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Surrendering Consumption to Artificial Intelligence: Consumer Agency and Responsible Consumption in AI-Mediated Markets

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Abstract

This paper explores the role of Artificial Intelligence (AI) in shaping consumption, and the contribution AI might make to transitioning to a responsible consumption and production regime, in line with Goal 12 of the UN Sustainable Development Goals. This paper draws on Practice Theory, an established framework for studying sustainable consumption practices. Based on this framework, the authors suggest that whilst in traditional consumption, the expertise required to consume resides in human subjects, in AI-shaped consumption this expertise resides in AI algorithms. This may have implications for consumers' agency and can put them at disadvantage. Indeed, the EU has proposed regulations to control the use of AI by providers. The paper draws on two case studies, *Ant Forest*, a Chinese app which prompts consumers to adopt responsible consumption practices and *Mobility as a Service*, a platform-based mobility offering. We find that whilst the former contributes to establishing consumers' expertise in sustainable behavior—for example, through gaming—the latter may remove consumers' choice by performing some of the consumption practices itself, such as selecting sustainable means of transportation. Our contribution is the formulation of a version of Practice Theory which is adapted to AI.

Keywords: artificial intelligence; consumption; practice theory; responsibility; sustainability; trust

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1. Introduction

Goals 11 and 12 of the United Nations' Sustainable Development Goals, respectively *Sustainable Cities and Communities* and *Responsible Consumption and Production*, are relevant to business planners [1]. At the same time, Artificial Intelligence (AI) shapes all domains of human activities, consumption and production [2]. In turn, the move towards responsible consumption and production shapes social practices [3] for sustainability, making consumption and production more sustainable. AI presents a unique opportunity to reshape consumption and production practices to enhance resource efficiency and sustainability. A practical example is the use of smart meters to optimize the energy efficiency of electro-domestic appliances.

The literature on responsible consumption and production has consistently proposed Practice Theory (PT) as a lens to study how human subjects shape their activities (or

practices) to reduce the impact of their consumption, cf. [4]. A question that concerns research is about the extent to which consumers, as human subjects, have real agency over their consumption activities, as some consumption is invisible and out of humans' control. This is the case with the consumption of resources such as heating and energy, of which consumers have little control over who provides them and how [5]. AI can enhance the resource efficiency of human subjects' practices, and at the same time remove some of their agency. However, research has recently highlighted that AI can be prone to errors and hallucinations, which could potentially bring about harm to consumers and the environment due to AI's errors.

The socio-technical development of AI systems vastly outpaces the research into how practices can be monitored and ensured to be "best practices" for the protection of consumers and AI harm mitigation [3]. Nogueira, Lopes [2] characterize the transition to AI's role in the economy and society as an "explosion", with challenges for policymakers and practitioners to monitor and address relevant issues. There is scant knowledge of what AI means for human behavior and for practices performed, or not, by consumers. This is such a crucial issue that the European Union, first in the world, drafted regulations in 2024, with implementation in 2026, in the form of the *EU AI Act 2024*. This regulation addresses the multifaceted risks of *cognitive behavioral manipulation, applications of facial recognition and biometric inferences of social* and *psychological consumer attributes* that AI presents to consumers and human subjects. Furthermore, the act names domains where AI can be particularly consequential for consumers, such as education and healthcare [6]. In the UK, *the Digital Markets, Competition and Consumers Act 2024 (DMCC)* prohibits "dark patterns" or manipulative designs that use AI to manipulate consumers into unwanted purchases or subscriptions [7]. In contrast, contemporary literature positions consumers as active yet vulnerable participants within AI-mediated consumption systems. Consumers benefit from convenience, personalization, and decision-support capabilities offered by AI-enabled platforms, while simultaneously being exposed to algorithmic influence, behavioral steering, and psychologically mediated interactions [8,9]. Therefore, consumers are positioned ambiguously within AI-enabled socio-technical systems, acting both as beneficiaries of enhanced efficiency and as subjects vulnerable to manipulation, reduced autonomy, and digital exclusion [2,10]. One important question is how consumers can be carriers of resource efficiency practices and how their role in diffusing and reproducing these practices will be challenged if there are no human carriers. Current research says very little on how managers can embed AI in employee practices [11] and, we argue, even less about how AI should be embedded in consumer practices or how policymakers should oversee its use to protect consumers, despite its potential to disrupt existing practices (Ibid.)

There is then a risk that the implementation of AI in consumption practices creates disparities and exclusion [2]; for example, when some types of consumers have little digital confidence, known as the "digital divide" [10].

We answered the call by Sloane and Zakrzewski [3] to refine the conceptual framework of social practice theory to fit the role of AI, and Bonetti, Montecchi [11] to investigate how consumers can be engaged in collaboration with AI. The research question that this paper addresses is:

How does AI shape the practices of responsible consumption and production and involve consumers in collaboration between providers and consumers, with the involvement of AI?

The contribution this paper aims to make is to develop knowledge of how AI can shape responsible consumption and production practices and to propose guidelines to discipline the use of AI in such contexts and directions for research. This paper is structured as follows: Section 2 revisits the literature on AI and consumption, Section 3 describes our research perspective, Section 4 describes our methods, and Section 5 presents our findings, followed by discussion and conclusions.

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2. AI and Its Role in Consumption

2.1. AI in Consumption and Production Practices

Artificial intelligence (AI) increasingly shapes consumption and production practices through resource management, decision support and automated service delivery [12]. AI-enabled applications use data-driven insights, personalized recommendations and predictive analytics to improve accessibility and efficiency of products and services [13]. These developments extend AI beyond a supporting technology, towards a practice-shaping force, as competences traditionally exercised by human actors increasingly become embedded within algorithms and automated systems [14]. In consumption contexts, personalized interactions, AI-enabled recommender systems, conversational AI, predictive analytics and virtual assistants emerged as prominent applications [2]. Recommender systems learn from consumers' previous behaviors, preferences, transactional and contextual data [15] to generate personalized recommendations that reduce information overload and support decision-making [16]. Therefore, AI-enabled technologies reduce search effort, increase the relevance of offerings and create more responsive shopping experiences [13,17–19]. However, these capabilities depend on consumers sharing personal information and accepting data-driven recommender systems [20], raising concerns regarding privacy and trust as AI becomes increasingly involved in consumer decision-making [21].

AI also reshapes provider-side practices. Huang and Rust [22] distinguish three complementary forms of AI: mechanical AI, which standardizes repetitive activities; thinking AI, which supports analytical and strategic decision-making; and feeling AI, which facilitates customer understanding and relationship management. These capabilities support activities including segmentation, targeting, positioning and personalized marketing, while AI-driven clustering, profiling and predictive models enable firms to identify consumer groups and tailor marketing activities [23,24]. Big data analytics and AI further enable organizations to move from retrospective analysis towards real-time forecasting and adaptive decision-making across activities including customer relationship management and product development [25]. Beyond supporting consumers and providers independently, AI increasingly mediates interactions between them. Conversational AI technologies, including chatbots and virtual assistants, facilitate information search, product evaluation, engagement and purchasing decisions throughout the customer journey [26]. Voice assistants and smart speakers similarly allow consumers to undertake purchasing activities through natural-language interactions [27]. Therefore, AI-enabled interfaces increasingly filter information, recommend alternatives and mediate purchasing decisions rather than simply providing passive technological support. These developments position AI within the performance of consumption practices and raise questions about the distribution of competences and decision-making between consumers and algorithmic systems. While AI can support consumers by reducing cognitive and informational demands, reliance on algorithmically mediated consumption also raises questions concerning autonomy, trust, transparency and consumer agency. These questions are particularly important where algorithmic systems operate according to commercial objectives that may not necessarily align with responsible or sustainable consumption [28,29]. They provide the basis for examining consumer agency in AI-mediated consumption.

2.2. Consumer Agency in AI-Mediated Consumption

Consumer agency in AI-mediated consumption concerns the extent to which consumers retain meaningful choice and control over consumption decisions, as algorithmic systems increasingly shape information search, evaluation and selection [30,31]. As AI systems assume greater decision-making responsibilities, competence and autonomy become particularly important in determining how consumers delegate decisions to AI

[32,33]. In AI-mediated contexts, consumer agency concerns not only whether consumers make the final choice, but also the extent to which they delegate decision-making competences and responsibilities to AI [30,32–34].

AI-enabled recommender systems illustrate this changing distribution. These systems reduce search effort and cognitive load by filtering available alternatives and identifying options considered relevant to individual consumers [35,36]. However, they can also influence preferences and evaluations through ranking, interface design and recommendation strategies [36]. For example, recommendation mechanisms can generate anchoring and information-cascade effects [35], while their persuasive effects vary according to how recommendations are presented [36]. AI-mediated choice therefore involves more than assisting pre-existing consumer decisions: a system can influence which alternatives become visible, salient and ultimately considered. This creates an important tension between the augmentation and potential displacement of consumer agency. Recommender systems can enhance consumers' capacity to navigate complex markets by reducing information overload and supporting decision-making, yet personalized or opaque systems may also reduce perceived control and raise concerns regarding privacy, transparency and behavioral manipulation [37,38]. Trust consequently becomes important in determining whether consumers accept algorithmic assistance [39]. Consumers may willingly delegate elements of decision-making to AI in exchange for convenience, particularly in routine or low-involvement purchases [30]. However, algorithms may also narrow the alternatives consumers encounter, reinforce existing preferences and potentially weaken opportunities for independent judgement [31].

The implications for agency appear to depend on the degree and form of algorithmic involvement rather than on the presence of AI alone. Moderate AI involvement may support consumer self-efficacy, whereas excessive decisional control can undermine it [34]. Similarly, consumers respond more positively to AI-driven personalization when they perceive that their autonomy remains respected [40], while perceived intrusiveness, privacy concerns and psychological reactance can reduce acceptance and engagement [41,42]. AI-mediated consumption can therefore involve simultaneous processes of empowerment, replacement, personalization and exploitation [43].

This perspective suggests that delegation should be distinguished from a complete loss of agency. Where AI provides information or recommendations, while consumers retain meaningful opportunities to evaluate alternatives and override the system, AI may augment consumer competence. However, as greater responsibility for evaluation, selection and execution is delegated to AI, competences previously exercised by consumers may increasingly reside within the technological system [32,33]. Consumer agency may therefore be redistributed rather than simply present or absent. This distinction is particularly significant for responsible consumption: AI may facilitate sustainability-oriented outcomes, while the extent to which those outcomes represent deliberate consumer practices depends on how much meaningful choice, competence and control remain with the consumer [33].

2.3. AI, Consumer Agency and Sustainable Consumption

AI has potential to support responsible consumption and production, by improving how resources are allocated, used and recovered across consumption and production systems. In energy and infrastructure, AI-enabled real-time data and demand forecasting can coordinate resource consumption and support demand-response management and the integration of renewable energy sources [44,45]. In manufacturing, AI can identify process inefficiencies and support predictive maintenance, reducing waste and energy use [46]. AI can also support circular business models that seek to minimize material use and maximize resource recovery [47], including Product-as-a-Service and platform-based models,

in which consumers access products through digitally mediated services rather than conventional ownership [48,49]. Data analytics and real-time tracking can further support product monitoring and end-of-life processes, including refurbishment, reuse and recycling [50]. These applications illustrate how AI may contribute to systemic changes in resource use and the organization of everyday practices that are required for more sustainable consumption [51].

Transport provides another example of how AI-mediated practices may contribute to sustainability. AI-supported route optimization, traffic coordination and multimodal travel planning can reduce unnecessary resource consumption and environmental impacts [52]. *Mobility as a Service* (MaaS) integrates different transport services around users' mobility needs [53], while AI-enhanced MaaS can facilitate shared and integrated mobility by coordinating transport alternatives through a common interface [54]. Such systems demonstrate that AI can potentially support sustainable consumption, not only by improving the efficiency of individual decisions but also by reconfiguring the material and technological arrangements through which consumption practices are performed. However, greater efficiency does not necessarily produce more sustainable consumption. At an organizational level, AI can support sustainable business models and incorporate resource considerations into decision-making [55,56], while broader evidence associates AI development with smaller ecological footprints, lower carbon emissions and progress in energy transition [57]. Nevertheless, AI is not inherently sustainability-oriented: its contribution to responsible production and consumption depends upon the objectives, management strategies, policies and institutional arrangements within which it is deployed [58]. This distinction is particularly important where AI systems are simultaneously used to optimize commercial objectives such as engagement, conversion and repeat purchasing [28,29].

AI-driven personalization may consequently create tension between efficiency and consumption intensity. By lowering the informational and cognitive effort involved in purchasing, AI-generated recommendations can strengthen purchase intentions [24] and, when optimized for engagement and sales, may contribute to the creation of additional demand [59,60]. These effects are consistent with broader rebound mechanisms, whereby reductions in time, effort or monetary cost associated with consumption can increase use or redirect savings towards other resource-intensive activities [61,62]. Similarly, improvements in energy efficiency may be offset by behavioral and economic responses that increase aggregate demand [62]. Efficiency gains in recommendation, production or distribution therefore cannot, by themselves, be assumed to reduce environmental impacts.

The sustainability implications of AI-mediated consumption also depend on the distribution of agency between consumers and algorithmic systems. AI may augment consumers' capacity for responsible consumption by providing sustainability-relevant information, coordinating complex alternatives or making lower-impact options easier to identify and perform. AI-enabled *gamification* may similarly encourage engagement with environmentally oriented behaviors. Gamification is "the process of making activities more game-like", involving users through competitions and rewards such as points, badges and leaderboards to shape their actions to support overall value creation [63]. Yet, as discussed in Section 2.2, greater delegation of evaluation and decision-making may also reduce the extent to which sustainability-related competences are exercised by consumers themselves. This creates an important distinction between sustainable outcomes facilitated by AI and sustainability-oriented consumption practices in which consumers retain meaningful competence and choice. AI may therefore support more sustainable outcomes, while simultaneously redistributing elements of consumer agency to algorithmic systems.

These tensions are accompanied by ethical, technical and regulatory considerations. The EU AI Act [6] addresses risks associated with AI applications through a risk-based

regulatory framework, reflecting broader concerns surrounding transparency, autonomy and potentially manipulative uses of AI. Technical failures also require careful differentiation: undesirable AI-mediated outcomes may arise not only from model-generated errors, but also from inaccurate, incomplete or outdated data and from failures within the wider digital infrastructure on which AI systems depend. Businesses remain responsible for AI systems deployed within activities such as chatbots, pricing and recommender systems [64], reinforcing the importance of considering AI-mediated consumption as part of a wider socio-technical system, rather than attributing outcomes to AI alone. Overall, the literature indicates that AI's contribution to responsible consumption and production cannot be evaluated solely through improvements in technological or resource efficiency. It also depends on the objectives embedded within AI systems, the consumption practices they enable or intensify, and the extent to which consumers retain meaningful agency within those practices. Therefore, the relationship between AI, consumer agency and sustainable consumption provides an important basis for examining how Practice Theory may need to account for competences and decision-making increasingly distributed between human and technological actors. The next section discusses this.

3. Conceptual Framework: Practice Theory

Practice Theory (PT) is a cultural theory [65] that focuses on social practices as the main unit of analysis [66]. A practice is a *"routinized type of behavior which consists of several elements, interconnected to one another: forms of bodily and mental activities, "things" and their use, a background knowledge in the form of understanding, know how, states of emotions and emotional knowledge"* [65].

To simplify, following Shove, Pantzar [66], constituent elements of practices include *materials* used to perform practices, *competences,* know-how humans possess that enable human subjects to operate on materials—and *meanings,* the value human subjects attribute to consumed products or services. With AI being involved in consumption, we propose a framework adapted from Ibid. [65]:

- *Materials*—hardware such as laptops, smartphones and apps, interfaces with human subjects (e.g., computer and smartphone screens), vehicles and more.
- *Competences*—algorithms, recommender systems, new digital literacies and confidence, reliance patterns, delegation to AI; all these competences may reside in AI instead of in human subjects.
- *Meanings*—trust in automation, expectations of personalization, norms of convenience, simplified life, saved effort and time.

In this AI practice framework, what is called materials can be digital, e.g., apps and other software, and it may be hosted online, e.g., in the cloud. As for competences, situatedness, i.e., the location of the competences, counts. In traditional societies, competences can be stored in the mind of human subjects or committed to printed or digital media. In the case of AI shaped practices, the competences, the "know how"—may be stored in AI algorithms because of delegation to AI. In conventional PT, human subjects are the "carriers" of practices. Therefore, practices are performed and reproduced through humans. In the case of AI-driven practices, whilst consumption practices rely on human–human interaction, such as when a salesman advises a client, conversational agents establish the conversation and interact with (e.g., advise) clients instead.

AI is often seen as a decision support tool and a mediator rather than an autonomous "decider" [67]. However, Moch [68] claims that thought processes, judgement and competences are progressively being delegated to algorithms. For example, in the hospitality industry, the trend is for AI agents to autonomously book hospitality services [32], by which means AI agents take agency away from human subjects by storing information in

algorithms. Despite varying levels of trust by human subjects in this increased AI decision autonomy and its security implications [67], human subjects are increasingly willing to delegate decisions to AI agents, often because of poor understanding of their own capabilities and a belief that AI holds competences that enhance consumers' ability to achieve tasks [32], which can lead to poor delegation decisions [33]. In other words, consumers may abdicate or "surrender" their agency in consumption to AI because of poor confidence in their own competences.

For all the above, AI agents become the carriers of practices, which are reproduced through AI agency. For example, a consumer can order food online, with AI agents making decisions about the delivery of the food and managing the transaction and payment.

Social practices are collective, have scale and are recursive [69]. In AI-shaped practices, these characteristics are due to the diffusion of AI agents supporting consumption, e.g., a travel booking agent. Further, practices are linked with each other, such as work, shopping and mobility practices being interlinked and mutually dependent [70]. Indeed, practices are aggregated in practice constellations [71], a term first used by Schatzki [72]. Constellations are large-scale, interdependent practice bundles and material arrangements [Ibid.], including distributed activities, ends, purposes (meanings in Shove, Pantzar [66]'s), rules and infrastructure, which can be integrated into the *sociotechnical landscape*. Following Shove, Pantzar [65] and Watson [70], we adopt the latter term from Geels [73]. The term denotes external structures of the context of society, e.g., material and spatial arrangements of cities, factories, highways, electricity infrastructures and heterogeneous factors such as economic growth, wars, environmental problems, demographics, political arrangements and cultural values, which shape actors' interactions [74]. To wit, practices aggregate in systems [66] or "bundles" of interdependent practices [75]. For example, the practice of participating in online meetings depends on multiple practices of using digital tools. Finally, the constitutive elements of practices may be tightly or loosely coupled, and the practices themselves are dynamic (they change over time) [76].

There is little research on how AI shapes consumption practices. A question is whether AI apps facilitate online purchases by consumers and encourage consumption only at the acquisition stage and not at the use stage, whereas Shove and Pantzar [65] focus on consumption in the use stage, after acquisition. One conclusion could be that AI encourages conspicuous consumption. The next section presents the methods used.

4. Materials and Methods

This research drew on a case study strategy to investigate how AI shapes responsible production and consumption processes. We use case studies, following Eisenhardt [77], with the aim of building theory or at least illustrating it. Paré and Elam [78] suggest that the same strategy is useful to build the theory of IT implementation. Following Thomas [79], a multiple case study approach was adopted to aid the robustness of the methods and to explore two different exemplars, one where the practices performed by consumers are shaped by AI and the other where AI performs the consumption practices directly. Two case studies, *Mobility as a Service* (MaaS) and *Ant Forest* (AF), are described in Section 5. Case study research enables the study of phenomena within a given context [80] and encompasses diverse methods, including secondary data and the collection of primary qualitative and quantitative data. This study is supported by secondary data, the use of which to build case studies for scholarly purposes is supported by Reddy and Agrawal [81].

The MaaS case study draws on secondary evidence and 34 interviews with users of shared mobility offerings akin to MaaS. Since this data was collected by one of the authors for another purpose and published, the authors took the view that this should be considered secondary data. Participants in that study consisted of a convenience sample of

Hertfordshire (UK) students and staff based at a University and parents of Scout club members, augmented by snowball recruitment. Table 1 summarizes the features of participants in the interviews. The numbers in the "P" column identify each participant in the findings.

Table 1. Demographic characteristics of the interview participants.

Age	Car Owner	Children	Ethnicity	Profession	P	Sex
30–39	Yes	No	white UK	Lawyer	1	Female
20–29	No	No	white EU	Student	2	Female
20–29	Yes	No	Black Afro-Caribbean	Medical	3	Female
20–29	Yes	No	white UK	Other	4	Female
30–39	Yes	No	Indian UK	Other	5	Female
30–39	No	No	white UK	Lawyer	6	Female
20–29	Yes	Yes	Black Afro-Caribbean	Nurse	7	Female
30–39	No	No	white UK	Other	8	Female
20–29	No	No	white UK	Other	9	Female
20–29	No	No	white UK	Counselling	10	Female
40–49	Yes	Yes	white UK	Tradesman	11	Male
40–49	No	Yes	white UK	Other	12	Female
20–29	No	No	Asian UK	Other	13	Female
50–59	Yes	Yes	white UK	Medical	14	Female
20–29	No	No	Asian UK	Other	15	Female
30–39	No	Yes	Black Afro-Caribbean	Student	16	Female
40–49	No	Yes	white UK	Academic	17	Transgender F
20–29	No	No	Asian UK	Other	18	Female
30–39	No	No	Asian UK	Other	19	Female
20–29	Yes	No	white UK	Student	20	Female
20–29	Yes	No	Black Afro-Caribbean	Medical	21	Female
40–49	No	No	Asian UK	Other	22	Female
20–29	Yes	No	Indian UK	Researcher	23	Female
Over 60	No	Yes	Asian UK	Retired	24	Female
20–29	Yes	Yes	white EU	Stay-at-home mum	25	Female
30–39	No	Yes	White EU	Consultant	26	Female
40–49	Yes	No	Indian UK	Academic	27	Female
20–29	No	No	Asian UK	Unassigned	28	Female
30–39	No	No	white EU	Other	29	Female
30–39	No	No	Black Afro-Caribbean	Other	30	Female
30–39	Yes	No	Indian UK	Other	31	Female
20–29	No	No	white UK	Psychologist	32	Female
20–29	Yes	No	white UK	IT Consultant	33	Male
20–29	No	No	Asian UK	IT Consultant	34	Female

The original interview guide listed questions about virtual materials (e.g., apps) and the meanings and routines users connected with their transport practices. This makes the data suitable for this study.

The *Ant Forest* case study draws on secondary data from various sources as listed in Table 2, which also shows examples of secondary data accessed and their sources, and

reports (Ant Group). This is a strategy like netnography, where users' comments accessible through forums are accessed and analyzed [82].

Considering that AF was introduced in 2016, we collected the data between 2016 and 2026. The data collection process, including the key search terms, time period and selection criteria, is illustrated in Figure 1.

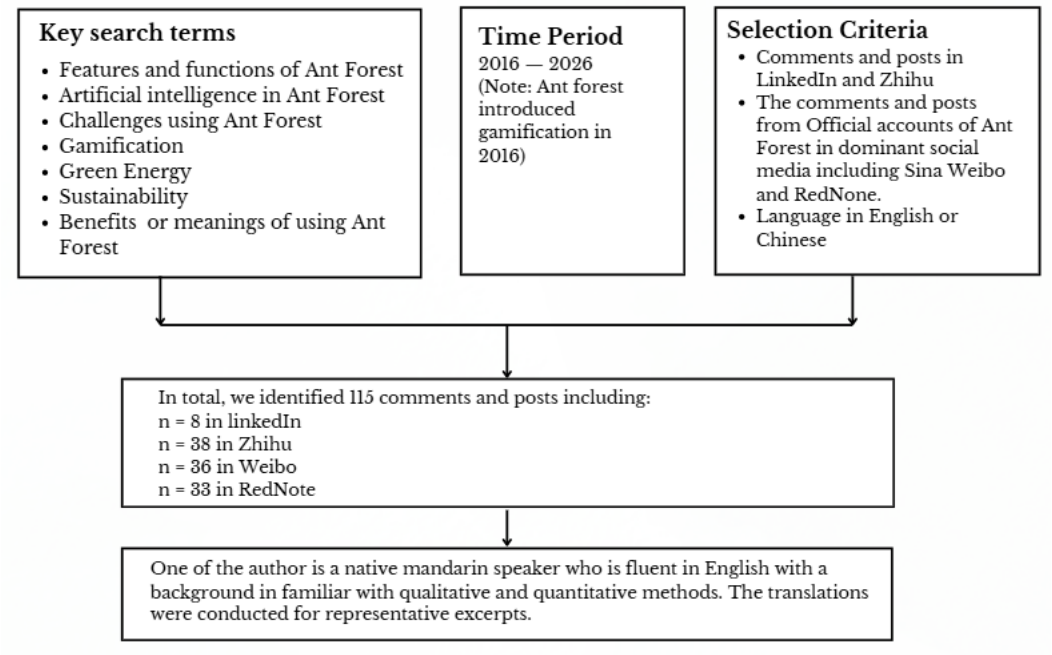


Figure 1. Data collection process.

This [83] part of the Ant Group belongs to the Chinese Alibaba Group [84]. Alipay Version 14 is used by many consumers of Chinese extraction, and their utterances are often in Chinese. Relevant user comments were translated and pasted into Word files, then thematic analysis was conducted to develop themes and identify patterns to generate novel insights. To ensure credibility, this study applied the RIPES model (Reflexivity, Interpretation, Procedural consistency, Evaluation and Situatedness) [85]. The interview transcripts and the diverse qualitative data were coded in NVivo Version 14, a qualitative analysis software package [86], based on a flexible template [87].

Table 2. Examples of secondary data on *Ant Forest*.

Data Category	Sources	Description	Generated Number of Posts/Comments
Forums	LinkedIn	*World's largest professional network and community. People create a professional profile to highlight their resume and work experience and find potential job opportunities. Users write posts and share articles with their connections.*	8
	Zhihu	*Chinese online content community. It offers various categories of content addressing social questions and answers. In 2024, average monthly active users reached 81.4 million. There are diverse topics about AF with multiple comments shared by users.*	38
Social Media	Sina Weibo	*One of the most popular social media platforms or leading microblogging platform in China, equivalent to Twitter. Users use it to discover new things and news, share daily life posts, comments, and microblogs, and catch trendy topics. 578 million*	36

	users in 2025. We collected posts and comments as secondary data via the official account of AF.	
RedNote	*One of the most famous social media and e-commerce platforms with over 300 million monthly active users. It enables users to post, search for tips, share life and connect with each other. We collected comments and posts as secondary data via AF official account in RedNote.*	33

5. Case Studies

To illustrate how AI shapes consumption, we use the two case studies mentioned in Section 4. *Ant Forest* (AF) is a pro-environmental feature within the Alipay app launched in 2016 by Ant Financial Services Group, an Alibaba affiliate in China, using AI technology to enhance public engagement with sustainable behavior. It has over 690 million users and has resulted in 475 million trees being planted and millions of tons of carbon emissions reduced [88]. The other case study is *Mobility as a Service* (MaaS), increasingly governed by AI, which shapes mobility practices and consumption of transportation means.

5.1. Ant Forest

Ant Forest gamifies sustainable behavior for the public through AI technology stimuli, which trigger significant changes in social practices [83]. A comment on a LinkedIn post noted:

> *"Alipay is used by tens of millions of people in China, and through this Ant Forest, a great thing can involve millions of people, which is both ordinary and great!"* (Post ID #2)

Consumers can access AF on Alipay through smartphones and tablets. AF is user-friendly and facilitates seamless operation. AF encourages consumers to use public transportation such as walking and cycling, reuse and recycle goods, pay utility fees and purchase online, go paperless, buy sustainable products, rent shared bicycles and interact with friends via the app. The instances of sustainable behavior are accumulated and calculated into green energy points to nurture saplings, accumulate and swap energy for planting real trees. However, users found the collection of points via AF time-consuming, as they must log in within a limited time window. The AI assistant "Ah Bao" in Alipay Apps helps to collect points, which reduces the amount of work users need to do to use AF. Additionally, the feature allowing friends to help to harvest energy makes AF convenient and functional. As this quote shows,

> *"I would rely on the AI assistant to collect green energy so I could use the saved time to wash up when getting up in the morning."* (Post ID #26)

> *"You can help your network with collecting the energies if they did not visit Ant Forest for a while (…). Also, it will notify your friend of your help. It's a very clever decision to keep people involved in it."* (Post ID #1)

5.1.1. Acquisition of Competences Through AF

Challenges constraining public engagement with sustainability include cognitive bias and lack of knowledge [89]. Diverse low-carbon behaviors will generate virtual green energy points that can be transformed into diverse species of trees. AF offers individualized experiences via recommender systems, enabling users to decide when and where to plant which tree species. During the process, users acquire relevant sustainability knowledge (e.g., low-carbon behavior and footprints, desertification, reforestation, and ecological restoration). In addition, through the *Amazing Species* project, users discover rare new species. A Weibo post states:

> *"I have participated to AF for 3400 days and I chose to plant the Hedysarum Scoparium in Alxa in Inner Mongolia. It has the functions of sand fixation and soil improvement".* (Post ID #35)

A comment from RedNote illustrates,

> *"In the past, few people knew or cared about the Aral Sea, and few people knew about the Prosopis Juliflora tree. Now, the situation is (…) different using AF."* (Post ID #25)

Collaborating with Jifei technology, AF allows users to gain sustainable consumption competencies situated in algorithms that monitor forest growth rates, calculate carbon footprints, and adjust the green energy needed for trees [16]. Users reported,

> *"With technologies such as artificial intelligence […], users can see […] the real impact of their actions. To see sandy plains transforming into forests." (Post ID #1) and "When I see the tree I planted via the satellite map, I realize that there will be big difference from changing low-carbon lifestyle".* (Post ID #16)

5.1.2. Acquisition of Awareness by Consumers

AF has been awarded *a Champions of the Earth* award, the UN's highest environmental honor, recognizing its contributions to planting around 122 million trees and highlighting how AF leverages technology to inspire consumers to behave in a more sustainable manner [90]. As this comment illustrates,

> *"What wakes me up every day is not dreams, but Ant Forest! Every day at 7 o'clock, I set the alarm and get up on time to collect energy (…). I now have 20 environmental certificates."* (Post ID #10)

> *"I walk and bike more now. The game's incentives make walking feel more purposeful… now, I assess how many green points I can get wherever I go."* (Post ID #14)

5.1.3. Controversies of AF

Despite the positives, there are concerns about the authenticity and trustworthiness of whether AF encourages the adoption of sustainable practices. Users complain that they spend a lot of time playing various games advertised by Alipay when using AF. As Zhihu illustrates,

> *"With the popularity of the project, there have been many behaviors of walking and swiping orders online and offline, which (…) violates the original intention of the (…) design and affects the confidence of the participants in the transparency and fairness of the project".* (Post ID #17)

Users can buy green energy from the black market, such as Xianyu, which is China's largest consumer-to-consumer community and marketplace for idle goods. Although AF has responded to this by blocking 26,000 accounts that violated its terms [91], its fairness and integrity are suspicious, as illustrated by the following quote:

> *"Can you believe that the gifts awarded to the top 5 in the leaderboard are being sold on Xianyu for 188 RMB?"* (Post ID #18)

Consumers can also generate points by watching ads and scrolling Alipay's shopping pages without adopting low-carbon behaviors. Additionally, AF held a player-killing competition to foster social impact. Some users find that this is entertaining, but others feel unfair to lose green energy if they fail the game. From a RedNote post:

> *"The AF should stop doing P.K. competitions (…) it's too time-consuming."* (Post ID #33) and *"I feel too anxious about the P.K. competitions and will not use them. AF makes the competition too fierce."* (Post ID #24)

Despite these controversies, users of AF are motivated by themes such as sustainability, altruism, enjoyment, entertainment, social ranking, personal achievement and satisfaction. This means that, assuming that AF is trustworthy, consumers retain their agency and decision autonomy.

5.2. Mobility as a Service

Within a fully integrated MaaS, AI can reduce the amount of work users need to perform to use MaaS apps, which is a significant barrier to adoption. Durand, Harms [92] suggest that the use of basic MaaS challenges users with the amount of work and level of skill needed to use several types of shared mobility. Participants in the study reported a strain from the cumulative work needed to acquire competences to manage mobility apps, which encompass journey planning, booking and ticketing. Even the management of apps themselves is a challenge, as this citation illustrates,

> "*… you tend to go back to the apps you've already got and (make them) work rather than (download another). (…). You know, spend time working out with the [app] you can connect to the (…) mobile data and [must input new registration information (…) to make it work.*" (P26)

The number of smartphone apps required to use MaaS can be overwhelming and induce app fatigue, where users suffer from "overapp" [93]. Participants report that the need to enter additional personal information into the system is a deterrent because of concerns about privacy and long-term commitment. Participants report that means of transport such as car clubs and other vehicle-sharing apps are complicated, as this comment illustrates,

> "*… there's a load of admin that comes with it and a lot of associated cost.*" (P7)

Therefore, the labor-intensive nature and the complexity of MaaS apps may be a deterrent [93]. Participants said that journey planning is cumbersome, as they noted,

> "*The only thing that would put me off is if, it was too complicated, (…) a mishmash of train booking and scheduling, club cars* [and other steps]." (P30)

All this suggests that consuming MaaS requires novel competences compared to just using one's own car. It is no longer simply a matter of getting into a car and driving; many ICT and administrative skills are involved, requiring elevated levels of digital confidence.

5.2.1. AI Contribution

This is where AI may support users in consuming MaaS. As seen in sections 2 and 3, competences which support that part of consumption can be stored in algorithms and recommender systems. This means that AI may integrate the competences consumers need to use MaaS apps and can facilitate MaaS consumption.

A key contribution of AI may lie in enhancing users' perception of safety. AI has the potential to enhance users' confidence and sense of control by enabling them to access information that helps them feel safe. Users can navigate the landscape, track and be tracked by relations, and check the location of vehicles and how crowded they are.

AI embodies competences to match the landscape and the provision available in an area, as well as the identity and professional details of human drivers of manned vehicles. Through smartphone apps, AI grants users access to ID, service-quality rankings and information on quality assurance, certifying drivers' trustworthiness. Services such as Uber can be tailored:

> *"… the whole point is that [AI may] send you a picture of John, you know, in his Toyota Prius 12345, […] give you the registration number, (…) (his) picture, so you know the driver's name and even their phone number.*" (P11)

Participants claimed they used MaaS apps to manage their costs. A participant reported:

> "*… even Google Maps now flashes [up] how much an Uber would be, not that I trust the price, (…) I'd always go and double-check.*" (P23)

So, AI also helps users manage the costs of a journey, acting like a butler. AI is connected to safety hardware, so apps enhance perceived safety, as this citation illustrates,

> "*Most of the stations have got CCTV, which I think's good. Some trains have got it.*" (P9)

Cameras and security hardware can be installed in vehicles and placed inside and around trains, docking stations and other landscape locations. AI provides feelings of control through information,

> "*…it gives me a real sense of security that I know I can just pull out my phone and get Google Maps up or TfL (Transport for London) to see when the next or the last bus or train (…) is going to take me home*"; "*… you know that the app will at least give you a route or a way to (…) get home and that's (…) comforting*." (P28)

Specialist AI also helps: one participant reported that she had downloaded "Find my Friend" on her phone. AI can update users on the correct stops, routes and transfers. Participants reported that they used apps to check the areas they would travel through to see whether these were dangerous areas, thus enhancing safety.

5.2.2. AI Shortcomings

Despite these potential benefits, participants identified several factors that may constrain trust in an AI-enabled MaaS. Our data suggest that human subjects prefer being supported by other humans rather than AI and apps. Some participants claimed that they were reassured by the presence of a driver and service personnel on board, such as the provider's staff, especially where staff members were vetted and safety-trained.

Some participants claimed that they did not notice enough security staff on services or at stations as they had expected. This suggests that AI cannot replace human service staff. Some participants claimed they would prefer walking to using MaaS. AI-driven MaaS apps can be misleading by giving users

> "*a route that goes through a dark alley or a park instead of a well-lit road simply because it is the shortest route…*" (P26) and "*most annoying wasn't like, don't go this way on the path. There was a nice path along the side of the A road that just literally came to a stop….*" (P26)

Thus, there can be a discrepancy between the maps on the system and the landscape. This error could be made by AI, as it would draw on the same data that basic MaaS apps use, and users could attribute this risk to AI, such as the reputed AI hallucinations, which can affect trust.

Importantly, AI depends on energy, as it would have to interface with users through smartphones with limited battery life. Some users mentioned "battery charge anxiety," and feared that a MaaS app failure could leave them stranded. To manage travel, AI would also need to interface with consumers' bank details, which could interfere. As an illustration, a participant shared that during use, the MaaS app did not connect with her bank and a payment failed, so she risked a fine for not having a ticket on board a service. This suggests that with highly integrated MaaS, where AI interfaces with financial services, consumers have little control. Other participants said that switching between vehicles, such as from a train to a bicycle, would be the least safe legs of their journey. This would shape users' expectations and trust in AI acting as an integrator of legs of journeys managed by different providers.

AI-enabled smartphone applications may also be perceived as intrusive, raising concerns about privacy and surveillance. A participant illustrated this by mentioning her suspicions and saying that she worried about being tracked. In summary, using an AI-driven MaaS would involve confidence, reliance patterns and delegation to AI.

A PT perspective would represent users as engaged in complex networks of interlinked practices, including shopping, caring responsibilities and leisure activities. Consequently, AI would need to coordinate not only multiple transport providers but also users' complex daily routines. This presents a considerable technical challenge and raises concerns that increasing reliance on AI could reduce users' agency in planning and adapting their journeys.

6. Discussion

This paper explored how Practice Theory can be adapted to integrate AI, and we propose an enhanced PT framework that accounts for the agency of AI in responsible consumption and production in line with Sloane and Zakrzewski [3]. To illustrate the framework, we assembled two case studies constructed from existing MaaS research and consumer data on *Ant Forest* available on social media through netnography. The results give insights into how AI can shape responsible consumption and production practices. The analysis shows that AI can indeed be beneficial for sustainability, as in the case of the operation of domestic appliances such as washing machines, which smart meters automatically set to 30-degree wash programs. In the case of MaaS, the literature agrees that it presents environmental benefits, because it has the potential to reduce the number of vehicles in circulation, including owned vehicles that are poorly maintained [52,94].

In addition, AI offers opportunities for consumers to learn and establish routines and practices to aid responsible consumption and production. These new practices, if they are adopted, have the potential to reduce the environmental impact of consumption [4].

In "traditional" Practice Theory, human subjects perform practices based on competences and meanings that are rooted in their social context or codified in media. For example, in the study of food practices by Halkier and Jensen [95], cooking practices such as selecting which specific type of cooking oil and in what quantity integrate competences (e.g., the type of oil needed to cook a meal) and meanings (e.g., a type of oil may be unhealthy), which are stored in cultural resources that human subjects share, or possibly these competences and meanings may be codified in media such as cookbooks. In contrast, AI stores competences and meanings, but as described in the case study, the use of gamification in AF encourages users to transfer competences and meanings in their heads, whilst they develop new routines. So, AI can have positive educational outcomes.

In the case of AF, the app shapes consumer behavior. Existing studies have confirmed AF's contributions to customers' low-carbon purchasing practices [56,96]. In contrast, in the case of MaaS, the need to decide is removed with a fully integrated MaaS. Indeed, AI-driven MaaS can facilitate travel by being able to select the most resource-efficient routes and means of transport autonomously.

On the negative side, AI is prone to hallucinations and errors. Outdated maps and wrong routes in the case of MaaS may be inputted into journey plans as a result of human error or due to poor data quality. This may lead to users being stranded, and the reputation of AI for hallucination may have a negative effect on consumer trust [67]. In the case of AF and other apps based on gamification, there is the risk of malevolent content injection [97], where actors with special interests may introduce data into the AI framework that favors products that are not necessarily sustainable. Based on social comparison theory, individuals assess their abilities and value by comparing them with others [98]. The AF friend leaderboard and publicly visible rewards features motivate users to adopt the low-carbon lifestyle but also lead to anxiety and pressure. Users who have low green

points may feel demotivated. Second, the overjustification effect maintains that individuals tend to be less intrinsically motivated to perform an action they enjoy when receiving a reward [99]. Gamification can shift users' low-carbon behavior to pursue points when there is too intense competition.

A further risk is misbehavior by human users using gamified apps such as AF, where they use different devices to report their consumption of green energy and state false performance to get rewards. There is also a danger that gamification is seen just as entertainment, and so the benefit of achieving sustainable practices fails [63]. Finally, AI-driven apps may challenge users who have little digital confidence and skills, referred to as the digital divide [10]. Furthermore, some may be concerned with privacy [93].

A theoretical issue of concern is related to who the carriers of practices are—here, the practices that shape consumption, e.g., using a product in the correct way—may stop residing within human subjects. Therefore, humans might not be the carriers of these practices at all. This raises the question of who is responsible for the reproduction of practices—here, this task might be housed within AI agents. These practices will be faithfully reproduced, but human subjects may lose these capabilities and the ability to learn them, so if AI fails, this might result in the fading [100] of practices and service failure. Therefore, a consequence of using AI may be that some competences may fade from human subjects' minds, so the ability to consume may rely on the functioning of AI agents and the hardware to interface users and on users' digital confidence and trust in AI. For example, using fully integrated AI-driven MaaS apps [54] may mean that people lose the ability to use physical maps. Because of all the above reasons, legislation, regulation and professional practice are essential to protect consumers and suppliers alike.

7. Conclusions

This paper's contribution to theory is to integrate theoretical aspects of the role of Artificial Intelligence in responsible consumption and production with Practice Theory, and we contribute to the literature on responsible consumption and production driven by AI. The resulting theoretical framework attributes key aspects of the performance of social practices to AI, with implications for human agency and possibly autonomy in consumption. With business models such as MaaS and platform-based business models, where consumption practices involve the use of an AI-governed platform (e.g., the delivery of print cartridges or food) and Product as a Service, AI can encourage consumers to develop new competences or govern consumption directly. On the other hand, AI will govern the exchange, and consumers might increasingly lose control.

An implication for policy is that consumers need to be educated about the limitations of AI in conveying correct information, and they should be deterred from "cheating" when competitions and other initiatives are used, through which consumers may seek advantages by declaring false actions. Guidelines should be introduced for providers to ensure that the data AI uses for decisions is up to date. Furthermore, the regulations and legislation protecting consumers from undue influence by AI should be extended.

An implication for practice is that gamification apps need to be designed so that they are fair and transparent. Providers should introduce governance systems that promote fair and good practice by users and the providers themselves; for example, the deployment of multi-source verification to prevent fraud. The gamification mechanism should not deviate from collecting green energy through adopting a more sustainable lifestyle to prioritize game-playing. So, optimization of game settings and adjustment of the rewards structure are important to reduce the anxiety and addiction of competition.

If MaaS apps were fully integrated to involve AI agency, the underlying data would need to be updated to avoid that users are routed to stations and locations that do not exist. Privacy issues related to consumer autonomy, which are affected by limited

personal visibility and control, need to be addressed; transparency regarding how artificial intelligence systems collect, process, and utilize personal information also needs to be improved.

The limitation of our research is that it merely draws on secondary data, including interview transcripts generated for previous research on MaaS, and publicly available consumer data for AF. Future research should address this limitation, by collecting live data to operationalize this framework. A formal backtranslation will be adopted in the future. The translation of comments and posts from social media for AF relies on a single translator is also acknowledged as a limitation.

Directions for research are on whether consumers trust AI and how they can be trained to be able to give their informed consent. At the same time, research should investigate how AI can be transparent about what data it uses and how it uses it. Furthermore, the possibility exists that consumers see AI as a soft target for misrepresenting their purchasing intentions. An important direction for research is the different workings of AI applications in diverse cultural contexts. For example, adaptations of AF, a Chinese app, would need to be used in the West.

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Abbreviations

The following abbreviations are used in this manuscript:

MaaS	*Mobility as a Service*
AF	*Ant Forest*
PT	Practice Theory

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