The Concept, Manifestations, and Causes of Naturalness Preference

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Abstract

"Nature" is often endowed with sacred and benevolent positive values. Although sometimes there is no objective difference between natural and artificial items, people still favor naturally generated things and innate abilities, which is termed "naturalness preference (naturalness preference/naturalness bias)." This paper aims to clarify the conceptual definition of naturalness preference, propose a "three-domain conceptual model of naturalness preference," summarize the development history and specific manifestations of naturalness preference across the domains of natural environment, natural objects, and innate preference, and for the first time attribute its causes to three factors: cognition (psychological essentialism), emotion (positive and negative emotions), and norm (sacred moral values). Future research should deeply explore the negative consequences of naturalness preference, cultural-psychological differences, and its impact on the acceptance of emerging technologies.

Full Text

The Concept, Manifestations, and Causes of Naturalness Preference

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Abstract: "Naturalness" is often endowed with sacred and benevolent positive value. Despite the absence of objective differences between natural and artificial objects at times, people still esteem naturally occurring entities and innate abilities—a phenomenon known as "naturalness preference" or "naturalness bias." This paper aims to clarify the conceptual definition of naturalness preference by proposing a "Three-Domain Conceptual Model of Naturalness

Preference," synthesizing its developmental trajectory and specific manifestations across natural environments, natural products, and talent preference. For the first time, we systematically categorize its causes into three factors: cognitive (psychological essentialism), affective (positive and negative emotions), and normative (sacred moral values). Future research should investigate the negative consequences of naturalness preference, its cultural-psychological variations, and its impact on the acceptance of emerging technologies.

Keywords: naturalness preference, psychological essentialism, morality, acceptance of emerging technology

People generally prefer natural environments or objects and often attribute positive value to natural entities. This psychological tendency of naturalness preference serves as an important criterion for aesthetic judgment, daily consumption, and evaluating others' achievements [**?**, **?**]. Regarding natural environments, people enjoy contact with nature, perceive pristine natural settings as more beautiful than built environments [**?**, **?**], and frequently celebrate nature's healing effects on physical and mental health in literature and art. However, naturalness preference extends beyond the external natural environment, transcending into an abstract, ideational value [**?**, **?**]. For instance, people favor foods labeled "all-natural" over those with additives [**?**, **?**, **?**], prefer handmade goods over machine-made products [**?**, **?**, **?**, **?**, **?**], and revere traditional production methods while rejecting emerging technologies such as gene editing and embryonic cloning [**?**, **?**, **?**], all because the former are perceived as more "natural." At the human level, people view innate abilities and traits as more natural and attribute others' achievements more to talent than effort [**?**, **?**, **?**]. Yet what exactly do people mean by "natural" or "unnatural," and does it necessarily equate to the natural environment? Although scholars have examined naturalness preference from philosophical, ethical, and psychological perspectives, discussions of its conceptual definition, specific manifestations, and formation mechanisms remain fragmented, lacking systematic synthesis of this common psychological phenomenon.

In this paper, we define naturalness preference as a psychological tendency to value naturally occurring entities and people with minimal human intervention. We aim to systematically review its conceptual definition, developmental trajectory, and specific manifestations, propose a "Three-Domain Conceptual Model of Naturalness Preference" and a "Perceived Naturalness Continuum Model," and summarize its formation mechanisms from cognitive, affective, and normative perspectives. Future research should further clarify the conceptual boundaries of naturalness preference, construct more comprehensive theoretical models of its formation mechanisms, examine its potential negative consequences, explore its cultural-psychological variations, and investigate its impact on the acceptance of emerging technologies.

2.1 What is Naturalness?

The concept of "naturalness" is rich and complex. Despite extensive discussion across philosophy, ethics, and psychology, no consensus definition exists. The Cambridge Dictionary defines "natural" as "coming from nature, not made or caused by humans," "innate abilities and inherent characteristics," "pure, without additives," "biological," and "normal." Research on laypeople indicates that the core meaning of "naturalness" involves minimal (or no) human processing, such as the use of chemical additives [**?**, **?**, **?**]. Moreover, research on naturalness preference extends beyond natural environments and objects to the human dimension, where researchers define it as a tendency to view innate abilities as superior to acquired effort [**?**, **?**, **?**].

It is important to note that "naturalness" and "nature" are not equivalent—the former is more conceptually expansive. "Nature" primarily refers to the natural environment or natural objects in a narrow sense, whereas "naturalness" is not confined to objective natural environments or objects but represents a more abstract, ideational value [**?**, **?**]: a psychological preference for things that are "uninterrupted by human intervention" or "innate." For example, people's perception of naturalness in food flavors or handmade goods is not directly related to the natural environment, and the concept of "naturalness" applies not only to natural environments or objects but also to preferences for innate human abilities [**?**, **?**]. Drawing on authoritative dictionaries and empirical research, naturalness preference manifests across numerous domains that seem difficult to capture with a single definition. We therefore propose a Three-Domain Conceptual Model spanning macro-level natural environments, specific natural objects, and the human dimension. Specifically, we define naturalness preference as a tendency to value naturally occurring entities and people with minimal human intervention. Conceptually, naturalness preference can be divided into three domains: natural environments (preference for pristine, non-human-made settings from nature), natural objects (preference for naturally occurring things), and human beings (preference for innate abilities and traits).

Table 1 The Three-Domain Conceptual Model of Naturalness Preference

Domain	Manifestation
Natural Environment	Preference for pristine, non-human-made environments from nature
Natural Objects	Preference for naturally occurring things, including handmade goods
Human Beings	Preference for innate abilities and traits

2.2 The Developmental Trajectory of Naturalness Preference

While most research has documented stable naturalness preference in adults, studies have also identified its early emergence in childhood. Balling and Falk (1982) surveyed participants aged 8 to 70 and found that nearly all significantly preferred natural environments, though preferences varied by age: children and adolescents aged 8–15 favored pristine savanna environments, while older participants increasingly preferred familiar natural settings such as temperate coniferous forests. Balling et al. argued that preference for natural environments likely stems from humans' long evolutionary history in East African savannas. However, Meidenbauer et al. (2019) found that 4–11-year-old children actually preferred urban environments, whereas adults showed stronger preference for natural settings, raising questions about whether naturalness preference is innate or learned.

Beyond natural environments, researchers have also documented children's naturalness preference for foods [**?**, **?**, **?**]. Girgis and Nguyen (2020) found that by age 5, children can distinguish between natural and processed foods. Wilks and Bloom (2022) conducted two preregistered studies comparing American children aged 5–10 and adults regarding preferences for natural versus lab-cultured foods. Results showed that, like adults, children as young as 5 already exhibit naturalness preference: they prefer natural foods over cultured alternatives, perceive them as more natural, tastier, and safer.

Finally, young children also demonstrate talent preference. Lockhart et al. (2013) examined American children across age groups—preschoolers (5–6 years), older children (8–13 years), and college students—asking their views on innate versus acquired traits (including intelligence, courage, charisma, and height). All age groups considered innate traits most natural and enduring, expressed greater willingness to reward those with innate traits, and preferred them as friends, with stronger talent preference beliefs emerging with age. Ma et al. (2023) found similar talent preference among 5–6-year-old Chinese children: even when told two protagonists achieved identical outcomes, children perceived those who succeeded through talent as more competent and warm, expressed desire to learn from and befriend them, and adults similarly rated high-talent individuals as more competent. In summary, across natural environments, natural foods, and talent preference, existing research supports the conclusion that naturalness preference emerges early in childhood, is reinforced by cultural context, and strengthens with age [**?**, **?**].

3.1 Natural versus Built Environments

Having evolved in natural environments for millions of years, humans' preference for nature is deeply ingrained, even constituting an instinctual need [**?**, **?**]. Psychologists conceptualize individuals' connection to and identification with nature as "nature connectedness" [**?**, **?**], encompassing both physical interac-

tion with natural environments and psychological bonding with nature [?, ?]. Extensive research demonstrates that people universally prefer natural over built environments, perceiving nature as more beautiful [?, ?], because contact with nature offers numerous health benefits: physiologically, it reduces hypertension and cortisol while boosting immunity; psychologically, it enhances subjective well-being, alleviates stress, anxiety, and depression, and improves attention and memory [?, ?]. Even viewing nature-related videos, slideshows, and virtual reality simulations can significantly improve emotional states [?, ?].

Current theories primarily explain these positive effects from an evolutionary psychology perspective, emphasizing that human ancestors developed adaptive physical and mental functions for nature during evolution. Representative theories include the Biophilia Hypothesis [?, ?], Savanna Hypothesis [?, ?], and Stress-Reduction Theory [?, ?]. The Biophilia and Savanna hypotheses are similar, positing that natural environments provide essential resources and shelter, ensuring survival, and that humans evolved specific preferences for natural settings that persist today, encoded in our genes. Consequently, humans have an instinctual need to connect with nature, and this preference shows cross-cultural and cross-age consistency [?, ?]. Stress-Reduction Theory, also called "psychoevolutionary theory," argues that humans lived in nature for most of evolutionary history, only recently moving to cities, and may be ill-adapted to urban environments, leading to cognitive and emotional depletion. Thus, exposure to non-threatening natural environments can significantly reduce physiological and psychological stress [?, ?]. Additionally, Attention Restoration Theory proposes that modern urban environments differ dramatically from ancestral natural settings, and that daily life's fast pace depletes attentional resources, prompting people to seek nature to restore depleted attention, particularly voluntary attention requiring effortful control [?, ?].

3.2 Natural Objects and Handmade Goods

People generally consider natural objects superior to artificial ones, exhibiting strong naturalness preference across food, medicine, art, and other consumption domains: even when artificial products match natural ones in appearance, function, or taste, people tend to choose the latter. Research shows that perceived naturalness is the primary psychological mechanism driving food choices [?, ?, ?], with natural products perceived as healthier and more trustworthy [?, ?], and consumers willing to pay premiums for natural foods [?, ?]. Similarly, even when natural and synthetic drugs have no objective differences in efficacy or safety, consumers overwhelmingly prefer natural medications, and physicians tend to recommend them [?, ?, ?]. For artificial foods like cultured meat, despite being more environmentally sustainable and nearly indistinguishable in taste from animal meat, consumers perceive it as highly unnatural and show low acceptance [?, ?]. Moreover, using healthy or unhealthy additives in food production significantly reduces perceived naturalness of ingredients, even without synthesizing or altering the food itself [?, ?]. These findings suggest that

naturalness preference is not based on instrumental considerations like health, efficacy, or practicality, but rather on ideational motivations that endow natural objects with sacred or aesthetic positive values [?, ?].

However, not all human processing triggers rejection. Perceptions of naturalness apply not only to pristine natural objects but also to handmade goods, which people perceive as more natural than machine-made products. This is because handmade production is viewed as a traditional method practiced for millennia, representing a more natural production process [?, ?, ?, ?, ?]. Research shows that compared to automated production, people perceive handmade goods as having more human contact, which better preserves products' natural essence [?, ?]. This contact extends beyond physical touch to the transmission of naturalness-preference values. Furthermore, handmade goods transfer creators' love for nature and positive emotions to products through contact [?, ?, ?, ?, ?, ?, ?, ?]. Many handmade goods (e.g., artwork, food) aim to "replicate nature" or "return to nature," with creators infusing products with respect and reverence for nature—an important manifestation of "craftsmanship spirit" [?, ?]. Conversely, creators consider consumers' strong naturalness preference and invest more time and effort to preserve or enhance products' naturalness to increase price and sales [?, ?, ?, ?, ?, ?]. While machine-made goods offer advantages in standardization, efficiency, and cost savings, machines lack mental capacities [?, ?], involve no direct human-product contact, and mechanically execute human commands without considering naturalness preferences, rendering their products devoid of naturalness [?, ?]. From this comparison, "natural" and "unnatural" are not dichotomous but represent degrees along a continuum of perceived naturalness (Figure 1 [Figure 1: see original paper]): natural objects (or environments) are perceived as most natural, followed by handmade goods, with machine-made products perceived as least natural.

3.3 Talent Preference versus Effort Preference

Naturalness preference extends beyond environmental and object judgments to talent preference in people. Although diligent effort is often considered a virtue [?, ?], people tend to view success based on talent as more natural and believe talented individuals are more likely to succeed. Researchers found that when participants evaluated musicians who succeeded through talent versus effort, explicit and implicit attitudes diverged: although people explicitly valued effortful training, they implicitly perceived talent-based musicians as more natural, more likely to succeed in the future, and more desirable to hire [?, ?]. As noted earlier, young children already show clear talent preference [?, ?, ?].

Moreover, naturalness preference for talent exists not only among laypeople but also among music experts [?, ?]. While experts value effort more than laypeople and believe effortful musicians possess greater psychological resilience to cope with setbacks, they still view effort as less natural than innate ability, with lower potential and less likelihood of achieving high success [?, ?, ?]. Although researchers suggested talent preference might be domain-specific because music

genuinely requires high innate ability, this preference does not weaken in domains considered more effort-dependent, such as business. People still perceive talented businesspeople as more natural, capable of higher achievement, and more desirable to hire, with experienced entrepreneurs sharing these judgments [?, ?].

Beyond the talent-effort dichotomy, effort itself is perceived as "natural effort" or "unnatural effort," creating a continuum effect similar to Figure 1. For example, athletes using performance-enhancing drugs like steroids are perceived as achieving success through highly unnatural and immoral means [?, ?]. Similarly, cosmetic surgery for appearance enhancement is viewed as unnatural effort compared to dieting or exercise [?, ?]. Thus, people consider effort more natural when it relies minimally on external aids; although effort entails greater cost, achievements based on individual effort are valued more highly [?, ?] and considered more morally virtuous [?, ?].

4 The Causes of Naturalness Preference

Despite extensive philosophical, ethical, and psychological speculation, no research has systematically summarized the causes of naturalness preference. Addressing the three manifestations described above, we propose the first comprehensive framework categorizing its causes into three factors: cognitive (psychological essentialism), affective (positive and negative emotions), and normative (sacred moral values).

4.1 Cognitive Factors

The cognitive cause of naturalness preference primarily manifests as psychological essentialism—the intuitive belief that beneath surface features, all things possess inherent, unchanging, unobservable essential characteristics [?, ?]. A key psychological cause of naturalness preference is the existence of a "essence of nature" in people's naive theories. Evolutionarily, psychological essentialism is an adaptive strategy that enabled human ancestors to quickly identify environmental dangers and increase survival odds [?, ?]. In specific domains, although people may not understand what "essence" abstractly represents, they use more concrete "placeholders" that might receive scientific explanation, such as genes being an important placeholder for human essence [?, ?]. Genetic essentialism—the belief that genes determine organisms' external traits and unchanging inner essence [?, ?]—leads people to embrace eugenics, view traits and abilities as innate and unchangeable, and consequently prefer talent while devaluing effort [?, ?].

Another core mechanism involves people's perception that human modification either destroys or enhances naturalness through the transmission of essence. Rozin et al. proposed the "contagion principle," whereby intangible essence can transfer between objects through physical contact [?, ?]. For example, people generally reject additives in food production as destroying naturalness, regard-

less of health effects, because they perceive unnatural additives as "contaminating" the food's natural essence [?, ?, ?]. Similarly, integrating genes from biologically distant organisms reduces perceived naturalness and increases moral condemnation and risk perception [?, ?]. In short, any addition or alteration "contaminates" natural objects' original essence with non-natural essence, destroying perceived purity. Conversely, handmade goods are perceived as more natural than machine-made products because the creation process transfers creators' positive emotions and naturalness-preference values to products, thereby increasing naturalness.

Another important cause is that natural people or objects possess higher "authenticity" [?, ?, ?]. From a psychological essentialism perspective, the degree to which objects and people reflect natural essence determines perceived authenticity [?, ?, ?, ?]. Authenticity related to natural environments or objects is termed "natural authenticity." Gilmore and Pine (2007) summarized natural authenticity into five principles: stressing materiality (valuing raw materials), leaving it raw (minimal processing), reeking rusticity (earthy quality), being bare (unadorned), and going green (environmental friendliness). Specifically, to display natural authenticity, designers must select raw materials from nature, minimize human processing and over-packaging, create a rustic quality, and incorporate environmental elements [?, ?]. Empirical research shows that natural authenticity enhances trust, transparency, and control [?, ?], and that more natural packaging colors increase perceived product authenticity and purchase intentions [?, ?]. Moreover, people perceive handmade goods as more authentic than machine-made products [?, ?], while unnatural mechanical artifacts or foods (e.g., GMOs, synthetic replicas) trigger aversion to inauthenticity, making consumers perceive them as "adulterated" and provoking disgust, anger, and moral condemnation of production methods [?, ?].

4.2 Affective Factors

Affective causes of naturalness preference include both positive and negative emotions. Positive emotions generate approach motivation toward natural objects, while disgust and fear produce avoidance motivation toward unnatural objects. Environmental psychology research shows that nature contact enhances positive emotions such as high-arousal pleasure and vitality, as well as low-arousal relaxation and calmness [?, ?], while increasing subjective well-being [?, ?]. Similarly, consuming natural or organic foods enhances satisfaction and comfort [?, ?]. Research on handmade goods' naturalness indicates that people believe human touch transfers positive emotions, including love for humanity [?, ?, ?, ?, ?, ?, ?] and positive values like warmth, friendliness, and sincerity [?, ?]. These transmitted positive values make people perceive handmade goods (especially compared to machine-made products) as more natural, increasing purchase intentions.

Negative emotions related to naturalness preference primarily involve disgust and fear. Disgust is a negative emotion evoked by repulsive objects. Evolu-

tionarily, disgust helps humans avoid pathogen transmission and protect safety, serving as a fundamental component of the behavioral immune system; thus, disrupting natural order and potential health risks trigger disgust [?, ?]. Surveys show that artificial foods like cultured meat and GMOs evoke disgust [?, ?, ?], and individuals higher in disgust sensitivity (the trait tendency to experience disgust) more strongly reject artificial foods [?, ?, ?]. Fear manifests primarily in risk perception about emerging food safety, avoidance of unfamiliar objects or uncertainty, and panic about environmental hazards [?, ?, ?]. Additionally, emerging technologies intensify fear of technological tampering with nature, termed "technology neophobia," with higher levels predicting lower acceptance of artificial products [?, ?].

4.3 Normative Factors

The normative cause of naturalness preference manifests as sacred moral values. People generally view the natural world as sacred and "benevolent" [?, ?], believe protecting nature is a moral responsibility, and reject sacrificing nature for economic gain [?, ?]. Some natural objects (e.g., foods) are endowed with sacred moral value [?, ?, ?]. Research shows that sacred moral beliefs are the primary reason for preferring natural foods, while trust in science or assessment of artificial foods' benefits and risks are secondary [?, ?]. Regarding GMOs, 71% of opponents are "moral absolutists" who view food naturalness as sacred and inviolable, a value that cannot be traded or measured by secular values like money or power [?, ?], with sacred moral values forming in childhood [?, ?]. From moral foundations theory, individuals who value "purity"—including cleanliness and temperance—more strongly reject vaccinations [?, ?] and GMOs [?, ?]. Furthermore, sacred moral beliefs about nature partly derive from religious connotations: Westerners believe scientists are "playing God" by using emerging technologies to forcibly alter nature, disrupting natural evolutionary laws and violating nature's sacredness [?, ?]. These moral judgments about food naturalness even generalize to consumers themselves: people perceive natural food consumers as more moral and trust them more in economic games [?, ?].

Why people endow natural objects with sacred moral value remains debated. Some scholars find that disgust toward non-natural products or trait-level disgust sensitivity primarily drives moral judgments [?, ?, ?]. Others argue that not all non-natural products evoke disgust, and that perceived potential risks and harm [?, ?] or fear of the unknown [?, ?, ?] predict naturalness preference better than disgust. However, most existing research relies on self-report measures, inevitably susceptible to social desirability biases; future studies should use implicit measures to clarify the moral psychological mechanisms of naturalness preference.

4.4 Summary and Critique

Although numerous studies have examined naturalness preference, no literature has systematically summarized its causes. This paper provides the first comprehensive synthesis from cognitive, affective, and normative perspectives, advancing beyond previous work but requiring further integration. First, although research confirms these three factors cause naturalness preference, from an evolutionary psychology perspective they may not be primary causes. As discussed in Section 3.1, scholars argue that humans' long evolutionary history in natural environments has made nature preference an instinctual need [**?**, **?**], suggesting evolutionary factors may be primary, with cognitive, affective, and normative factors being secondary. That is, innate preference for nature leads to cognitions, emotions, and norms related to nature, which are learned sociocultural factors that further reinforce naturalness preference values. Future research should integrate evolutionary psychology to clarify interactions among different causes, distinguishing primary from secondary factors to construct more systematic theoretical models. Second, this paper explains causes through three manifestations, but the three domains—natural environment, natural objects, and talent preference—differ substantially. The three causes we summarize may not apply equally to each domain; for example, normative factors may be less relevant to talent preference. Future research should examine domain-specific causes and explore whether these factors can be integrated. Overall, research on naturalness preference concepts and causes remains in early stages, presenting opportunities for development along these directions.

5 Summary and Future Directions

Naturalness preference is a common heuristic and deeply rooted value bias, ubiquitous in daily life. Although philosophy, ethics, and psychology have discussed this phenomenon, research remains plagued by conceptual ambiguity and unclear causal mechanisms. This paper proposes a Three-Domain Conceptual Model of naturalness preference, defining the concept more specifically across natural environments, natural objects, and talent preference, and systematically reviews its developmental trajectory, manifestations, and formation mechanisms. However, substantial research gaps remain, and many topics require further "pioneering" work. We suggest three directions for future research.

5.1 Negative Consequences of Naturalness Preference

People tend to attribute positive value to natural environments and objects [**?**, **?**, **?**, **?**]. While natural environments and objects indeed benefit human health, naturalness preference itself is not inherently problematic. However, people often overlook its negative consequences and underestimate human intervention's role: human processing makes naturally toxic or bacteria-laden foods safer and tastier, and many synthetic drugs (e.g., penicillin) have saved millions of lives. The value of natural environments or objects should be "neutral" [**?**, **?**]. Believing natural objects are necessarily "sacred" and "benevolent"

while ignoring potential harms commits the "naturalistic fallacy" [?, ?]. Research shows that "natural" labeling in cigarette advertisements reduces public awareness of smoking risks, and even explicit health warnings fail to diminish interest in "natural" cigarettes [?, ?]. Importantly, naturalness preference is a major cause of anti-science beliefs [?, ?]; individuals who prefer natural medicine and natural immunity more strongly reject COVID-19 vaccination [?, ?, ?]. Companies exploit consumers' naturalness values through deceptive marketing, such as "greenwashing": advertising products as environmentally friendly with "natural," "green," or "eco-friendly" visual designs while taking no actual environmental measures. While greenwashing companies bear primary legal and moral responsibility, consumers' lack of critical evaluation of "natural" labels also enables such practices.

Given these potential negative effects, psychologists urgently need strategies to attenuate naturalness preference. Scholars have attempted rational persuasion using scientific evidence to explain synthetic drugs' safety and efficacy, informing participants that some natural drugs are also harmful [?, ?, ?, ?, ?]. Others have explained the subjectivity of naturalness preference [?, ?] and people's misguided expectations of "natural" products [?, ?], finding these interventions significantly reduce naturalness preference. However, most research holds positive value assumptions about naturalness preference, with few studies addressing its attenuation. Future research should examine negative consequences and scientifically popularize beneficial "non-natural" products, using "nudge" techniques such as setting default options, increasing availability of "non-natural" alternatives, and providing descriptive social norm information to correct biased views and irrational consumption behaviors resulting from naturalness preference.

5.2 Cultural-Psychological Variations in Naturalness Preference

Future research should also investigate cultural-psychological variations in naturalness preference. Most existing research focuses on Western populations, with few studies examining Chinese people's naturalness preference and even fewer comparing cultural differences. A recent study found that although both Chinese and Canadian/American participants showed clear naturalness preference for medicine, Chinese participants' preference was significantly stronger [?, ?], though the mechanisms remain unclear. From a comparative philosophical perspective, Plato's "Theory of Forms" holds that the sensory world is not real, and "Forms" constitute true reality. Thus, from a Western philosophical view, nature should be transformed to approach perfect Forms [?, ?]. Traditional Chinese philosophy, by contrast, has long emphasized harmonious coexistence between humans and nature, with Daoist concepts like "Dao follows nature," "unity of heaven and humanity," and "governing by non-action" reflecting Chinese culture's reverence for following nature [?, ?]. From a socio-ecological perspective, China's traditional agrarian culture depended deeply on natural environments, requiring farmers to adapt to seasonal changes and emphasizing understanding and reverence for natural laws [?, ?]. These perspectives may ex-

plain East-West differences in attitudes toward nature. Recent research found that Chinese Taoists show stronger naturalness preference than atheists [?, ?], suggesting that religious beliefs and traditional cultural ideas shape naturalness preference in Chinese culture. Future research should explore how indigenous religious beliefs and traditional cultural ideas shape different attitudes toward nature across cultures.

5.3 Impact of Naturalness Preference on Emerging Technology Acceptance

Finally, technological development's transformation of nature cannot be ignored. Recent technologies like cloning and gene editing have sparked widespread ethical controversy. The public often feels unfamiliar with and fearful of emerging production technologies and their products [?, ?, ?], believing that genetic modification violates natural laws, breaks species barriers, and disrupts natural evolutionary order, leading to greater rejection [?, ?, ?]. By contrast, people strongly prefer traditional processing methods, viewing ancestral production practices as very natural [?, ?]. For example, compared to gene editing, animal domestication is perceived as more natural [?, ?], indicating that despite both causing genetic change, human labor-driven change is seen as more natural than technological intervention. Understanding naturalness preference can thus help reflect on technology's transformation of nature and explore how to make technology better serve humanity and promote harmonious coexistence.

Yet technological advancement is unstoppable, and humanity has entered the "Fourth Industrial Revolution" of information and intelligence. Technology developers now aim beyond mechanized production to develop Artificial Intelligence (AI) with autonomous learning capabilities that mimic human minds. As highly intelligent artifacts, AI provides numerous conveniences and has become indispensable to societal development, yet remains rejected in some domains. Research shows that even when people cannot objectively distinguish human- from AI-made products, they prefer human labor for products with high symbolic value related to personal beliefs and identity expression (e.g., tattoos) [?, ?], dislike robot-cooked food [?, ?], and aesthetically reject AI-generated art [?, ?]. Researchers have examined factors influencing AI acceptance from perspectives like anthropomorphism, human uniqueness, and individual traits [?, ?, ?], but the "unnaturalness" of machine-made art or food may also drive human rejection of AI, though few empirical studies have explored AI acceptance from a naturalness preference perspective, with only occasional opinion pieces in philosophy and ethics literature [?, ?].

Finally, to cure disease and maximize physical and mental enhancement, scientists and tech companies have developed brain-computer interfaces and smart chip implantation concepts, which are viewed as highly unnatural [?, ?] and raise ethical controversies [?, ?]. Westerners believe scientists "play God" by artificially altering human structure and disrupting natural evolution's sacredness [?, ?]. Chinese culture similarly emphasizes that "the body, hair, and

skin are received from one's parents," leading people to view implanting non-living entities into the body as unnatural and immoral, prompting rejection [**?**, **?**]. In summary, while technological development brings positive impacts, its disruptive transformation of natural objects and evolutionary processes triggers deep-seated anxiety and panic about AI and other emerging technologies. Investigating naturalness preference is thus crucial for understanding public acceptance of various emerging technologies.

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Note: Figure translations are in progress. See original paper for figures.