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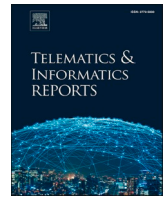
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Considering the IMPACT framework to understand the AI-well-being-complex from an interdisciplinary perspective

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ABSTRACT

Artificial intelligence (AI) is built into many products and has the potential to dramatically impact societies around the world.

This short theoretical paper aims to provide a simple framework that might help us understand how the introduction and/or use of products with AI might influence the well-being of humans.

It is proposed that considering the dynamic Interplay between variables stemming from Modality, Person, Area, Culture and Transparency categories will help to understand the influence of AI on well-being. The Modality category encompasses areas such as the degree of AI being interactive, informational versus actualizing, or autonomous. The Person variable contains variables such as age, gender, personality, technological self-efficacy, and perceived competence when interacting with AI, whereas the Area variable can comprise a certain product where AI is in-built or a certain domain where AI is used to make a difference (such as the health sector, military sector, education sector, etc.). The Culture variable is of importance to understand because cultural settings might shape attitudes towards AI. Finally, this might also be true for transparent AI (or understandable/explainable AI), with high degrees of transparency likely to elicit trust.

The proposed model suggests that there is no easy answer when one seeks to understand the impact of AI on the world and humans. Only by considering a myriad number of variables in a model, summed up in the acronym IMPACT (Interaction/Interplay of Modality-Person-Area-Culture-Transparency), we might get closer to an understanding of how AI impacts individuals' well-being.

Background

Since the launch of generative AI products, including ChatGPT, Stable Diffusion, DALL-E 2, Midjourney—to name a few—and the following AI race between many companies such as Google and Open AI, societies around the globe have intensively discussed the consequences of artificial intelligence (AI) [1]. A recent initiative by the Future of Life Institute promoted the idea of stopping working on a more powerful AI than the current GPT-4 model for a minimum of six months to discuss safety guardrails around AI products [2]. Recent developments in AI are accompanied by both enthusiasm and fear, showing a wide range of emotional reactions towards AI. The diverse and sometimes diffuse reactions to tools such as ChatGPT underline that it is time to systematically investigate the impact of AI on society. One way to do this would be an individual-centered focus to answer the question of whether the

introduction and/or use of AI in society impacts (subjective) human well-being; hence, a socio-emotional approach is relevant here. Subjective well-being can be understood as an umbrella concept comprising cognitive and affective variables, whereas the cognitive variables comprise the assessment of life satisfaction and the affective variables involve emotional experiences [3]. In line with other research in related areas dealing with (over-)use of new technologies (i.e. social media use or Internet use disorders; [4–6]), it is not expected that simple equations are valid, such as that the introduction or use of AI will simply enhance or reduce a person's well-being. This does not mean that such main effects might exist, but we expect that such effects might in some cases be in the lower effect size area. To illustrate this in more detail, see examples from a related field, namely social media, where associations between longer social media use and lower well-being are small [5]. Research on social media can actually be a guide here because in this

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product, AI is in-built, for instance, in its recommendation engines [7] or curation of newsfeeds [8]. However, AI scenarios with larger impacts on a person's well-being are also imaginable. For instance, this could be the case if a person experiences income loss owing to AI taking over a job.

We believe that the effects of AI on human well-being are complex, for several reasons. The reasons for this are outlined in the following parts of this paper. Further, we developed a theoretical model to systematically study the impact of AI on users' well-being from an interdisciplinary perspective.

Categories to study and understand the AI-well-being-complex

The impact of technology on well-being has been researched over the last decades, with a focus on social media, video gaming, and online gambling. While some studies have highlighted the potential of these technologies to foster social connections and strengthen relationships [9], others have pointed to negative effects such as poor sleep [10] and fear of missing out [11,12], which could also lead to fatigue [13]. It remains an open question whether technology is primarily responsible for impacting well-being or whether it simply enhances the effects of more fundamental personal or social factors. In this realm also the digital well-being concept is of interest. This concept has been established recently and has been typically used to denote the balance between digital and non-digital presence and activity, both for individuals and society as a whole. Vanden Abeele [14] argued that shedding light on the digital well-being concept must consider a complex interplay between factors related to person, device, and the broader context. However, there is still considerable debate over what is actually meant by digital well-being. For instance, in the field of Computing and Informatics, the discipline of User Experience (UX) has traditionally focused on aspects related to usability and overall satisfaction with a product or service before, during, and after use. However, there has been relatively limited focus on exploring the impact of technology on users' socio-emotional state within the literature on UX. This calls for the inclusion of an additional layer of socio-emotional well-being at the top of the pyramid of Accessibility, Usability, and UX [15]. In the context of the present paper, where we focus on the influence of AI on subjective well-being, we mention the importance to think already at design stage of the AI product on how it could impact a person's subjective well-being (hence digital well-being, when interacting with a machine). Considering well-being as a primary concern when designing AI products involves integrating it into all stages of development, starting from the initial planning and feasibility studies to the requirements, design, and implementation phases. This comprehensive integration is more effective than addressing well-being retrospectively, whether it is considered as a quality and acceptance criterion or relying solely on external applications to regulate and enhance healthy technology usage. The latter approach has demonstrated limitations in terms of scope and efficiency, as evident from user reviews of such applications [16]. By treating well-being as an integral part of the design process, similar to paradigms like Privacy by Design [17], positive outcomes can be achieved in a more cost-effective and seamless manner.

AI has become an inherent component of numerous contemporary systems, yet it possesses distinct identity and prominence. While social media and gaming heavily utilize AI (e.g. the newsfeed on social media is curated with AI; [8]), or video game creation can be supported via AI; [18]), users typically perceive them in terms of their visible functionality and services, such as facilitating social connections, sharing information, and providing a playful experience. However, in other systems, AI interfaces more directly with the public, such as AI recommending loans, providing medical advice, or assisting in job hunting. Therefore, studying the relationship between (subjective) well-being and AI as separate entities is needed. Several factors must be considered in this regard.

First, AI is itself a very broad term and has been compared with "Thomas Edison's harnessing of electricity" to explain its broad impact

[19], page 13. In short: In the future, you either have AI (and then there is light) or you do not have it (and there is no light to speak metaphorically). Therefore, to understand the impact of AI on the lives of humans, it needs to be considered in what areas and/or in what products the AI is operating. Of course, it will make a difference if AI supports the medical doctor in diagnosing cancer and thereby perhaps rescues the life of a patient, if AI is used for warfare and misinformation campaigns (or to decode deep fakes), or if AI, for instance, will be a helpful guide in a white collar's work life to create sophisticated presentations quickly. In short, the product and area in which AI operates matters.

Second, recent work on positive and negative attitudes towards AI shows that person-centered variables matter. For instance, some studies suggest that males tend to have slightly more positive attitudes towards AI (broadly speaking; [20]) and that, for instance, more neurotic persons tend to report more fear of AI [21]. Please note, that neuroticism represents a prominent personality trait being highly investigated in many disciplines [22] and is robustly linked to negative primary emotional traits [23]. Therefore, it is also important to consider psychological traits and states interacting with AI use and the introduction of AI products to understand well-being variables.

Third, culture and unique societal factors will likely shape how we see AI and thereby also impact our well-being. If from early on or via mass media, it is rather positively spoken about AI, people might develop more favorable views. This might explain the recent observation that significantly higher positive attitudes towards AI were reported in Chinese samples than in German samples [20,21]. Government initiatives in China such as "New Generation Artificial Intelligence Development Plan" might in parts be responsible for positive media views, as it puts the development of AI at the center of governmental plans [24] and mass media then likely will report on such visible initiatives. It should be mentioned that China is not alone in its efforts to invest in AI technology, and other countries such as the USA have a keen interest in becoming key players in worldwide AI development. This said, China and USA are just two prominent examples [19]. In the context of the country variable of the IMPACT framework (see also below) – likely shedding light on attitude formation towards AI – one could also name the EU (consisting at the moment of 27 countries), who recently came up with AI-regulation plans to foster "Trustworthy AI" [25]. Such regulation plans need also to be investigated in the context of attitude formation towards AI.

Personally, we believe that it is important to speak in balanced terms about AI taking both advantages and disadvantages into account, but it should also be clear that the minds and attitudes towards AI might be shaped by the kind of reporting on AI. For instance, more authoritarian states might find it easier to enforce AI policies based on their own understanding (for a discussion on authoritarianism see Adler et al. [26]). The freedom to use AI or interact with it, as well as providing alternatives for those who are not comfortable with AI, remains an unexplored area. It has implications for the well-being aspect of autonomy and freedom of choice. Neglecting this aspect may result in stressful and negative experiences with AI, potentially triggering psychological reactance that refers to the negative reaction of people to situations where their free choice is threatened [27]. Offering alternatives is a key principle of inclusive and universal design in UX [28]. It also touches upon the ethical and moral dimensions of technology innovations. The idea that culture plays an important role in understanding attitudes towards AI is also supported by observations that higher spirituality went along with lower positive and higher negative attitudes towards AI [29], and countries likely differ in their spirituality levels. However, note that the effect sizes of the spirituality associations in this recent work were in the mild area. Spirituality was assessed in this study with items such as "Feeling a oneness with all of creation helps give more meaning to my life" (p. 165) [30] and should not be mistaken for religiosity.

The last factor that likely shapes a person's well-being in the context of AI is transparency of AI or explainable AI (XAI) (see: [31,32]; also, see

[33], for information on the relationship between transparency and explainability). This represents a difficult issue, because today, much of what AI learns is a black box. One reason for this is the inherent complexity of explaining the logic and training processes of AI systems. The inner workings of AI algorithms can be highly intricate and difficult to comprehend, thus making it challenging to provide clear explanations to users. Additionally, the cost efficiency of designing an XAI is a relevant point to consider for tech companies. Developing effective XAI methods requires additional resources including research, development, and implementation. Still, the demand for XAI is increasing, with some instances where it is mandated by judicial bodies [34]. However, there might be additional solutions: A recent work put forward some ideas for the psychological sciences that psychologists and data scientists might narrow down on what the machine learns [35], namely, by only feeding the machine with information, which from a theoretical perspective makes sense to predict a certain outcome. Beyond this, one could investigate how predictions from data change when some data are provided to a machine and others are excluded.

Why is transparency of importance in impacting human well-being with AI? To establish trust in products where AI is built, it is important to understand how a machine operates and learns [36]. This might reduce fear, and perhaps even foster the acceptance and well-being of a person, and the acceptance and fear of AI dimensions are negatively correlated with moderate effect sizes [20].

XAI in the field of AI also addresses the need for simplicity among ordinary users. XAI models offer explanations or justifications for decisions made by AI systems at a higher level of abstraction. These explanations may include the main parameters considered, their weights, characteristics of the data sample used, and other relevant factors. The aim is to help stakeholders understand the reasoning behind AI predictions or actions, thereby enhancing the transparency, accountability, and trustworthiness of AI systems.

However, it is important to note that the different classes of explanations within these models can have a significant impact on how users perceive and calibrate their trust in AI [37]. To avoid the introduction of biases by XAI, there is a need for collaboration between psychological and AI experts.

Considering the five categories of the IMPACT framework in dynamic interplay

The five categories discussed in the present theoretical piece to understand how AI will impact well-being should not be considered in isolation but in a dynamic interplay leading to what we call the IMPACT model to understand the AI-well-being-complex. IMPACT is an acronym for the Interaction of Modality-Person-Area-Culture-Transparency categories, pointing to relevant areas that need to be understood to predict a person's well-being when interacting with AI or thinking about the AI-well-being-complex. Hence, five questions should be raised to predict the AI-well-being-complex:

MODALITY: How is AI applied, and how does it intersect with the notion of human agency? The key considerations include the following modal facets. **Availability:** Is AI presented as an alternative choice, or is its use mandated? **Interactivity:** Can users interact with AI systems by querying, providing updates, or correcting information? **Informational vs. Actualizing:** Does AI primarily provide information and recommendations, or does it directly lead to actions being taken? **Autonomy:** To what extent is AI autonomous or semi-autonomous regarding the actions it takes?

PERSON: What are the characteristics of an individual? Is the person male or female? Is a person highly neurotic? Furthermore, does the person have recourse to technological self-efficacy and sufficient experience with AI? Research from the technology acceptance model clearly underlines the relevance of such variables [38].

AREA: What AI areas do we speak about? The military sector, health sector, work sector, etc.? What products with built-in AI are considered?

Smartphones, social media, chatbots, etc.? To illustrate this in more detail: It logically makes a difference for a person's well-being if AI is used to detect tumors and improve diagnostics in the health care system (hence the patient could profit from early tumor detection and treatment; [39]) or if a person's well-being is undermined by a generative AI taking over the job and loss of the associated job income – for instance as it can replace ad writers in an ad agency. We further believe that the impact of AI on a person's well-being will also be influenced by the availability of such AI-tools. For instance, AI-powered smartphones (e.g. language assistants) are already ubiquitously available. The high availability will make it more likely that such AI systems are used and therefore also chances are higher that their influence are felt – including on a person's well-being.

CULTURE: The culture and/or country with their unique AI policies in which a person has been socialized/lives should be considered. Are certain AI products only available in certain countries? How strong is AI pushed in certain cultures? In this context also the concept of uncertainty avoidance is of interest. Uncertainty avoidance is one of the cultural dimensions according to Hofstede [40] which can also relate to the impact of AI on well-being. AI designs that do not adequately explain the degree of confidence and potential consequences may be deemed unacceptable and might have negative effects on the well-being of populations characterized by a high need for certainty. Likewise, collectivism as another cultural dimension implies that individuals influenced by their culture may vary in their willingness to adopt new AI solutions that are less socially proven.

TRANSPARENCY: How transparent is the AI? How well is this understood in terms of learning outcomes? Can we understand how the AI comes to a certain result? Is AI transparent regarding the sample used for training the model, including its size and demographics? Does it provide transparency about any failures encountered during both the training and production stages? Is the business model of AI transparent, at least in general terms? Please note that the degree of transparency of an AI system could also be seen as belonging to the Modality category, but we deem it as so important to present it as unique category here.

Exploring these questions helps us to understand how AI systems are integrated into human decision-making processes and the level of control individuals have in utilizing and interacting with AI.

The IMPACT framework is also depicted in Fig. 1, where it is shown that each category could theoretically contribute independently to the well-being of a person, but very likely, and most importantly, the dynamic Interplay between the variables/categories needs to be taken into account. For instance, if a certain AI product (e.g. medical) is only available in a certain country, it can only have a direct impact on the users in this country. In this case the Country and Area variable of the IMPACT framework would have interacted. Another exemplary interaction could be an Interplay of Person and Transparency variables. It is likely that not all persons have the same need to understand what's going on in the AI-black box. We imagine that persons with higher need for cognition [41], hence higher need to understand complex issues, might have also a higher need to understand artificial intelligence.

Finally, we want to explain another element of Fig. 1, where the box with "Attitudes towards artificial intelligence" can be seen. We believe that it is important to understand whether the five areas directly impact human well-being or whether this is done by molding human attitudes towards AI. Furthermore, it is imaginable that after well-being has been reduced or heightened due to the use of AI products (or the introduction of AI in society), this again shapes human attitudes towards AI. Hence, we would observe a reinforcing circle. Please note that well-being might be influenced at a more general level or a narrower facet level. This issue should be discussed in the future.

Summary and outlook

The present paper aims to make researchers sensitive to the idea that there will be no simple answers to how AI impacts societies and,

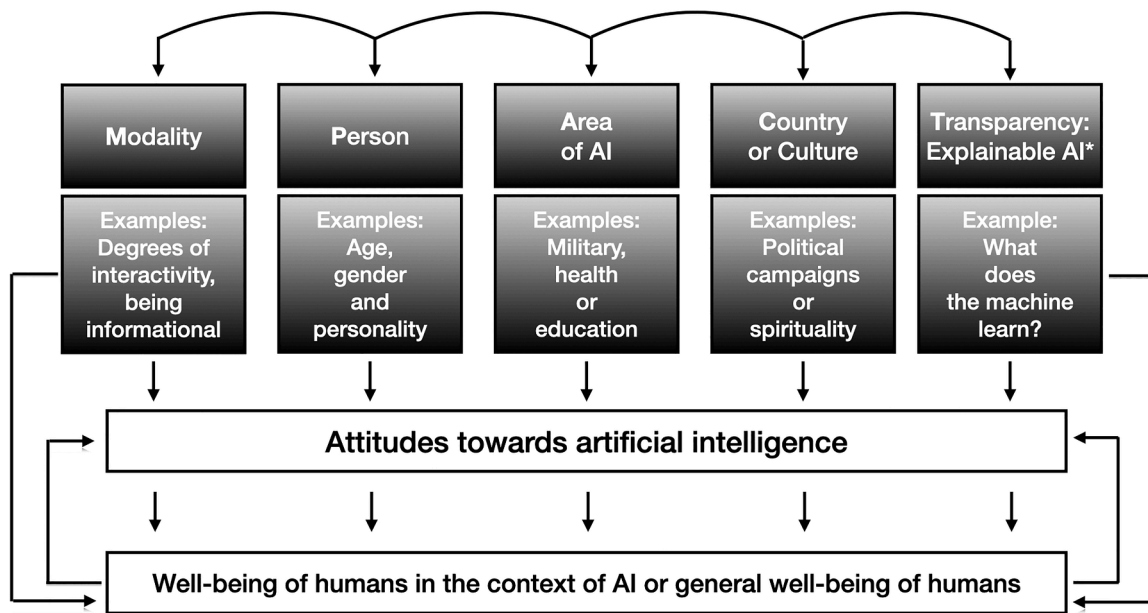


Fig. 1. The IMPACT framework to understand well-being in the age of AI; in principle there can be main effects of each category on attitudes towards AI/AI-well-being or interaction effects between the categories of the IMPACT framework on attitudes towards AI/AI-well-being including reinforcing effects; * explainable AI can result in more transparency of an AI system.

ultimately, the well-being of their users. Of note, it will also be a matter of debate which well-being measures are best suited for assessing well-being in the AI-complex. Should we use classic approaches, such as the cognitive approach, to study well-being with the assessment of life satisfaction or a more emotional approach to study well-being by asking about a person's emotional reactions [3,42]? We already mentioned this approach in the beginning of this article. Further research is needed to show if the impact of AI on a person's well-being is so large that general well-being measures can be used, or if we need to develop more specific well-being measures, hence asking about well-being in the context of interacting with AI and so forth. Hence, it likely is a huge difference, if we ask a person "Are you satisfied with your life?" or "Are you satisfied with your life when thinking about what AI does for you?". As pointed out in the A-(area)-category, we may need to narrow the well-being-question to AI operating in certain areas or products. Finally, the field is also in its infancy to assess attitudes towards AI, because only a few measures are out at the moment and no consensus exists as how to best operationalize it; see, for example, the following works [20,43].

In summary, understanding the AI-well-being-complex will not be easy, and many variables need to be considered in the future to understand how AI will contribute or have detrimental effects on a person's life. Without doubt AI will help to automate complex tasks (for deeper discussion on automation and AI see [44]) and therefore can assist humans in their everyday life, but depending on the many variables discussed in the IMPACT framework, AI has the potential to also reduce a person's well-being. Therefore, questions raised around the AI-well-being-complex are touching thorny and ethical terrain. In the context of our IMPACT framework, we believe that in each variable of the framework unique ethical issues could arise. For instance: Would it be ethical if an AI powered system is not interactive (Modality), when it is used for public discourse? Would it be ethical to use AI powered election campaigns to manipulate voters? From our view these are rhetorical questions and the EU already provides clear guidelines for personalized targeting in their digital services act [45]. It also needs to be mentioned that in the recent past already societal problems arose from AI technology likely impacting the well-being of humans: For instance, the meanwhile famous example of Google's algorithm misclassifying dark skinned persons for a Gorilla speaks for the dangers arising from training algorithms on biased data and potentially lack of

diversity awareness by the AI designers (see this and another examples; [46]). Against the background of such observations, it becomes clear that regulation of AI technology is central to reduce its dangers in many scenarios [47].

Of note, the present model is not without limitations, as it cannot be exhaustive, given that we know very little about the AI-well-being-complex. Therefore, other categories are likely to be added to the IMPACT framework. Nevertheless, we hope that this simple to remember framework might be a guide to study the AI-well-being-complex in the years to come, already acknowledging that understanding the AI-well-being-complex will not be a simple endeavor.

CRedit authorship contribution statement

Christian Montag: Writing – original draft. **Preslav Nakov:** Writing – review & editing. **Raian Ali:** Writing – review & editing.

Declaration of competing interest

Dr. Montag reports no conflict of interest. However, for reasons of transparency Dr. Montag mentions that he has received (to Ulm University and earlier University of Bonn) grants from agencies such as the German Research Foundation (DFG). Dr. Montag has performed grant reviews for several agencies; has edited journal sections and articles; has given academic lectures in clinical or scientific venues or companies; and has generated books or book chapters for publishers of mental health texts. For some of these activities he received royalties, but never from gaming or social media companies. Dr. Montag mentions that he was part of a discussion circle (Digitalität und Verantwortung: <https://about.fb.com/de/news/h/gesprachskreis-digitalitaet-und-verantwortung/>) debating ethical questions linked to social media, digitalization and society/democracy at Facebook. In this context, he received no salary for his activities. Finally, he mentions that he currently functions as independent scientist on the scientific advisory board of the Nymphenburg group (Munich, Germany). This activity is financially compensated. Moreover, he is on the scientific advisory board of Applied Cognition (Redwood City, CA, USA), an activity which is also compensated.

Data availability

No data was used for the research described in the article.

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