. However, from a critical point of view, there are also reports on the subjective overestimation of competences discussed as the Dunning-Kruger effect [41,42] and there are also reports of decreased academic achievement associated with social networking [29].

(11) Humans acting as a subsystem of information technology (computers). Although this aspect can be seen as a separate characteristic of the *Homo informaticus*, it is also a “general” characteristic including the claims made in (1)-(10). As people became more and more educated and confronted with information technology their “mental set” [43-45] will be shaped more and more by changes in perception, thinking, decision making and motivation towards the inclusion of information technology – even if this was not necessary or might be counterproductive. Such implications of mental sets on the unknowingly undertaken limitation of the space where designers search for solutions was recently demonstrated experimentally [46]. Moreover, humans perceive the social and physical environment in a way that it can be incorporated into information technology, thus, humans are acting like a subsystem of the information technology.

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