Hypernudging in the Digital Era: Exploring the Impact and Ethical Considerations of Advanced Behavioral Interventions

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Abstract

Purpose: This conceptual review explores the phenomenon of "hypernudging" advanced, algorithm-driven behavioral interventions in digital environments. It aims to distinguish hypernudging from traditional nudging, assess its ethical implications, and propose a comparative framework to guide future research.

Design/methodology/approach: The study uses a conceptual narrative review method, drawing on interdisciplinary literature from behavioral economics, digital governance, and information systems.

Findings: Hypernudging introduces a unique form of behavioral influence marked by personalization, algorithmic opacity, and real-time adaptability. While enhancing digital decision-making efficiency, it challenges core ethical principles such as transparency, autonomy, and accountability.

Originality/value: This paper contributes by introducing a novel comparative matrix differentiating nudging types and proposing an ethical evaluation lens based on autonomy theory and algorithmic accountability.

Limitations: This paper is limited to a conceptual nature; future empirical validation is needed in real-world digital contexts and across diverse populations.

Practical implications: Understanding hypernudging can guide digital marketers, policy designers, and technology developers to ethically design interventions that respect user autonomy while effectively influencing decision-making in digital spaces.

Keyword: hypernudge, digital ethics, algorithmic design, behavioral interventions, digital autonomy.

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Introduction

Behavioral economics has transformed how we understand human behavior by highlighting cognitive biases and systematic deviations from rational choice. A key concept within this field is *nudging*, defined by Thaler and Sunstein (2008) as an alteration of choice architecture that predictably influences behavior without restricting options or significantly changing economic incentives.

In the digital age, however, behavioral interventions have evolved beyond these conventional bounds, giving rise to more sophisticated and opaque mechanisms of influence. This transformation is encapsulated in the emerging concept of the *hypernudge*. Coined by legal

scholar Yeung (2019), *hypernudging* refers to the fusion of behavioral science with data-driven algorithmic systems to regulate behavior in digital environments. Unlike traditional nudges, hypernudges utilize real-time data analytics, artificial intelligence, and machine learning to create highly personalized, dynamic, and often invisible forms of behavioral influence at scale. These algorithms may be dynamically modified, enhancing the effectiveness of the technique

Scholars have recently acknowledged the significance of nudging in the field of information systems, which has led to the concept of digital nudging. This recognition is supported by various studies (Weinmann, Schneider and Brocke, 2016; Meske and Potthoff, 2017; Mirsch, Lehrer and Jung, 2017; Schneider, Weinmann and Brocke, 2018; Hummel and Maedche, 2019) Initially, nudging arises from a context of policy formulation, where the majority of behaviorally-informed tools and their underlying systemic cognitive limitations are mostly centered around the physical world and hence cannot be directly applied to digital decision-making settings (Benartzi et al., 2017). Furthermore, the growing digitization of our society results in a heightened utilization of digital decision support systems (DSS), encompassing gadgets such as smartphones. Considering the influence of context on choice architectures and decision-making, it is important to take into account the specific structure and display of choice architectures, as well as how individuals behave and the decisions they make. This is particularly relevant in the digital context. While there has been some recognition of the ethical implications of digital nudging (Weinmann, Schneider and Brocke, 2016; Meske and Potthoff, 2017), there is still a lack of explicit recommendations or a comprehensive discussion of the ethical acceptability of digital nudging.

Since its inception, the word has had a modest although increasing usage among researchers who are interested in comprehending the utilization of 'nudging' and comparable notions inside the digital economy. However, neither the original users of the phrase nor others who have used it thereafter have specifically examined the connection, if any, between the concept of a hypernudge and that of a 'conventional' nudge. This is regrettable, since it hampers discussions between behavioral scientists and opponents of hypernudging, as the former face difficulties in comprehending the topic that the latter are criticizing. With the rise of surveillance and data collecting technology, behavioural science and nudging have become more technologically focused. This article provides a clear conceptual explanation of hypernudging and its direct connection to the field of behavioral research.

This paper makes three key contributions to the growing discourse on digital nudging and hypernudging. First, it provides a structured comparative framework including a formal matrix—that distinguishes between conventional nudges, digital nudges, and hypernudges across core dimensions such as adaptivity, personalization, algorithmic opacity, real-time feedback, and user awareness. This framework clarifies conceptual ambiguities and bridges the gap between behavioral economists and critics of algorithmic governance.

Second, drawing from Lanzing's (2018) foundational work, the paper reconceptualizes the defining characteristics of hypernudge *dynamism*, *predictive capacity*, and *hiddenness*—by proposing a twofold refinement of dynamism into *personalization* and *real-time reconfiguration*. This reconceptualization better captures the technological sophistication of hypernudging mechanisms and their unique capacity to shape individual and collective behaviors in digital ecosystems.

Third, the paper introduces a novel ethical lens grounded in the emerging concerns of *behavioral inequality*, *cross-platform targeting*, and the erosion of *collective autonomy*. By addressing the power asymmetries embedded in algorithmic choice architectures, the paper advances a more critical and normatively engaged perspective on the societal impacts of hypernudging.

The structure of this paper is as follows. Section 1 presents a detailed comparison between nudging and hypernudging, identifying recurring themes and conceptual distinctions. Section 2 unpacks the core attributes of hypernudging, including its dynamic and predictive capacities. Section 3 analyzes the implications of hypernudging for consumer decision-making, distinguishing between individual-level and social-level effects. Section 4 discusses ethical

challenges, with particular attention to behavioral manipulation, transparency, and autonomy. The conclusion synthesizes the paper's insights and outlines avenues for future research, particularly in the development of ethical guidelines and regulatory frameworks for hypernudging technologies.

Literature Review

The emergence of hypernudging represents a significant development in the intersection of behavioral economics, digital technology, and algorithmic governance. This section synthesizes foundational and recent literature to trace the evolution from traditional nudging to hypernudging and identifies key conceptual tensions and ethical debates. The review is organized around four key themes: (1) The Foundations of Nudging; (2) The Rise of Digital and Hypernudging; (3) Technological Dimensions and Behavioral Control; and (4) Ethical and Governance Implications.

1. The Foundations of Nudging

The concept of nudging, introduced by Thaler and Sunstein (2008), describes subtle interventions in the choice architecture that influence decision-making without restricting options or significantly altering economic incentives. Nudges exploit cognitive biases, such as default effects and loss aversion, to steer individuals toward beneficial choices in domains such as health, savings, and education (Samuelson & Zeckhauser, 1988; DellaVigna, 2009). Nudging has since gained popularity in public policy, supported by empirical studies across behavioral economics and psychology (Cashore et al., 2019; Folkvord et al., 2020).

However, critics have highlighted its limitations, especially in addressing heterogeneous populations and complex, digital environments (Congiu & Moscati, 2018; Harbers et al., 2020). Standard nudges are typically static and designed for average effects, which can produce unintended consequences or fail to accommodate diverse user needs (Sunstein, 2020).

2. The Rise of Digital and Hypernudging

As societies increasingly rely on digital infrastructures, nudging has expanded into algorithmic and data-driven environments, giving rise to the concepts of digital nudging and hypernudging. Digital nudging refers to user-interface design elements that guide digital behavior, such as notification prompts or interface defaults (Weinmann et al., 2016; Meske & Potthoff, 2017). These nudges maintain the non-coercive ethos of traditional nudging but are adapted for online platforms.

By contrast, hypernudging, a term introduced by Yeung (2019), represents a qualitatively different form of influence. It incorporates real-time behavioral tracking, machine learning, and predictive analytics to generate personalized and dynamically adaptive interventions. Hypernudging thus transforms choice architecture into a technologically mediated system of behavioral control, often opaque to the user.

3. Technological Dimensions and Behavioral Control

Lanzing (2018) identified three defining features of hypernudging: dynamism, predictive capability, and hiddenness. Mills (2022) further refined this framework by dividing dynamism into personalization and real-time reconfiguration. These dimensions distinguish hypernudging from traditional nudging in both functionality and scope:

- *Personalization:* Hypernudges are tailored to individual user profiles based on behavioral data (Sunstein, 2021; Porat & Strahilevitz, 2013). This enhances efficacy but raises questions about fairness and behavioral inequality.
- *Real-time Reconfiguration*: Unlike static nudges, hypernudges can adjust dynamically as user context changes (Mills, 2020). Tools like Google Maps and adaptive streaming services

exemplify this feature.

- *Predictive Capacity:* Hypernudging leverages AI and big data to forecast user behavior and optimize interventions. This shifts the focus from reactive to proactive behavioral engineering (DellaVigna & Linos, 2020).
- *Hiddenness:* Hypernudges are often embedded in digital platforms with limited user awareness or consent, raising significant concerns about transparency and manipulation (Van Dijck, 2014; Susser, 2019).

Table 1. Difference between traditional nudge and hypernudge

Feature	Traditional Nudge	Hypernudge
Personalisation	Often are not personalised and suffer from the 'problem of heterogeneity.' However, these nudges can be personalised using low intensity 'crude' methods which may reduce problems caused by heterogeneity in the population.	Always consist of personalised nudges personalised using high intensity 'sophisticated' methods such as machine learning and big data. Through personalisation, hypernudges are expected to significantly reduce the problem of heterogeneity.
Real-time (Re) Configuration	Often only change periodically, either during a pre-defined periodicity (e.g., an annual review) or a periodicity implied from the context in which the nudge operates (e.g., a school year).	Always change as quickly as possible, ideally in real-time, to reflect as much feedback, collected in the form of data, as possible.
Predictive Capacity	Often the predictive capacity may vary and will be highly influenced by the environment in which preliminary trials took place. Opportunities for feedback to evaluate predictions are determined by the rapidity of the nudge, which often spans several months or years.	Always constructed to maximise predictive capacity through an optimisation perspective compatible with various technologies such as loss functions in machine learning. Opportunities to evaluate predictions are common owing to the rapidity of the hypernudge.
Hiddenness	The role of hiddenness in improving nudges remains debatable, with empirical evidence suggesting that nudges remain effective even when transparent. Owing to the ubiquity of choice architecture, transparency is never guaranteed.	Hypernudges may be hidden owing to the technology which enables them to fade into the background. Furthermore, technology itself can easily become 'hidden' in a philosophical sense as attention turns from the technology to the ends which the technology facilitates.

Source: (Mills, 2022)

4. Ethical and Governance Implications

Hypernudging challenges traditional ethical frameworks by introducing algorithmic opacity, behavioral asymmetry, and commercial motivations into the nudge paradigm. While traditional nudges are typically developed by governments or policy actors with public welfare goals, hypernudges are often driven by platform companies with economic incentives (Yeung, 2016).

The ethical critique focuses on whether users retain meaningful autonomy and agency in hypernudged environments (Frischmann & Selinger, 2016). Scholars have proposed concepts like behavioral inequality and collective autonomy to assess how personalization may differentially benefit or harm individuals (Bang, Shu & Weber, 2020; Rookhuijzen et al., 2023). Additionally, the hidden nature of hypernudges, combined with their predictive power, raises regulatory concerns about informed consent, data protection, and algorithmic accountability.

This literature review demonstrates that hypernudging departs significantly from traditional nudging in terms of its technological basis, degree of personalization, dynamic feedback loops, and ethical complexity.

Research Questions

In the domain of behavioral economics, nudging has been widely recognized as an effective tool for influencing individual decision-making by subtly altering the choice architecture without significantly restricting options (Thaler & Sunstein, 2008). However, recent advancements in digital technology and data analytics have given rise to "hypernudging," a more sophisticated form of nudging utilizing predictive algorithms, personalization, and real-time adaptability (Yeung, 2019; Lanzing, 2018). While hypernudging shows great potential in behavioral modification, it also raises significant ethical concerns, particularly regarding transparency, user autonomy, and manipulation (Susser, 2019; Mills, 2022). Based on the analysis of existing theoretical frameworks and empirical evidence, the following research questions have been developed:

- How does the concept of hypernudging expand upon or diverge from traditional notions of nudging?
- What are the technological and ethical characteristics that define hypernudging in digital decision environments?
- What are the theoretical and normative implications of hypernudging for behavioral design and digital governance?

Research Methods

This study adopts a narrative literature review methodology to critically examine and synthesize the emerging concept of *hypernudging* within digital environments. The narrative review approach was selected due to its suitability for providing an interpretative, theory-driven exploration of a complex and evolving interdisciplinary topic. Rather than aiming for exhaustive coverage or systematic quantification, the review focuses on developing conceptual clarity and analytical depth by integrating theoretical arguments, empirical findings, and ethical reflections from diverse academic sources.

Research Scope and Sampling Strategy

The scope of the review encompassed scholarly publications addressing hypernudging and its relationship to traditional nudging, with particular attention to applications in digital contexts and associated ethical considerations. The sampling frame included peer-reviewed journal articles, academic books, and key theoretical contributions published primarily in the fields of behavioral economics, information systems, digital ethics, and policy studies.

Relevant literature was identified through iterative, purposive searches in academic databases including *Web of Science*, *Scopus*, and *Google Scholar*. Search terms included: "hypernudge," "digital nudging," "behavioral intervention," "algorithmic nudging," "behavioral design," "data-driven influence," and "ethics of nudging."

Publications were selected based on their conceptual relevance, scholarly credibility, and contribution to the ongoing dialogue on digital behavioral influence. The review did not apply rigid inclusion or exclusion criteria, in line with the flexible and interpretative nature of narrative inquiry.

Data Analysis and Thematic Synthesis

The analysis proceeded through **thematic synthesis** and **interpretative evaluation**. Each selected source was examined to extract key arguments, conceptual frameworks, empirical insights, and normative positions. Thematic categories emerged inductively and were refined through constant comparison of the literature.

Four major conceptual dimensions were identified as defining features of hypernudging personalization, real-time reconfiguration, predictive capacity, and hiddenness serving as the

organizing framework for the discussion. These dimensions were used to compare hypernudging with traditional nudging approaches, highlight theoretical tensions, and surface ethical implications related to transparency, agency, and behavioral governance.

Results and Discussion

This section presents a synthesized analysis of the concept of hypernudging, drawing on the identified literature to map its distinctive features and implications in comparison to traditional nudging. Organized thematically, it provides interpretive insights into four core dimensions: (1) conceptual and technological distinctions, (2) behavioral implications at the individual level, (3) societal and normative dynamics, and (4) ethical concerns in digital environments.

1. **Conceptual and Technological Distinctions: From Choice Architecture to Algorithmic Orchestration**

   Traditional nudging, grounded in the behavioral economics work of Thaler and Sunstein (2008), emphasizes non-coercive adjustments to physical or informational environments to predictably influence behavior. These interventions are typically designed for a general audience and are static, transparent, and modest in scope.

   Hypernudging, by contrast, introduces a qualitatively different mode of influence. As Yeung (2019) and Rookhuijzen et al. (2023) explain, hypernudges are powered by real-time data collection, predictive analytics, and adaptive algorithms. Following the framework of Lanzing (2018) and Mills (2022), hypernudging is characterized by four interrelated features: personalization, real-time (re)configuration, predictive capacity, and hiddenness. These dynamics shift the practice from a universal, environment-based choice architecture to a computationally orchestrated and highly individualized behavioral regime.

   Technological systems such as Google Maps, Netflix's autoplay, and Facebook's newsfeed illustrate how real-time feedback, big data, and machine learning algorithms create an architecture of influence that is no longer transparent or static, but dynamic, opaque, and self-adjusting.

2. **Behavioral Impacts: Autonomy and the Shaping of Digital Decision-Making**

   At the individual level, hypernudging raises significant concerns about autonomy and decision quality. Unlike standard nudges which often rely on heuristic shortcuts or cognitive biases (e.g., default effects) hypernudges anticipate user preferences and guide behavior in increasingly precise and proactive ways.

   Empirical and conceptual analyses (Jun & Couldry, 2020; Faraoni, 2023; Chomanski, 2022) suggest that hypernudges, particularly in commercial contexts, may erode user autonomy by aligning behavioral outcomes with the objectives of platform owners rather than user interests. These effects are intensified by the perpetual adaptation of nudges to real-time behavioral feedback and the reduction of user awareness through interface concealment. Furthermore, as Yeung (2016) notes, this creates algorithmically curated environments in which users are subtly maneuvered into predefined behavioral pathways raising the risk of "computational manipulation" and what Zuboff (2015) terms surveillance capitalism.

3. **Societal Dynamics: Social Norms, Echo Chambers, and Collective Behavior**

   Hypernudging not only affects individuals but also shapes collective behavior by embedding normative cues into digital infrastructures. As digital platforms often mediate social interaction and information exposure, hypernudges can amplify conformity to algorithmically reinforced social norms, potentially creating digital echo chambers (Mollen et al., 2013; Leander & Burriss, 2020).

   Studies on energy use (Abrahamse & Steg, 2013), cooperation (Fehr &

Schurtenberger, 2018), and food consumption (Stok et al., 2016) highlight how digital platforms influence social learning processes. When hypernudges exploit these mechanisms—such as through socially endorsed recommendations or algorithmic ranking—they may not only guide behavior but subtly redefine what is perceived as normative or acceptable.

This has implications for digital citizenship, participatory democracy, and the emergence of normatively coded public spheres. Moreover, as platforms increasingly mediate public discourse, hypernudging could contribute to opinion polarization, information silos, and social fragmentation.

4. Ethical Considerations of Digital Nudging

This research adapted the guiding questions by (Lembcke et al., 2019) regarding ethical consideration of digital nudging. This table summarize from the questions of the Which ethical consideration do arise when using digital nudging mechanisms in digital environment and what potential resolutions do exist to address these ethical considerations.

Table 2. Guiding Questions Regarding Ethical Considerations for Digital Nudging

Freedom of Choice / Autonomy
▪ E1: How much effort on the behalf of individuals is justified to preserve their freedom of choice?

Transparency
▪ E2.1: How much concealment of a nudge is bearable to still be considered transparent?
▪ E2.2: How much difficulty to identify nudges as nudges is justified in order to still consider the nudge as transparent?

Goal-Oriented Justification
▪ E3.1: How aligned do choice architects' goals need to be with those of the individuals' in order to render a nudge as justifiable?
▪ E3.2: How much disagreement among targeted individuals is bearable to still justify a nudge's pro-social implementation?

Source: Lembcke et al. (2019)

- ***Freedom of Choice / Autonomy***

E1: How much effort is justified on the behalf of individuals to preserve their freedom of choice?

It is important for digital nudges to uphold individuals' freedom in decision-making, without enforcing limitations or restraints. Studies indicate that digital settings frequently include an excessive amount of information (Liu, 2005), resulting in diminished attention spans, banner blindness, and superficial information processing method (Benway, 1998; Burke et al., 2005; Loh and Kanai, 2016). This indicates that individuals exhibit diminished levels of consciousness when influenced in digital environments as opposed to conventional physical decision-making scenarios. Hence, it is imperative for the choice architect to refrain from capitalizing on the limited attention and overwhelming number of choices in digital environments.

Digital nudges are simple and cost-effective procedures that may be employed to shape persons (Schneider, Weinmann and Brocke, 2018). Nevertheless, the absence of expense may result in an overabundance of influence, such as the incessant delivery of messages on an hourly basis. The frequency and style of nudges can have an influence on people' freedom of choice and autonomy. Notifications have the potential to interrupt meetings and impede focus, resulting in psychological consequences known as "psychic tax" (Barton and Grüne-Yanoff, 2015). Untimely and excessive interruptions might cause individuals to exert more mental effort, which may contribute to the emergence of problems such as smartphone addiction (Duke and Montag, 2017). Hence, it is imperative for decision architects to exercise prudence while employing digital nudges to prevent over use and severe psychological ramifications.

Digital choice designers must be aware of their responsibilities to design nudge

interventions that are not exploitative, restrict choices, and preserve individuals' decision-making abilities. Advanced digital technologies should be used to maximize autonomy and freedom of choice. Users should have control over the nature, structure, and frequency of nudge interventions, such as customizable experiences in online stores. Users should be able to disable or customize features such as recommender systems, reminder mechanisms, conversational agents, scarcity mechanisms, simplification mechanisms, and website personalization. Users should be proactively notified of changes to the IS and their implications. It is crucial to minimize cognitive effort required to ignore nudge techniques, with a compelling rationale for repeated use. The effort to ignore a digital nudge can be quantified in conjunction with transparency.

- ***Transparency***

E2.1: How much concealment of a nudge is bearable to still be considered transparent?

The transparency of analog nudges is challenging due to the complexity of information systems and advancements in artificial intelligence algorithms. Digital nudges can be easily understood if they follow clear guidelines. However, when guided by advanced machine learning algorithms, understanding the underlying mechanisms becomes obscure. These algorithms categorize vast data sets, offering diverse outcomes. The choice of nudge or the implementation of nudging can be opaque, as recipients may not understand the reasoning behind the classification (Burrell, 2016).

Our resolution is to advocate for a meticulous selection of the design for a "digital choice architect". These concerns should encompass ethical aspects of algorithms, as well as assuring the comprehensibility of the machine learning model and its results (Vellido, Martín-Guerrero and Lisboa, 2012; Mittelstadt et al., 2016). In order to make sure that the recipients of nudges have full visibility into the process, there are two possible approaches: (1) simplifying the nudging procedures so that they can be easily understood by the average person, or (2) obtaining ethical validation through professional methods, such as having external auditors assess the code to ensure it aligns with nudging standards (Pasquale, 2016), or collaborating with interdisciplinary partnerships to guarantee the ethical compliance of one's algorithmic efforts (Kraemer, Van Overveld and Peterson, 2011; Burrell, 2016).

E2.2: How much difficulty to identify nudges as nudges is justified in order to still consider the nudge transparent?

Transparency is crucial when using digital nudges, ensuring individuals are aware of the instances and locations where they are being influenced. However, concerns arise regarding the level of ease required for nudges to be considered simple. Factors such as the visual representation of nudges, the availability of comprehensive information on information system usage, and the presence of distinct attributes can impact the ease of understanding. Additionally, not all buttons or notices on a website without coercion can be considered a nudge.

The resolution states that interventions deemed nudges must exceed a specific goal formulation level and consider human factors. These nudges aim beyond typical website engagement and require a deliberate choice architect to establish goal setting within user interface elements.

The nudge intervention, which uses visible cues like borders, can be recognized by recipients with minimal focus. Online research, like questionnaires, can assess the effectiveness of the design before deploying it. Metrics include the time individuals take to recognize the nudge and the likelihood of correct recognition in stressful scenarios.

- ***Goal-Oriented Justification***

E3.1: How aligned do choice architects' goals need to be with those of the individuals' in order to render a nudge as justifiable?

Both Information System and digital settings have comparable obstacles to conventional Behavioral Economics contexts when it comes to identifying people' preferences and developing solutions that can be universally applied. The acceptance of nudges varies based on the specific intervention approach employed (Reisch and Sunstein, 2015; Sunstein, 2016). Digital surroundings provide supplementary means for shaping behavior, but their ubiquity and persuasive characteristics may render them more intrusive than analog ones (Schneider, Weinmann and Brocke, 2018). Choice architects may have a greater vulnerability to pursuing self-centered goals and being influenced by manipulative methods, such as "dark UX patterns." Considering the cost-effectiveness and creative freedom of Information Systems designers, it is essential to carefully determine the objectives of digital nudges in order to effectively affect a wide range of targets.

Information Systems can provide three ways as a resolution: (1) Cost-effective and comprehensive user research methods, (2) more accurate targeting mechanisms, and (3) simplified feedback mechanisms for individuals: (1) With the advent of information systems (IS), the implementation of user research techniques such as interviews and surveys has become significantly more convenient. Choice architects might strive to achieve a "shared preference justification" by asserting that they are pursuing aims that align with the preferences of those affected by the nudge (Clavien, 2018). The input explores the utilization of search engines and databases to assist nudges in acquiring a more comprehensive comprehension of their intended audience, hence augmenting the ethical contemplation procedure. Additionally, it states that digital surroundings offer greater possibilities for specific and individualized prompts in comparison to analog ones (Smith, 2012; Kannan and Li, 2017). The input implies that using digital marketing tactics can aid in the creation and implementation of digital nudges. Furthermore, it states that digital user research approaches may be employed to get feedback from those who have experienced digital nudging, hence enhancing the efficacy of nudging treatments.

E3.2: How much disagreement among targeted individuals is bearable to still justify a nudge's pro-social implementation?

As previously stated, it is sometimes impractical to obtain unanimous approval from all those being nudged. In such instances, certain nudges may still be deemed morally permissible if they meet additional ethical requirements: Specifically, it has been shown that nudges do not result in any discernible evidence of moral transgression on the individuals being nudged (Clavien, 2018).

The text suggests that social welfare nudges can be effective if decision architects can justify their implementation and follow all other aspects of a nudge. In digital contexts, the pro-social aspect can also be extended to valid nudging actions. However, achieving unanimous agreement among those being nudged remains impractical. The proposal is to use digital user research and feedback technologies to gather data on consent and document social and societal preferences. This should be included in presurvey and pre-tests to assess the intervention before it is offered to a public audience. In cases where direct targeting is not possible, nudges can establish a digital platform or network for users to join, allowing them to get voluntary permission without coercion.

Conclusion

The rise of *hypernudging* marks a pivotal evolution in the architecture of behavioral influence, bringing with it both novel capabilities and complex ethical dilemmas. Building upon the foundational work of Thaler and Sunstein (2008), nudging was initially conceived as a tool for public policy that subtly alters choice environments without restricting options or changing economic incentives. However, the digital transformation of behavioral design facilitated by algorithmic decision systems, big data analytics, and artificial intelligence has given birth to hypernudging, a phenomenon that transcends the static, one-size-fits-all approach of traditional nudges.

As this review has demonstrated, hypernudging is defined by four interlocking characteristics personalization, real-time (re)configuration, predictive capacity, and hiddenness (Lanzing, 2018; Mills, 2022). These features not only enhance the precision and adaptability of behavioral interventions but also raise significant concerns about autonomy, consent, and transparency. The personalization of digital nudges, enabled by data-mining and profiling techniques (Porat & Strahilevitz, 2013), allows platforms to target individuals with finely tuned behavioral cues. However, this same personalization risks deepening behavioral inequality (Sunstein, 2021), as interventions may privilege certain user groups while marginalizing others.

Real-time reconfiguration further amplifies the power of hypernudging by allowing digital systems to dynamically adapt interventions based on continuous user feedback. Unlike traditional nudges, which are designed in advance and applied uniformly, hypernudges evolve contextually, making them more responsive but also more opaque (Weinmann, Schneider & Brocke, 2016). This raises epistemic and moral challenges. Users are often unaware of how or why their choices are being shaped in real time, and the sheer speed of algorithmic adaptation may outpace their ability to reflect or resist (Chomanski, 2022; Susser, 2019).

The *predictive capacity* of hypernudging, derived from machine learning models trained on massive datasets, has also transformed behavioral design from a reactive to a proactive practice. Predictive hypernudges are not just shaping current behavior they are constructing futures based on calculated probabilities (DellaVigna & Linos, 2020). In this way, hypernudging becomes a form of behavioral preemption, where user autonomy is subtly replaced by algorithmic foresight. While potentially beneficial for decision-support systems (e.g., health apps or financial planning tools), this also invites concerns about manipulation and control, especially when users cannot access or contest the logic behind the interventions (Burrell, 2016; Pasquale, 2016).

Perhaps most troubling is the hiddenness of hypernudging. Unlike traditional nudges, which are often physically observable (e.g., cafeteria layout changes), hypernudges are embedded in algorithmic infrastructures and digital interfaces, often imperceptibly. As Yeung (2019) argues, these "hypernudges" function as systems of algorithmic governance, subtly but systematically modulating behavior in ways that are difficult to detect and nearly impossible to audit. This challenges traditional notions of informed consent and choice awareness, as users may unknowingly participate in behavioral experiments without understanding their scope or purpose (Zuboff, 2015; Van Dijck, 2014).

The ethical stakes of hypernudging are therefore profound. As demonstrated through the application of Lembcke et al.'s (2019) ethical framework, the legitimacy of hypernudging hinges on key criteria: the preservation of autonomy, the transparency of interventions, and the alignment of the choice architect's goals with those of the user. However, as the literature shows, these conditions are frequently unmet in practice, particularly in commercial platforms driven by profit motives rather than pro-social outcomes (Clavien, 2018; Reisch & Sunstein, 2015). In digital settings, the line between nudging and manipulation becomes dangerously thin, especially when users lack the tools or awareness to push back against algorithmic influence.

This review also highlights the broader societal implications of hypernudging, particularly its role in shaping social norms, collective behavior, and the formation of digital echo chambers.

Through design choices that prioritize engagement and retention, digital platforms can unintentionally or deliberately foster environments that amplify polarization, reinforce biases, and reduce exposure to alternative viewpoints (Fehr & Schurtenberger, 2018; Stok et al., 2016). This raises critical questions about the democratic legitimacy of algorithmically curated public discourse and the responsibilities of platform providers in maintaining a pluralistic and open digital society.

Theoretically, hypernudging challenges the foundational premises of behavioral economics by shifting the locus of choice architecture from human policymakers to autonomous, data-driven systems. As such, it demands a reevaluation of key normative assumptions, including paternalism, consent, and the boundaries between public and private interests. The growing body of literature on *digital behavioral governance* (Yeung, 2016; Frischmann & Selinger, 2016) calls for new interdisciplinary models that integrate insights from information systems, political philosophy, and critical data studies.

From a regulatory perspective, hypernudging exposes the limitations of existing ethical and legal frameworks. Emerging proposals for algorithmic transparency, explainable AI, and data protection rights offer partial remedies but remain underdeveloped in relation to behavioral influence. There is an urgent need to formulate digital choice architecture standards that promote user empowerment, consent, and fairness. Future policy should also address asymmetries of power and information between platform providers and users, ensuring that behavioral interventions serve not only efficiency but also equity and justice.

In conclusion, this review has argued that hypernudging is not simply an extension of nudging it represents a paradigm shift in how human behavior is shaped and governed in the digital age. While offering new tools for influencing decisions, hypernudging also presents significant ethical, societal, and theoretical challenges that must be critically addressed. As digital environments become the dominant context for everyday decision-making, the need to rethink the ethics, design, and regulation of behavioral influence becomes both urgent and unavoidable.

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