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Threat to Nature Connectedness: How Does It Influence Consumers' Preferences for Automated Products?

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Abstract: Connection with the natural world is a fundamental human need related to sustainable development. However, such a human need is very likely to be threatened in modern, industrialized society. This paper represents the first attempt to investigate the effect of perceived disconnection from nature on consumers' preference for automated products (e.g., virtual assistants). Based on two surveys (276 adult participants) and one experimental study (282 adult participants), we found that perceived disconnection from nature can magnify consumers' resistance to automated products. We further examined the underlying mechanism through moderated mediation model and revealed that consumers who perceive greater nature disconnection are less likely to perceive automated products as helpful friends, leading to a lower likelihood of adopting these products. The present research unveils this novel effect of perceived disconnection with nature on consumer behavior and provides fresh insight into how consumers' preferences for automated products can be influenced by psychology rather than technology. Additionally, these findings can extend the research regarding sustainable consumption.

Keywords: nature connectedness; biophilia theory; consumer's preferences; automated products; sustainability

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1. Introduction

Human beings enjoy myriad benefits in modern life. Novel technologies, especially automated products, offer far-reaching convenience. For example, virtual assistants and service robots can excel in domains including restaurant recommendations, medical decision making, and customer service [1–3]. Such products are expected to become more anthropomorphic and engage in deeper social interactions with humans in the future [4]. Despite the advantages that automated products offer to modern society, consumers have expressed mixed attitudes toward such devices [5]. In particular, there is growing concern that these technological products may separate human beings from the natural world [6–8], which threatens sustainable development. Consistent with this viewpoint, previous research studied cultural products across decades and found that the frequency of nature-related words is declining substantially in books, songs, movies, and other media [6]. Relatedly, a recent national research report revealed that over 50% of Americans spent no more than 5 h outside in nature per week [9].

The present research posits that automated products may be undesirable when consumers perceive themselves as disconnected from nature. This proposition is built on the biophilia theory, which posits that being connected to nature is a fundamental human need [10,11]. We suggest that individuals will try to reconnect with natural entities after they perceive this need as threatened, leading them to consider automated products as potential enemies rather than friends.

Our research contributes to the relevant literature in several ways. First, nature connectedness is important for a sustainable relationship between humans and the natural

world. Recent empirical studies have begun to examine the relationship between technology and connectedness to nature. For example, prior work noted that growing disconnection from nature has arisen from humans' increasing reliance on virtual and indoor recreation technology (e.g., television and video games) rather than from urbanization alone [6]. However, scarce research has explored whether and how subjective perceptions of nature disconnection may influence consumers' attitudes toward technological products, especially automated products. The current study seeks to fill this gap by investigating such effects.

Second, this research contributes to the literature on consumers' adoption of automated products. In particular, the unique features of automated products (i.e., machines which can perform tasks by themselves and require less engagement by humans) differentiate automated products from other non-automated products. Although the extant literature on consumers' adoption of new products, consumption formats, and commercial systems [11,12], along with research regarding the antecedents of product preferences [13–15], have suggested possible factors that may facilitate or hinder adoption of automated products [16,17], this work seldom looks at the role of people's psychological needs related to sustainable development. Therefore, this study offers direct implications for sustainability and consumer behavior regarding automated products.

The remainder of this manuscript is organized as follows. First, we review the literature regarding some factors which can impact consumers' preferences for automated products. Next, drawing on the biophilia theory, we discuss how and why threat to perceived nature connectedness, as a psychological factor, can influence consumers' preference for automated products, and then propose our research hypotheses. After that, we present three studies to test our research hypotheses. Finally, we conclude with the discussion about theoretical/practical implications as well as future research orientations.

2. Theoretical Background

2.1. Consumers' Preferences for Automated Products

Automated products can perform tasks without much human engagement. For example, some industrial automated products, such as 3D printers or industrial robotics, often work based on rules that have been pre-programmed; as such, these devices can follow orders and perform repetitive and monotonous tasks [18]. In addition, some automated products powered by artificial intelligence can operate and react like a human being [19]. For example, automated products powered by AI such as self-driving cars and virtual assistants can perform tasks involving capabilities similar to human intelligence, such as recognition, learning, social interaction, and decision making [20,21]. In one word, automated products are designed to minimize and replace human efforts.

Consumers' attitudes toward automated products are mixed. In one sense, some individuals believe automated products can function as helpful friends in domains such as education (e.g., virtual teaching assistants) and healthcare (e.g., social robots and nursing assistants) [22]. Yet, despite such benefits, many consumers remain reluctant to adopt automated products [23,24]. For instance, the proportion of consumers who are willing to try self-driving vehicles and AI-powered medical diagnostic systems is quite low [25]. Resistance to automated products may arise from factors related to human psychology. Previous literature found that people are increasingly worried about losing control over automated products as these devices become more and more powerful [22,25]. Other research indicated that people with a desire to express expertise in a particular area (e.g., fishing or cooking) may avoid using related automated products to protect their sense of personal achievement [26].

These phenomena are rooted in a shared psychological concern that automated products pose potential threats to humans' psychological needs [4,27]. This anxiety is also evident in journalistic articles discussing how various job positions may disappear due to the rise of automation and the likelihood that autonomous robots could eventually enslave or even eliminate humankind [28,29]. In light of the preceding discussion, consumers' adoption of automated products largely depends on whether these products are perceived

as helpful friends or potential enemies. This study delineates consumers' perceived disconnection with nature as a novel condition in which automated products can be considered as potential enemies and thus become undesirable.

2.2. Perceived Nature Disconnection and Automated Product Adoption: Effect and Underlying Mechanism

Nature connectedness, as an important construct in sustainability research, refers to individuals' closeness and relatedness with the natural environment [30,31]. Nature connectedness is an important part in biophilia theory [10,32]. The biophilia theory asserts that humans have a fundamental need to connect with the natural environment and affiliate with other life forms in the natural world [10,11]. Research has revealed numerous benefits when individuals forge strong connections with the natural world, such as enhanced cognitive capacity [33], increased mindfulness [34], a greater sense of meaning in life [35], improved psychological well-being [36], and more pro-environmental behaviors [37].

Related work has demonstrated that people seek to satisfy fundamental needs once these needs are threatened. For example, individuals tend to restore social connections with others when their need to belong is thwarted [38]. When faced with growing human–nature disconnection, people also tend to seek reconnection with the natural world [39–41]. For instance, individuals may choose to participate in more outdoor activities or environmental education programs [42,43]. Drawing on findings from earlier studies, consumers may also modify their purchase preferences to satisfy the needs which are threatened [38,44]. However, limited attention has been paid to how individuals rely on consumption to cope with nature disconnection. Thus, this research aims to address this question by examining consumers' preferences for automated products when experiencing nature disconnection.

When perceiving a particular need as threatened, consumers tend to purchase products that can help satisfy that need and avoid products that exacerbate such a threat [45,46]. Relatedly, when perceiving disconnection from nature, consumers tend to choose a lifestyle which enables them to shorten the psychological distance between themselves and the natural environment (e.g., wildlife and natural beauty). Even though automated consumer products (e.g., social robots) can be perceived as living entities similar to animals or other life forms [47,48], such products are inherently unnatural entities rather than natural life forms [49]. In addition, consumers usually associate more human effort investment (e.g., handmade) with high nature connection (e.g., more natural and eco-friendly) [50], while automation aims to reduce the involvement of human effort in using products. Thus, automated products cannot be perceived as helpful when people want to re-connect with the natural world. Instead, reliance on automated products (e.g., artificial intelligence) may ironically heighten rather than reduce perceived nature disconnection because it occupies people's time or effort spent with the real natural world. Accordingly, we propose that consumers who perceive greater nature disconnection are less likely to perceive automated products as helpful friends for restoring nature connection, leading to a lower preference for automated products. The formal hypotheses are as follows:

Hypothesis 1. *Consumers perceiving high (vs. low) nature disconnection will reduce their preference for automated products.*

Hypothesis 2. *The proposed effect is mediated by the reduced perception of automated products as friends among consumers experiencing high (vs. low) nature disconnection.*

2.3. Overview of Studies

Across three studies, the present research investigated whether perceived disconnection from nature can undermine consumers' preference for automated products. Studies 1 and 2 adopt correlational design and provide initial evidence for the association between perceived nature disconnectedness and preference for automated products. Study 3 provides converging causal evidence by manipulating the threat to nature connectedness (vs.

baseline). In addition, this study provides direct process evidence by demonstrating that perceived nature disconnection demotivates people to perceive automated products as friends, which then undermines their preference for automated products. All participants gave their informed consent for inclusion before they participated in this research, which was approved by an appropriate ethics committee.

3. Study 1

Study 1 served as an initial test of Hypothesis 1. Specifically, this study measured perceived distance between humankind and nature through a drawing task and people's preference for AI-powered automated products. The study predicted that people who perceived humankind as more disconnected from nature would indicate lower preference for automated products.

3.1. Materials and Procedure

Eighty-eight participants from Amazon Mechanical Turk (40.9% female, M_{age} = 32.47 years) participated in this study for monetary compensation. Amazon Mechanical Turk is a popular online platform with large numbers of participants. All participants completed two purportedly unrelated tasks. Participants first completed a survey about automated products. In this survey, participants were presented with definitions and several examples of some AI-powered automated products, including virtual personal assistants and smart home devices (see Appendix A for details). Next, we measured consumers' preference for automated products based on a 7-point scale (i.e., "How likely are you to try newly developed AI products in the future?"; 1 = very unlikely, 7 = very likely, adapted from previous literature measuring product preference [16,26]). After completing the survey, participants proceeded to the next task.

In the second task, participants were asked to create a drawing to illustrate their perceptions of human–nature connectedness. This measurement is adapted from prior work [51], which captures the perceived distance between humans and the natural world as the indicator of nature connectedness. Participants were required to open the word processing program such as Microsoft Word on their computer and draw two circles: one circle symbolizing humankind and another symbolizing nature. In the task instructions, participants were reminded to use the distance between circles to represent perceived connectedness between human beings and the natural environment. In other words, the closer the two circles were, the more interconnected human beings and the natural environment were perceived to be. After drawing the two circles, participants saved their documents and uploaded them into the online survey platform. Finally, participants provided demographic information and received a monetary reward for their participation. In particular, we measure participants' gender (1= male, 0 = female), age, income (i.e., "What is your annual household level of income?" 1 = below $20,000, 5 = above $90,000), and education (i.e., "What is the highest degree or level of school you have completed? If currently enrolled, highest degree received." 1 = no schooling completed, 5 = doctoral degree).

3.2. Results and Discussion

For each document that participants uploaded, we used two steps to code data related to the degree of disconnection between the two circles representing humankind and the natural world. First, we coded each circle's position and size (i.e., in centimeters) to determine the location of each circle's center. Next, we calculated the horizontal distance between the centers of the circles as a reflection of the perceived disconnection between humans and nature; a longer (vs. shorter) distance indicated higher (vs. lower) perceived nature disconnection. Then, we regressed participants' preference for automated products on the perceived disconnection between humans and nature. Results revealed that participants' preference for automated products was negatively associated with perceived human–nature disconnection, $B = -0.21$, $SE = 0.07$, $t(86) = -2.92$, $p = 0.005$. In other words, the more disconnected participants perceived humans and nature to be, the less willing they were to adopt automated products. After controlling for participants' gender, age, education, and

income, the effect of perceived human–nature disconnection remained significant, $B = -0.22$, $SE = 0.08$, $t(82) = -2.94$, $p = 0.004$. These results support Hypothesis 1.

4. Study 2

The objective of Study 2 was to further demonstrate the proposed effect by measuring preference for automated products and perceived nature disconnection differently. Rather than measuring perceived disconnection between the natural environment and humankind, this study captured consumers' perceived disconnection between the natural environment and themselves. Moreover, instead of evaluating consumers' general tendency to adopt automated products, this study explored consumers' real consumption behavior in an incentive-compatible manner. We predicted that higher perceived nature disconnection would lead consumers to allocate less money to automated products (vs. non-automated products) when devising purchase plans.

4.1. Materials and Procedure

One hundred eighty-eight participants (51.1% female, M_{age} = 36.66 years) from Amazon Mechanical Turk participated in this study for monetary compensation. Previous research has showed that the amount of money people would like to spend on certain products can reveal their preferences [52,53]. Therefore, we decide to capture people's preference for automated products in a similar way. All participants completed two purportedly unrelated tasks. In the first task, participants were asked to develop a purchase plan for online shopping. To measure participants' preference for automated products in an incentive-compatible manner, we told participants that at the end of the survey, one of them would be randomly chosen to receive a gift card worth US $500. Before learning the results of the lucky draw, participants needed to decide how to allocate this money across product categories. They were then presented with two product categories (automated products vs. non-automated products). Drawing on the paradigms in previous literature [26], we highlighted several major differences between automated and non-automated products (see Appendix B for details). Participants learned that automated products (1) can learn consumers' preferences over time, (2) can easily identify consumers' physical and mental states and provide appropriate suggestions, and (3) can self-learn and rapidly become smarter without human aid. Conversely, in the non-automated product category, participants were informed that these products (1) have a large set of built-in programs for easy operation, (2) store large amounts of data so consumers can follow their own preferences, and (3) are updated frequently by service teams. After reading this information, participants indicated how they would choose to allocate their US $500 budget per category. The portion of the budget allocated to the automated product category served as an indicator of consumers' preference for automated products.

Next, participants completed a 1-item, 7-point scale adapted from prior work measuring perceived nature disconnection (see Appendix C for details) [51]. Overlapping circles represented the relationship between self and nature. Higher (vs. lower) scores, as indicated by the higher (vs. lower) degree of overlap, suggested that individuals perceived themselves as more connected (vs. disconnected) with the natural world. Participants picked the option that best described their relationship with nature. Finally, participants provided demographic information (i.e., we only measured participants' age and gender in this study). A winner was randomly selected to receive the gift card after the study was completed.

4.2. Results and Discussion

We regressed the proportion of money participants allocated to automated products category on perceived nature disconnection (reverse coded). Findings revealed that participants' preference for automated products was negatively associated with perceived nature disconnection, $B = -0.03$, $SE = 0.01$, $t(186) = -2.04$, $p = 0.043$. Essentially, the more disconnected consumers perceived themselves to be from the natural environment,

the less of the $500 they allocated to the automated product category. After controlling for participants' gender and age, the effect of perceived nature disconnection remained significant, $B = -0.03$, $SE = 0.01$, $t(184) = -2.22$, $p = 0.028$. These results replicated those of Study 1, using an incentive-compatible indicator and a different measure of perceived nature disconnection.

Although the results of Studies 1 and 2 were consistent with Hypothesis 1, they did not illuminate the causality of the effect. The next study manipulated (rather than measured) perceived nature disconnectedness to establish a causal relationship. In addition, participants indicated their preferences for a specific automated product rather than a general automated product category. Most importantly, Study 3 shed light on the mechanism underlying the proposed effect.

5. Study 3

Study 3 included two objectives. First, the study induced perceived nature disconnection to test its causal effect on consumers' preference for automated products. Second, this study aimed to reveal the underlying mechanism driving the proposed effect. We expected that stronger perceived nature disconnection would reduce consumers' perceptions of automated products as friends, and thus undermine their preference for such products.

5.1. Materials and Procedure

Two hundred eighty-four participants from Amazon Mechanical Turk participated in this study for monetary compensation. Two participants who were suspicious of our research purpose were excluded from the final data analyses, leaving 282 participants (54.3% female, M_{age} = 39.09 years). Participants were randomly assigned to conditions of a 2 (nature connectedness: threatened vs. baseline) × 2 (product feature: automation vs. non-automation) between-subjects design.

Participants were informed that the study included several unrelated tasks. First, to manipulate nature disconnection, participants were asked to complete a reading comprehension task. This paradigm is found effective when researchers aim to induce threats to human needs [54]. In this task, participants read a short article and wrote a brief summary depending on the study condition. In the threatened connectedness (i.e., perceived nature disconnection) condition, the article explained how humans in modern society are moving away from the natural environment (see Appendix D for details). In the baseline condition, the article discussed a neutral topic unrelated to the natural environment. Participants were asked to summarize the main points of the article in their own words. On the next page, they answered a manipulation check question measuring perceived nature connectedness ("How connected are humans with nature right now?"; 1 = not at all connected, 7 = very connected).

After that, participants proceeded to a consumer product survey in which they were presented with a newly developed digital speaker (i.e., a fictitious brand named "Porvy") and asked to evaluate it. Product features (i.e., automation vs. non-automation) differed depending on the study condition. In the automation (vs. non-automation) condition, participants learned that this digital speaker (1) learned consumers' preferences (vs. had a large set of built-in programs), (2) recommended tailored songs to consumers (vs. stored a large number of songs for consumers to choose), and (3) self-updated without further consumer programming (vs. was upgraded by a dedicated service team). We asked participants to use three keywords to summarize the features of the Porvy speaker to keep them engaged when reading product descriptions. Then, participants indicated their preference for this speaker by answering two questions: "How much do you like the product based on its description?" (1 = not at all, 7 = very much) and "How likely are you to buy this product?" (1 = very unlikely, 7 = very likely), which are adapted from previous research [26]. Responses to these two questions were averaged to form a single index (r = 0.78).

To test the underlying mechanism of the proposed effect, we next measured participants' product perceptions ("Porvy speaker looks like a friend who can help me"; 1 = strongly disagree, 7 = strongly agree). After that, participants were asked to recall the article they had read in the reading comprehension task and respond to questions that measured several covariates, including perceived credibility of the article (i.e., "I think the content of the article is credible"), perceived difficulty in reading the article (i.e., "I think the content is easy to understand"), and engagement when reading the article (i.e., "I paid great attention while reading the article") on a 7-point scale from 1 (strongly disagree) to 7 (strongly agree). Finally, participants completed the same demographic questions as study 1, including age, gender, education, and income.

5.2. Results and Discussion

5.2.1. Manipulation Check

As expected, perceived nature connectedness in the threatened connectedness condition (M = 3.11, SD = 1.45) was significantly lower than in the baseline condition (M = 4.43, SD = 1.67; $t(280)$ = -7.10, $p < 0.001$, d = 0.85), suggesting that the manipulation of perceived disconnection was effective.

5.2.2. Preference for Automated Products

We predicted that consumers' preferences for automated products would be lowered when their perceived nature connectedness was threatened. A 2 (perceived nature connectedness: threatened vs. baseline) × 2 (product features: automation vs. non-automation) ANOVA revealed a significant main effect of perceived nature connectedness ($F(1, 278) = 3.96$, $p = 0.047$, $\eta_p^2 = 0.014$) and a non-significant main effect of product features ($F < 1$, NS). More importantly, the results showed a significant interaction between perceived nature connectedness and product features, $F(1, 278) = 4.19$, $p = 0.042$, $\eta_p^2 = 0.015$, see Figure 1. Planned contrasts revealed that in the automation condition, participants in the threatened connectedness condition (M = 3.59, SD = 1.84) expressed significantly lower preferences for the product than those in the baseline condition (M = 4.44, SD = 1.85; $t(278) = -2.88$, $p = 0.004$, d = 0.46). By contrast, in the non-automation condition, the difference between the threatened connectedness (M = 4.03, SD = 1.74) and baseline conditions was not significant (M = 4.02, SD = 1.64; NS).

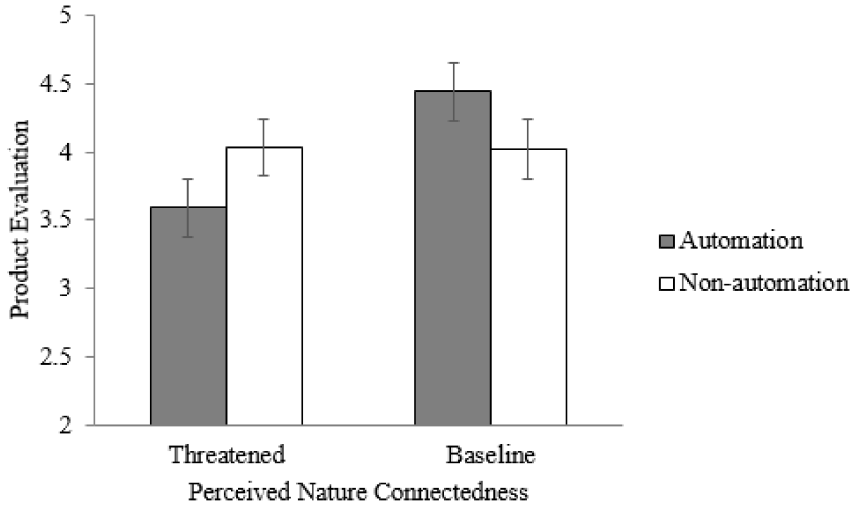

Figure 1. Perceived nature connectedness and product evaluation.

To examine possible effects of other covariates (i.e., perceived credibility of the article, perceived difficulty in reading the article, engagement when reading the article, age, gender, income, and education), we re-ran a 2 × 2 ANCOVA taking all these measures as covariates. Results showed that including these covariates did not change the interaction effect between

perceived nature connectedness and product features, $F(1, 271) = 3.91$, $p = 0.049$, $\eta_p^2 = 0.014$, suggesting that these factors did not influence our focal effects.

5.2.3. Moderated Mediation Model

Next, we tested whether consumers' perceptions (i.e., perceiving the product as a friend) mediated the interactive effect of nature connectedness and product features. We first examined the effects of perceived nature connectedness and product features on consumers' perceptions of the target product. A 2 (perceived connectedness: threatened vs. baseline) × 2 (product features: automation vs. non-automation) ANOVA revealed a marginally significant main effect of perceived nature connectedness ($F(1, 278) = 3.56$, $p = 0.060$, $\eta_p^2 = 0.013$) and a non-significant main effect of product features ($F < 1$, NS). More importantly, a significant interaction was observed between perceived nature connectedness and product features, $F(1, 278) = 14.48$, $p < 0.001$, $\eta_p^2 = 0.050$, see Figure 2. Planned contrasts revealed that when the product is automated, participants in the threatened connectedness condition ($M = 3.26$, $SD = 1.74$) were less likely to perceive the product as a friend than those in the baseline condition ($M = 4.46$, $SD = 1.75$; $t(278) = -4.06$, $p < 0.001$, $d = 0.69$). Conversely, when the product is non-automated, the difference between the threatened connectedness ($M = 3.86$, $SD = 1.85$) and baseline conditions was not significant ($M = 3.46$, $SD = 1.71$; NS).

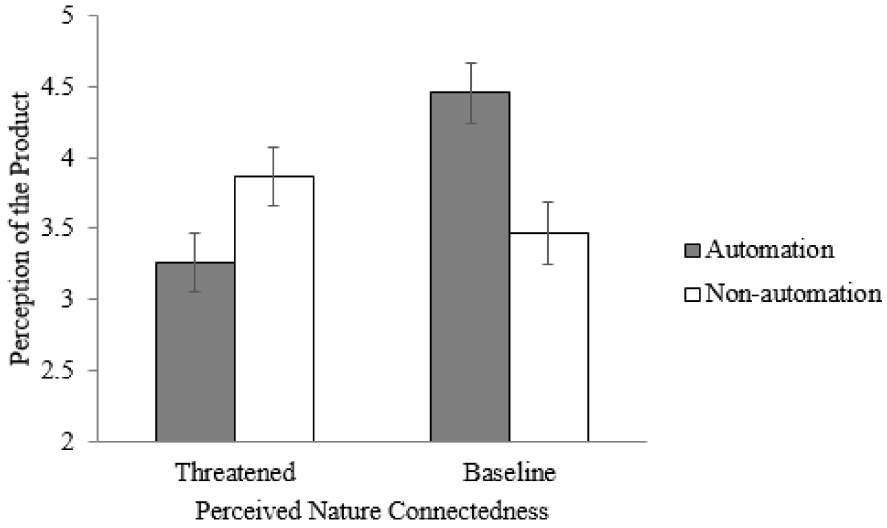

Figure 2. Perceived nature connectedness and product perception.

Next, we coded perceived nature connectedness (1 = threatened, 0 = baseline) and product features (1 = automation, 0 = non-automation). Then, we tested a moderated mediation model [55] using PROCESS Model 8 with 5000 bootstrap samples and a 95% confidence interval (CI). Results indicated that the interaction effect of perceived nature connectedness and product features was mediated by consumers' product perceptions (95% CI = [−1.72, −0.54]). In the automation condition, product perceptions mediated the effect of perceived nature connectedness on consumers' preferences for the product (95% CI = [−1.24, −0.44]); however, the mediation was not significant in the non-automation condition (95% CI = [−0.13, 0.69]). Therefore, these findings support Hypothesis 2.

This study documented that threats to perceived nature connectedness inhibited consumers' preferences for automated products, yet this effect did not hold for non-automated products. These results suggest that when perceived nature connectedness was threatened, consumers were less likely to perceive an automated product as a friend, which undermined their product preferences. These findings present three important implications. First, these results further confirm Hypothesis 1 in that perceived nature disconnection was negatively associated with consumers' preferences for automated products. Second, these findings shed light on the underlying mechanism by indicating that the reduced

perceptions of automated products as friends can mediate the link between perceived nature disconnection and consumers' preferences for automated products.

6. Conclusions

This research shows that perceived nature disconnection can undermine consumers' preferences for automated products. We illuminated the underlying mechanism by demonstrating that perceived nature disconnection may reduce consumers' perceptions of automated products as friends. To substantiate our hypotheses, we either measured or manipulated perceived nature disconnection across three studies. Additionally, we examined consumers' general tendencies to try automated products (Study 1), the actual money participants allocated to an automated product category (Study 2), and preferences for specific automated products (Study 3). All results provided coherent evidence to support our hypotheses.

6.1. Contributions and Implications

The current research contributes to the literature in three major ways. First, prior work has shown that consumers' preferences for automated products are contingent on two seemingly conflicting considerations. On one hand, individuals expect automated products to perform well and may abandon them if such products fall short of consumers' performance expectations [56]. On the other hand, consumers may resist adopting automated products out of concerns that these products may one day become too powerful and threaten human needs [57]. Technological advances can ease the first concern, but the second cannot be addressed by more sophisticated technology. Therefore, it is meaningful to identify psychological factors that may heighten consumers' concerns about automated products. Different from previous literature exploring psychological characteristics related to consumers' sense of self (e.g., autonomy and unique identity) [4,26], the present research investigates the psychological antecedents of automated products adoption from the perspective of sustainable development. In particular, the present research focuses on the relationship between humankind and the natural world and identifies perceived nature disconnection as a novel antecedent behind consumers' resistance to automated products. These findings provide some insights on the relationships among humanity, technology, and nature. Additionally, the current research opens a promising avenue for future research into other sustainability-related factors (e.g., pro-environmental goal) that may increase or decrease consumers' preferences for automated products.

Second, our research enriches the literature on perceived nature connectedness [6,58]. Amidst growing concern that people are becoming disconnected from the natural world, consumers are more likely to be exposed to related information via the media. Therefore, perceived nature disconnection may be strengthened when consumers read such information. This research marks the first attempt to investigate the impact of perceived disconnection from nature on consumer behavior, which has rarely appeared in prior literature. Particularly, this research can enhance our understanding of the relationship between technology consumption and nature disconnection. Although prior work sought to identify the causal impact of technology consumption on nature connectedness, nearly no papers have investigated whether the reverse causal effect (i.e., the effect of perceived nature disconnection on technology consumption) holds [6]. Therefore, our research fills this gap. In addition, by investigating the consumption consequence (e.g., avoiding choosing automated products) of threat to nature connectedness, our paper contributes to biophilia theory by showing people's coping strategy (i.e., changing their product preference to buffer such threat) when their innate needs to connect with nature are threatened.

Finally, the findings of our research also carry managerial implications for policy makers or marketers. Although there is a growing concern that automated products can pose threats to humanity, such type of products can still be beneficial to humans when they are used properly in certain situations. Thus, we can consider highlighting the friendliness rather than competence of automated products when utilization of automated

products (e.g., virtual assistants, medical artificial intelligence) can indeed benefit the potential consumers.

6.2. Future Research

Our research explores how and why threats to nature-connectedness can influence the preference for automated products. Scholars can extend the current research in the future. First, while we collect data from Mturk users, other scholars can consider different samples when working on related topics. Specifically, future research can investigate how some cultural and demographic variables can themselves influence people's preference for automated products. Second, future research can consider different types of scales when measuring people's automation adoption and nature connectedness so as to enhance the generalizability. For example, recent research has developed scales for measuring the acceptance of automated technologies [59] and consumers' willingness to use the technology [60]. Besides, other research papers also provide us with various measurements of nature connection [61,62]. Utilization of different samples and measures can thus help us gain a deeper understanding of the association between nature connectedness and consumer preference for automated products.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the studies.

Data Availability Statement: The data presented in this research are available on request from the first author and the corresponding author. The data are not publicly available to protect the confidentiality of the participants.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Instructions Used in Study 1

Thank you for participating in our survey. In this survey, we are interested in your opinions about smart products powered by artificial intelligence (AI).

With the advancement of modern technology, we can find more and more products which adopt artificial intelligence. By definition, AI refers to the capability of a machine to imitate intelligent human behavior.

Here are several major examples of artificial intelligence that you're already using every day.

(1) Virtual Personal Assistants

Siri, Google Now, and Cortana are all intelligent digital personal assistants on various platforms (iOS, Android, and Windows Mobile).

(2) Smart Cars Google's self-driving car project and Tesla's "autopilot" feature

(3) Smart Home Devices A thermostat that knows when you're home and adjusts the temperature accordingly can help you save money by not heating the house when you're out.

(4) AI in games and matches

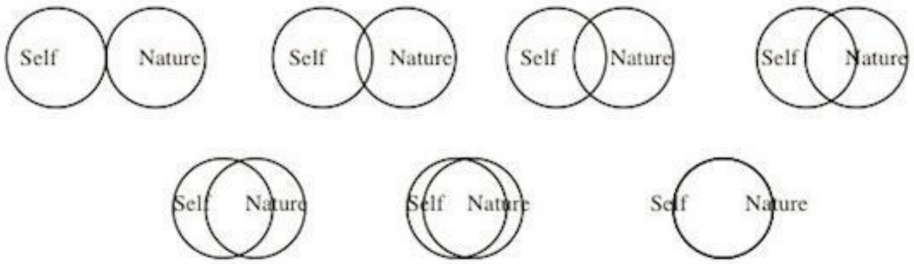
Alpha Go, an AI good at playing Go (a game played with black and white pieces on a board of 361 crosses); Open AI, an AI good at playing Dota (a famous strategy game on the computer)

Appendix B. Instructions Used in Study 2

Automation	Non-Automation
This category covers digital products that are powered by AI. AI enables these products to learn your preference over time.	This category covers digital products that are powered by advanced technology that does not depend on AI. These products usually have a large set of built-in programs available for simple operation.
AI products can easily identify your body and mood states even better than you do and make proper recommendations.	These products allow you to store large amount of data so that you can easily follow and subscribe to what you like.
Thanks to AI, they can also self-learn without further programming by you and become smarter at a rate you cannot imagine.	The companies supporting these products also maintain and provide software updates for the products from time to time.
Some exemplary products in this category include AI speaker and AI home assistant.	Some exemplary products in this category include high sound quality speaker and all-in-one remote control for your home.

Appendix C. Measurement of Perceived Nature Disconnection in Study 2

Please circle the picture below that best describes your relationship with the natural environment. How interconnected are you with nature?



Appendix D. Manipulation of Perceived Nature Disconnection in Study 3

Appendix D.1. Disconnected from Nature (Threat to Perceived Nature Connection)

Humans evolved in natural environments and possess an innate need to affiliate with other living things. However, nowadays people are getting disconnected from nature.

In a world governed by consumerism, people seem less focused on the natural environment. A recent Nielsen global online study found that many of respondents are not so willing to pay extra for sustainable offerings.

This survey also suggests that many people do not connect themselves with nature and rarely take steps to get in touch with Mother Earth. The world is becoming much smaller, as it is becoming almost second nature to chat with somebody on the other side of the world, or across town (or even simply in a different room) with a quick text, instant message, call, video call or email within arm's reach. However, people gradually forget what Mother Earth looks like.

More and more people are indeed shifting away from nature. "We are living a very different way than our ancestors. I don't think we see as much nature in our lives as our grandparents or grand grandparents did. I feel I can survive in today's world without much of nature affecting me," said John, a postgraduate student.

Appendix D.2. Impressionism (Control Condition)

Impressionism is a 19th-century art movement characterized by relatively small, thin, visible brush strokes; open composition; emphasis on accurate depiction of light and its changing qualities (often accentuating the effects of the passage of time); ordinary subject matter; inclusion of movement as a crucial element of human perception and experience; and unusual visual angles. Impressionism originated with a group of Paris-based artists whose independent exhibitions brought them to prominence during the 1870s and 1880s.

The Impressionists faced harsh opposition from the conventional art community in France. The name of the style is derived from the title of a Claude Monet work, Impression, soleil levant (Impression, Sunrise), which provoked critic Louis Leroy to coin the term in a satirical review published in the Parisian newspaper Le Charivari.

The public, at first hostile, gradually came to believe that the Impressionists had captured a fresh and original vision, even if the art critics and art establishment disapproved of the new style.

By recreating the sensation in the eye that views the subject, rather than delineating the details of the subject, and by creating a welter of techniques and forms, Impressionism is a precursor to various painting styles, including Neo-Impressionism, Post-Impressionism, Fauvism, and Cubism.

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