Future Directions for Behavior Change Support Systems

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Abstract

Over the past 15 years, Persuasive Technology (PT) and Behavior Change Support Systems (BCSS) have made remarkable strides with very active research centers worldwide. In these years information and communication technologies have exponentially advanced in terms of worldwide penetration, sophistication, and capabilities. Progress has been especially noteworthy in mobile devices, wearable sensors, Virtual/Augmented Reality, Artificial Intelligence, Machine Intelligence. At this juncture in the evolution of the discipline of Persuasive Technology, it seems appropriate to take a step back and identify important challenges and new directions for future PT research that can make optimal use of these recent advances. The purpose of this viewpoint paper is to suggest fruitful research directions, identify areas of fundamental importance to the future growth of basic and applied PT leading to major impacts. Advances in basic PT research will yield long-term rewards, laying the infrastructure for future applications, while those in applied areas could yield immediate rewards. We present five such Future Directions: 1) Long-term sustained behavior change; 2) Motivation; 3) Role of artificial intelligence; 4) Mitigating misinformation and disinformation; 5) Cognitive science underlying persuasive technology. Addressing these challenges will require interdisciplinary collaboration, ethical guardrails, and integration of cognitive, social, and technological perspectives. For each of these challenges we summarize the current state of the art, describe the benefits of addressing the challenge, and suggest promising research directions for the benefit of students and beginning researchers.

Keywords

Challenges, Persuasive Technology, Research

1. Introduction

Over the last 15 years researchers in Persuasive Technology (PT) and Behavior Change Support Systems (BCSS) have generated a large body of research that has identified and solved many challenges to supporting beneficial behaviors in health, sustainability, and other areas.

Over the same span of time hardware/software technologies have exponentially advanced in terms of worldwide penetration, sophistication, and capabilities. Progress has been especially noteworthy in mobile devices, wearable sensors, Information/Communication Technologies, Virtual/Augmented Reality, Artificial Intelligence, and Machine Intelligence.

At this juncture in the evolution of the discipline of Persuasive Technology it seems appropriate to take a step back and identify important challenges and new areas for future PT research that can make optimal use of these recent advances and build upon the worldwide efforts so far. The purpose is to answer the question "Where should PT/BCSS be 10 years from today?" by suggesting fruitful research directions, and identifying areas of fundamental importance to the future growth of basic and applied PT.

To this end we propose five Future Directions that need to be investigated in depth. These Future Directions are problem areas that are of fundamental importance to the future development of PT as a science and provide fruitful directions for applied and basic future research especially for those

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beginning research in PT. Due to their wide scope, research into these grand challenges will necessarily proceed in multiple streams and directions, depending on the problem area of interest, and result in multiple solutions and tools. While solutions and tools may be daunting to conceptualize and systematize, we suggest that investigations into these grand challenges may be of seminal impact to address current problems in health, sustainability, resilience to climate change, and other urgent issues confronting people worldwide.

This paper is not intended to be a history of Persuasive Technology/BCSS or a comprehensive narrative/systematic literature review. It represents viewpoints by the authors who have a total of more than 100 years of experience in PT/BCSS research. The purpose of this paper is to generate discussion, criticism and encourage future research in PT/BCSS.

2. Five Future Directions

2.1. Long-term Sustained Behavior Change

Our first grand challenge focuses on long-term sustained behavior change. What PT techniques and paradigms can realize sustained persuasion and long-term behavior change? Sustained, long-term behavior change is clearly necessary for chronic conditions such as obesity, depression, diabetes, hypertension, cancer recovery, and sustainability. Yet, there have been few successful such interventions and long-term studies. One great example is an information system known as Onnikka [1]. Why do PT tools seemingly get less used or lose persuasiveness over time? Conversely, what could improve engagement over the long term? Intuitively it would seem that certain principles in Dialog support such as Rewards and Reminders [2] could enhance long-term persuasion.

In "Persuading from the Start: Participatory Development of Sustainable Persuasive Data-Driven Technologies in Healthcare" [3], the authors tested an Audit Feedback (AF) system to reduce antimicrobial resistance (AMR) in healthcare settings. They investigated a participatory development approach and monitored its effectiveness in long-term persuasion. Central to their design was the need for constant and iterative feedback and design of the product with clear attention to the roles of the end users. The researchers showed that such user-centered can support engagement and long-term behavior change.

In "Persuasive System Design Does Matter: A Systematic Review of Adherence to Web-Based Interventions" [4] the authors investigated the role of Persuasive Systems Design [32] principles in improving long-term adherence to web-based health interventions. For web-based interventions, the most promising principles are personalization, self-monitoring, and social support. Personalization of content to the user significantly enhances user engagement, while self-monitoring provides useful feedback, thus improving adherence. Social support of community and peers helps with the commitment of the user. While effectiveness varied between contexts and implementations, in general the use of multiple components together had a compounding effect, giving stronger results. User centric design emerges again, but this time its positive effects can be enhanced further with other synergistic principles.

In "Theoretical Explanations for Maintenance of Behaviour Change: A Systematic Review of Behaviour Theories" [5] the authors investigate multiple behavioral theories to identify factors that help in creating and maintaining long-term behavior change. Several crucial factors emerged from this systematic review. Personalization appears again as self-regulation, achieved through setting goals and monitoring progress, and Social Support structured as continuous and flexible in its strategies, is deemed crucial for adherence. Self-Efficacy, as one's belief in success, and various external factors, like the environment, are also highlighted as strong elements of influence for the success of failure of long-term behavior change. Identifying the key theoretical ingredients that can influence the process gives us strong and broader insights on how to proceed while developing new strategies and e-health interventions.

These studies highlight persuasive design principles that are promising for long-term behavior change. User-centered design and the synergistic integration of various behavior change theories and techniques appear to play major roles. There is a general emphasis on iterative and flexible design, resembling

the agile development cycle, with its focus on a continuous feedback loop, iterations, and testing. This consideration would help in future research and development approach in practical applications, for a better personalized, multi approach, and effective strategy.

2.2. Motivation

Motivation has been identified as key to achieving behavior change [6]. Individuals who need to but don't want to, e.g., stop smoking, reduce food/drink consumption, will not change their behavior. Motivation is a complex topic in behavioral science and an area of active research. From the Persuasive Technology point of view the following simple classification of potential users of motivation-enhancing health tools could be a good starting point:

1. Those who do not want to change even though they know it would be good for them. But there is an ethical issue: Who decides what is good for someone?
2. Those in good health who know that they should engage in healthful behaviors but are not sufficiently motivated to do so.
3. Those with chronic disease who know they need to change certain behaviors but do not know how to.

In "Learning to Stop Smoking: Understanding Persuasive Applications' Long-Term Behavior Change Effectiveness Through User Achievement Motivation" [7] the authors investigated motivational factors underlying the effectiveness of persuasive applications designed to help users stop smoking. The authors found that learning goal-oriented participants, focused on self-improvement, reported higher long-term success in quitting. Meanwhile, performance approach-oriented participants showed mixed results, with no statistically significant correlation. Lastly, performance avoidance goal-oriented participants had the lowest success rates and experienced the shortest periods of remaining smoke-free, with a general struggle of maintaining motivation. There is a fundamental need to understand the user motivation and to leverage it for sustainable and effective change. In general, the design of an ehealth app should be able to support adaptive motivational patterns, with an emphasis on usercentric approaches.

The paper "A Taxonomy of Motivational Affordances for Gamified Technologies" [8] investigates the role of motivational affordances in gamified and persuasive technologies. The authors created a taxonomy that divides various design components into categories based on their ability to motivate the user. The motivational affordances that are being identified in the paper are feedback of progress to the user through various sensorial stimuli, rewards for achievements that can be tangible or intangible, motivation through clear, scalable, and achievable challenges and goals, social support and interactions that can help motivation through social comparison and peer support, a sense of autonomy of the user, which is a key driver of intrinsic motivation, and an estimation of competence level to balance other affordances, as a task too easy or too difficult could be detrimental in maintaining the users feel competent and engaged. The user-centered approach aimed at tailoring motivational strategies to the needs of the individuals could also support long-term behavior change.

In "Activity Trackers, Prior Motivation, and Perceived Informational and Motivational Affordances" [9] the authors examine in depth the roles of prior motivation and perceived affordances of activity trackers on user engagement and behavior change. The authors uncovered a robust link between prior motivation and the perceived beneficial level of the activity trackers, with long-term usage of them. Real time data tracking and detailed feedback to the user were generally highly valued features. Motivational affordances like goal setting, rewards, social support, and gamification helped considerably the user engagement retention. The synergistic effects of high prior motivation combined with the selected affordances created a virtuous cycle. Robust information feedback to the user and well-thought affordances are pointed out as necessary for the development of robust and effective activity trackers. This paper reveals the fundamental importance of initial motivation, and how it should be possible to leverage and enhance it with the correct implementation of persuasive principles in tracking devices.

The common trend in all these papers is the critical role of motivation in designing persuasive technologies. The user is again at the forefront of the designer's thoughts, providing them with more

agency and allowing customization based on individual needs and motivations. This approach not only enhances user engagement but also ensures the long-term sustainability of behavior change. There is an evident need to tailor the motivational strategies in persuasive technology to fit the unique preferences and goals of each user. This will enable designers create more effective and enduring interventions.

2.3. Role of Artificial Intelligence

Since mid 2024 there has been an explosion of interest, research and development in artificial intelligence systems such as Large Language Models (LLMs). The most well-known LLM is ChatGPT [10]. While much of this research indicates useful roles for AI and LLMs, it is noteworthy that it is also easy to generate disinformation and hallucination [11]. The paper "Working with AI to Persuade: Examining a Large Language Model's Ability to Generate Pro-Vaccination Messages" [12] explores the effectiveness of large language models (LLMs) in generating persuasive pro-vaccination messages. The AI generated messages were compared against similar messages created by human experts. The participants of this experiment were then exposed to the messages and their attitudes and intentions toward vaccination were measured. The most striking result is that AI messages were as persuasive, and in some cases even more persuasive, as the messages created by experts. The biggest strength that was highlighted in the paper is the ability of LLMs to quickly customize its messages based on user data and feedback. AI messages were perceived as clear, relevant, and able to answer personal concerns and questions. The AI components that contributed to its success were the factuality of information presented, its ability to appeal to emotions to quell fears, and its calls to get vaccinated. The ability to quickly and in real time tailor the message to the individual user's needs and preferences is highly valuable and provides LLMs with significant advantages in building effective persuasive communication strategies. Developing AI-driven interventions to influence public health behaviors is a promising and expanding area of research and development.

In "The Persuasive Power of Large Language Models" [13] the AI-generated messages were also compared in performance with traditional human made content. The study was carried out through various domains, including marketing, health, and social behavior. The broad applicability of LLMs is confirmed and strengthened by the results of this paper. The study found that LLMs are highly effective in generating persuasive content. In many cases, the AI-generated messages were found to be as persuasive or more persuasive than human-created content. Adaptability, together with consistency and efficiency of the AI generated messages was also improved in comparison with human-generated content. This paper strengthens the results presented in the previous one, as it confirms the effectiveness of elements like logical arguments, emotional appeals, credibility, and clear calls to action when deployed by an LLM. Moreover, it confirms the strong flexibility and adaptability of a LLM if pitted against traditional humangenerated content. Additionally, the authors describe how this highly personalized content can be produced efficiently, and in a timely manner, saving resources while maintaining high standards. The LLMs could be a new strong asset for persuasive content production.

Minimizing the ethical risk while also being able to harvest the full potential of LLMs for academic research is an integral part of our third grand challenge. In "Evaluating the Persuasive Influence of Political Microtargeting with Large Language Models" [[14]] the authors used LLMs to generate highly tailored political messages. In contrast to other research regarding personalization it was observed that messages tailored using specific attributes (e.g., gender or age) did not consistently out-perform general messages. The authors conclude that the effectiveness of LLMs should not be attributed to the high personalization they are capable of, at least in political microtargeting, but in the general persuasiveness of their messaging.

The recent development of Agentic AI is of particular interest to researchers in Persuasive Technology and BCSS. Unlike generative AI systems that passively respond to user input, Agentic AI systems can act autonomously, taking actions in digital environments, modulating their actions in response to user needs [15],[16]. In the context of behavior change, a high-level request such as "help me lose weight" could be broken down by the Agentic AI into subtasks such as planning meals, exercise regimen etc. and the agent could actively prompt the user with these at optimal times. The Agent could be integrated with

wearable sensors to monitor blood pressure, oxygen saturation, sleep durations and similar parameters, to provide specific advice to address health issues. In addition, it is easy to conceive that Agentic AI systems could rapidly progress from merely providing information to actively controlling physical robots intended to support behavior change. Such digital companions offer intriguing potential to support behavior change that needs to be explored in detail to understand their implications and affects. At what point do agentic AI systems cross the line from being supportive to coercive or manipulative? What relationships do people develop, perhaps even on an emotional level, with Agentic AI tools? Are such systems secure and impervious to manipulation by malicious external actors? These questions, and numerous others, need scientific study sooner rather than later, given rapid advancements in AI that could lead to Artificial General Intelligence [17].

The example papers referenced illustrate the transformative potential of AI, generative and agentic. Some major challenges for PT researchers and developers with this fast-growing technology are to balance persuasiveness with ethical considerations, identify best practices for optimum use, and developing mechanisms for identifying and re-moving misleading and hallucinatory content. We suggest that PT and PSD can be used to guide prompt engineering [18] in AI-based persuasive tools. The task for PT researchers is to develop best practices, prevent inappropriate inputs and outputs. Especially in PT research where we explicitly forbid coercive systems, it is important to be informed by ethical considerations [19].

2.4. Mitigating Misinformation and Disinformation

How can we develop PT systems as countermeasures to the prevalence of misinformation and disinformation about, e.g., climate change and other similar topics. It is noteworthy that unfortunately PT and PSD tools may have the potential to enhance unhealthful behaviors based on pseudoscience or political agendas [20],[21],[22].

In [20], the authors analyze the role of fake news in contemporary information warfare, with an in-depth view of the political and psychological contexts. This paper provides a detailed analysis of how the misuse of persuasion can lead to dire consequences but also can be seen as a foundation for building persuasive tools to combat these effects.

The article "Persuasion Strategies of Misinformation-Containing Posts in the Social Media" [23] investigates inner working of the strategies used in posts containing misinformation on Sina Weibo, a Chinese microblogging platform. The authors studied at the sociological and psychological mechanisms behind the presentation and diffusion of misinformation. As an uncommon frame of reference, they used Aristotle's rhetorical work with its ethos (credibility), logos (logic), and pathos (emotion). Pathos, in particular negative emotions, was the primary emotional appeal in misinformation posts, the other two attributes, logos and ethos were less represented in their sample. Interestingly, the analysis revealed how heavily misinformation creators rely on negative emotional appeals to persuade and motivate their userbase. There is a suggestion in the paper on how to improve our current strategies for combating misinformation. Those strategies are often based on logic (fact-checking), and this paper makes a compelling argument for the need to keep the strong emotional tone of misinformation posts into account when trying to contrast their diffusion.

In "Can We Re-design social media to Persuade People to Challenge Misinformation? An Exploratory Study [24] the authors investigated the redesign of social media interfaces to encourage users to challenge misinformation. They developed prototypes for seven strategies of persuasion: reduction, suggestion, selfmonitoring, recognition, normative influence, tunneling, and liking. Subsequently they conducted a survey to gauge the effectiveness of their designs, and they pitted them against the standard comment box. This study is an interesting piece that directly tackles the issue of misinformation and disinformation, and it proposes interventions designed to motivate users to fight this issue more proactively.

In "User Engagement with Digital Deception" [25] the authors thoroughly investigated user engagement with misinformation and disinformation on social media, focusing on who engages, how quickly they engage, and what kind of feedback they provide. They also examined user engagement

habits with various news sources of higher and lower credibility and examined recent developments to further media literacy and informed engagement. The most striking discoveries are the diffusion patterns, where the authors noted how content sharing tends to be concentrated mostly soon after its release. They brought to attention other peculiarities, such as platform specific differences in sharing patterns, the demographic split with older people engaging in disinformation slower than young ones, and the inverse correlation between education level and sharing speed. All these analyses are quite relevant for our grand challenge as they can help address the challenge of combating misinformation and disinformation by giving us insights into how users are engaging with malicious social media content.

This collection of studies gives us a wide and comprehensive overview of how misinformation and disinformation work. They highlight the psychological, social, and emotional mechanisms that are at play when we are subjected to, and when we are active spreaders of, disinformation. They are also capable of providing us with insights to fight these practices by creating more robust and engaging tools that can positively influence our behavior when trying to defend ourselves. A major challenge is designing PT systems that can help individuals who have been misinformed to follow healthful behaviors based on scientific evidence. The challenge is exacerbated by Brandolini's Law which states that the amount of energy needed to refute mis/disinformation is an order of magnitude larger than that needed to create it. [26].

2.5. Cognitive Science Underlying Persuasion

PT systems act in large part by stimulating and modifying cognitive processes. What are these cognitive processes? Are there differences in cognition between the application of specific Primary Task support principles and various PSD principles [2]? For example, if a system includes tunneling and another includes reminders, are the users' cognitive processes different? What are the cognitive processes triggered by coercive systems? Studying coercive systems could lead to improved methods for developing noncoercive PT. In addition, detailed research on cognitive processes underlying behavior change could give insights on causality as opposed to statistical studies that typically provide correlations.

The paper "Psychological Processes Underlying Persuasion: A Social Psychological Approach" [27] presents an indepth vision of the mechanisms that drive attitude change through persuasion from a social psychological perspective. There is a strong focus on the Elaboration Likelihood Model [28],[29] as a core framework to understand persuasion, with its central and peripheral routes to persuasion (thoughtful and instinctual). The authors investigate mechanisms by which various processes can lead to persuasion including the amount of thinking (elaboration), the direction of thinking (biased processing), and metacognitive aspects such as thought confidence. In conclusion, the authors suggest how persuasion can be affected by the intersection of the message, the recipient, and the context.

In "Brain Mechanisms of Persuasion: How 'Expert Power' Modulates Memory and Attitudes" [30] the researchers used Functional Magnetic Resonance Imaging(FMRI) [31] to study participants' brain activity while the subject was shown persuasive messaging. The objective of the experiment was to see if different sources (expert vs non-experts) could affect memory retention and attitude changes at the neural level. The results of this interesting study revealed that messaging prepared by experts was able to better activate areas of the brain related to memory and cognitive processing. In particular, the areas activated most were the medial prefrontal cortex (mPFC) and the hippocampus. These findings suggest that source credibility can influence the effectiveness of persuasive messages, and how this can be demonstrated by the detection of differences in patterns of brain activity, memory, and attitudes. Knowing the relationship between expert messaging and neural response can be informative for the developers of persuasive technologies.

The thread uniting all these papers is the critical role of cognitive science for the deepening of our understanding and effective deployment of persuasion mechanisms. The persuasive technologies that we want to deliver should be mindful of the cognitive and emotional processes of the target audience. From the exploration of social psychological theories to the examination of the neurological basis of persuasion, the research here mentioned underlines how strongly connected are the cognitive

and emotional factors to the effectiveness of persuasive messages. This cognitive-centric approach could be one of the focal points that permits us to advance in the field and achieve long-term success. Neurological correlates underlying persuasion, studied using FMRI, could provide useful insights in this regard. Another often-used technique in cognitive science is "Think aloud". Here subjects are exposed to an intervention and asked to think aloud as they progress. The record of their thoughts is analyzed using grounded theory techniques to discover and identify common themes [32].

3. Discussion

Taken together, the future directions described in this paper reveal a rapidly evolving research landscape in Persuasive Technology (PT) and Behavior Change Support Systems (BCSS). Collectively, they point toward a discipline that is maturing beyond the development of isolated interventions toward the creation of integrated, ethical, and adaptive systems capable of sustaining meaningful change in complex sociotechnical contexts. Across all five challenges—sustained behavior change, motivation, artificial intelligence, misinformation and disinformation, and the cognitive science underlying persuasion—one unifying theme emerges: the centrality of the human user as both the beneficiary and active participant in persuasive system design.

A recurring finding across the research reviewed is that long-term effectiveness of Persuasive Technology seems to depend on personalization, social support, and iterative, user-centered design. These insights suggest that the field must continue to move beyond one-time interventions and instead embrace dynamic, evolving persuasive systems that adapt to users' goals, contexts, and motivational states over time. Integrating principles from agile development, human-centered computing, and behavioral science may yield PT interventions capable of maintaining engagement and efficacy across the life span of behavior change.

The challenge of motivation underscores that persuasion cannot occur in a vacuum; rather, it must align with users' goals. The literature on motivational affordances and goal orientation shows that effective PT design requires understanding why users engage with a system, not just how they interact with it. Systems that flexibly match motivational messages to users' regulatory focus or goal orientation can produce stronger, more enduring effects. Future PT research should therefore incorporate adaptive motivational modeling, possibly informed by physiological or behavioral sensing, to deliver messages that remain relevant as user motivations evolve.

The emergence of Artificial Intelligence, Agentic AI, and Large Language Models (LLMs) offers both unprecedented opportunities and profound ethical responsibilities. As shown in the reviewed studies, AI systems can generate persuasive content that rivals or exceeds human performance in certain contexts. Yet, this same capability can amplify misinformation or manipulation if deployed irresponsibly. The grand challenge for PT researchers is to develop transparent, accountable frameworks for AI-mediated persuasion—frameworks that prioritize user autonomy, informed consent, and noncoercive influence. Research should aim to define clear boundaries between persuasive assistance and manipulation, perhaps by codifying ethical design heuristics or certification standards for AI-driven PT.

Closely linked is the challenge of mitigating misinformation and disinformation, which represents one of the most urgent applications for PT today. The same persuasive principles that can encourage healthful or sustainable behaviors can also be weaponized to spread falsehoods. Understanding the psychological and emotional mechanisms that make misinformation persuasive—particularly the use of affective and social validation cues—can guide the development of counter-persuasive systems. Future PT tools could leverage emotional resonance, narrative framing, and community-based credibility cues to inoculate users against deception, while fostering critical digital literacy and resilience.

Finally, the cognitive science underlying persuasion remains foundational to the field. Advances in neuroscience, social psychology, and cognitive modeling are beginning to clarify the mechanisms through which persuasive systems influence attitudes and behaviors. These insights highlight the need for PT research to remain grounded in theory-driven experimentation that distinguishes correlation from causality. Integrating cognitive process tracing methods (e.g., think-aloud protocols, eye tracking,

or neuroimaging) with traditional design research could illuminate why certain persuasive strategies succeed or fail. A deeper understanding of users' cognitive and emotional responses will enable the next generation of persuasive systems to be not only more effective but also more transparent and humane.

Overall, these Future Directions call for a new synthesis of technological innovation, ethical reflection, and cognitive insight. The field stands at a pivotal moment where cross-disciplinary collaboration—linking psychology, data science, design, and ethics—is essential to ensure that persuasive technologies enhance, rather than erode, human well-being. Addressing these challenges will help the PT community articulate a vision for technologies that are adaptive, trustworthy, and genuinely supportive of human goals across diverse domains.

4. Limitations

While this paper sought to identify the most pressing Future Directions for the next decade of persuasive technology research, several limitations must be acknowledged. The challenges outlined here are necessarily selective rather than exhaustive; they reflect the themes most prominent in recent literature and discussions among the PT community rather than a systematic empirical prioritization. Moreover, the examples reviewed under each challenge were chosen to illustrate emerging trends and opportunities, not to provide a comprehensive analysis. Another limitation lies in the field's current methodological fragmentation: many PT studies remain small-scale, context-specific, or lack longitudinal follow-up, which makes it difficult to generalize findings across domains such as health, sustainability, and misinformation. Finally, as the field increasingly integrates artificial intelligence and real-time data analytics, ethical and cultural perspectives outside Western contexts remain underrepresented. Addressing these gaps will be crucial to ensure that PT evolves as a truly global and responsible scientific discipline.

5. Conclusion

Future research could build upon these Future Directions through interdisciplinary collaboration, methodological rigor, and explicit ethical grounding. One key direction is to develop adaptive persuasive systems capable of sustaining longterm engagement by continuously learning from users' behavior, context, and motivational states. Advances in machine learning and affective computing can support such adaptivity, provided they are designed transparently and respect user autonomy. Researchers should also prioritize theoretical integration, linking Persuasive Systems Design (PSD) principles [32] with established psychological and cognitive frameworks to clarify mechanisms of action. To counter misinformation and promote trust, future PT interventions should test emotionally intelligent counter-persuasive strategies that appeal to both cognition and affect. Expanding cross-cultural studies, open science practices, and participatory design approaches will further strengthen the field's empirical and ethical foundations. Ultimately, addressing these Future Directions requires not only technological innovation but also sustained reflection on the societal values that persuasive technologies are meant to serve.

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Declaration on Generative AI

During the preparation of this work, the author(s) used Chat-GPT-5 in order to: Grammar and spelling check. After using this tool, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the publication's content.

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