



Of faith and forks: The role of religiosity and uncertainty in food technology adoption readiness

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ABSTRACT

Novel food technologies, such as genetic editing, cell-cultured foods, and controlled environment agriculture, offer potential solutions to global challenges like climate change and resource scarcity, yet their success depends on consumer readiness to adopt them. This research examines how cultural uncertainty avoidance and religiosity jointly shape adoption readiness for these technologies. Two studies were conducted with participants from Japan (a high uncertainty avoidance culture; $n = 1214$) and Singapore (a low uncertainty avoidance culture; $n = 1189$). Study 1 showed that in Japan, highly religious consumers were more willing to pay for and support novel food technologies than their secular counterparts, whereas in Singapore, secular consumers expressed greater support than more religious consumers. Study 2 demonstrated that symbolic value mediates these cross-cultural patterns, revealing how consumers interpret novel food technologies through identity- and value-based meanings that vary by cultural and religious context. These findings offer theoretical insight into the sociocultural predictors of technology adoption and provide practical guidance for tailoring strategies for adoption readiness across diverse markets.

1. Introduction

The global food system is under immense pressure from climate change, water scarcity, and natural disasters, making horticulture and agriculture critical global issues (Piancharoenwong and Badir, 2024). For instance, dairy shortages in New Zealand disrupt exports, while wheat shortages exist across Europe (Devadoss and Ridley, 2024). As food systems become more interconnected, solutions must also be global. Novel food technologies (NFTs), such as genetic editing, cell-cultured meats, and controlled environment agriculture, are seen as vital for addressing these challenges (Garland, 2021; Jahir et al., 2023). However, adoption readiness varies significantly across countries, shaped by psychological, cultural, and belief-based factors. While existing research often focuses on country-level adoption (Giacalone and Jaeger, 2023) or demand-pull (Bor et al., 2024), less is known about how belief systems influence adoption readiness (Aschemann-Witzel et al., 2023; Friedman and Ormiston, 2022; Pang and Chen, 2024; Schulze et al., 2024). Although consumers have been clustered based on psychographics (Schnack et al., 2024), this paper uniquely examines structural belief systems, particularly religiosity, to understand adoption patterns across diverse groups.

A key cultural factor influencing technology adoption is uncertainty avoidance, which shapes how comfortable consumers are with unfamiliar innovations (Hofstede, 1983). Countries differ substantially on this dimension: Japan scores high on uncertainty avoidance (Index 92; Hofstede Insights, 2024) and tends to prefer stability and clearly defined structures before accepting new innovations (Minkov and Hofstede, 2012; Sunny et al., 2019), while Singapore scores low (Index 8; Hofstede Insights, 2024) and is comparatively more open to change as opportunities for progress (House, 2004). Understanding these cultural orientations provides important context for how emerging food technologies are evaluated (Tuorila and Hartmann, 2020).

However, religiosity further shapes how individuals interpret and respond to emerging innovations, either mitigating or intensifying the effects of uncertainty avoidance. Although religiosity manifests differently across societies, it plays an important role in guiding beliefs, values, and decision-making (Mathras et al., 2016; Riesebrodt, 2010). In high uncertainty avoidance cultures, highly religious individuals may rely on faith to manage anxiety around novel technologies, increasing acceptance through cognitive and emotional support (Septianto et al., 2021; Mathras et al., 2016; Riesebrodt, 2010; Sood and Nasu, 1995), whereas in low uncertainty avoidance cultures, despite greater openness

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to change, high religiosity can still promote traditional preferences that counterbalance cultural receptivity to innovation (Septianto et al., 2021; Sung, 2013).

Japan and Singapore provide contrasting contexts for exploring these influences. In Japan, few citizens describe themselves as formally religious, yet Shinto and Buddhist traditions remain embedded in everyday rituals and food practices (Kavanaugh and Jong, 2020). Singapore, by contrast, has high religious diversity, including Buddhist, Christian, Muslim, Hindu, and Taoist communities, and active state management of inter-religious relations (Neo, 2016). Although religious belief may be less visible at a national level, it remains highly salient within particular groups in both countries. This combination of secular institutions, active religious subcultures, and contrasting levels of uncertainty avoidance makes Japan and Singapore a valuable contrast for examining how religiosity shapes the symbolic meaning and adoption readiness of novel food technologies.

Symbolic value may help explain the interaction between uncertainty avoidance and religiosity in technology adoption. Symbolic meanings are central to how individuals interpret the social or identity-related significance of products and may therefore play a role in how novel technologies are understood (Bernritter et al., 2017). In high uncertainty-avoidance countries like Japan, highly religious people may emphasize the symbolic use of food to reinforce religious values while less religious people prioritize predictability and tradition (Minton et al., 2019; Tsuchiya et al., 2021), whereas in low uncertainty-avoidance countries like Singapore this pattern may reverse, with low-religiosity consumers using NFTs to signal modernity and innovation and highly religious consumers relying more on traditional frameworks (Islam and Chandrasekaran, 2019; Perrea et al., 2017; Sekerdej et al., 2018). Given differences in cultural uncertainty and religious orientations, symbolic value offers a promising psychological mechanism that may help explain variation in adoption readiness.

Although prior research has highlighted individual-level drivers of NFT acceptance, far less is known about how broader sociocultural forces shape adoption readiness (Siegrist and Hartmann, 2020; Albertsen et al., 2020; Schnack et al., 2024). This study fills this gap by examining how cultural uncertainty avoidance (Japan vs. Singapore) and religiosity jointly shape willingness to adopt NFTs and by identifying symbolic value as the mechanism linking these factors. In doing so, it extends knowledge of cultural dimensions and recent cross-country NFT work (Giacalone and Jaeger, 2023) by showing that religiosity operates differently across cultural contexts—sometimes reducing uncertainty and sometimes heightening resistance (Minton and Cabano, 2021; Sekerdej et al., 2018)—thereby offering a more holistic framework for understanding when emerging food technologies gain acceptance across diverse cultural and belief systems.

2. Conceptual background

2.1. Consumer adoption of NFTs

Technological developments in food have drawn significant attention due to their potential to address global challenges like food security, sustainability, and climate change (Frewer et al., 2011; Schnack et al., 2024). NFTs, including controlled environment agriculture, gene editing, and cellular agriculture, offer promising alternatives to conventional food production methods (Giacalone and Jaeger, 2023; Siegrist and Hartmann, 2020). Recent work shows that consumers increasingly associate these technologies with sustainability and efficiency, particularly in vertically farmed or controlled-environment systems (Jaeger et al., 2023; Jaeger et al., 2022). Controlled environment agriculture aims to maximize food production by growing crops in carefully regulated settings, which can accelerate growth and lower the risk of diseases (Broad et al., 2022). Gene editing enables targeted modifications without introducing foreign DNA (Wang et al., 2021), and its acceptance often depends on perceived benefits, naturalness, and transparency

(Ortega et al., 2022; Kilders and Ali, 2024). Cellular agriculture produces edible meat, fish, and plant components directly from cells, reducing animal slaughter and land use (Eibl et al., 2021), yet its acceptance depends on trust, perceived safety, and symbolic concerns about naturalness and morality (Castellani et al., 2025; Baum et al., 2021; da Silva and Conte-Junior, 2024). However, consumer readiness to embrace these advances remains a critical question (Song et al., 2022). Recent work similarly notes that adoption depends on how these technologies are framed and the social values consumers attach to them (Castellani et al., 2025).

Consumers also often lack knowledge about NFTs and may hold misconceptions about their benefits or environmental impacts (Deliza and Ares, 2018). When evaluating unfamiliar technologies, consumers rely on heuristic processing, such as perceiving foods as healthier based on their perceived naturalness (Rozin et al., 2012). This focus on production processes rather than product outcomes can distort risk-benefit assessments (Rozin, 2005; Siegrist and Hartmann, 2020). Additionally, how information is communicated shapes consumer trust (Tversky and Kahneman, 1981), with recent research emphasizing that both message framing and source credibility affect acceptance of emerging technologies (Runge et al., 2018; see also Baum et al., 2021). Trust is critical when direct experience is limited (Frewer et al., 1996; Earle, 2010), and skepticism grows when consumers perceive industry motives as profit-driven (Siegrist et al., 2010).

Other individual-level factors also influence adoption (Giacalone and Jaeger, 2023), including values, emotions, and food technology neophobia (Evans et al., 2010; Krings et al., 2022). Emotions such as disgust can be strong barriers, particularly for unfamiliar concepts like insect-based foods or cultured meat (Hoeffling et al., 2009; Onwezen et al., 2021). Practical considerations, including price, taste, and availability, further shape readiness to adopt (Alemu and Olsen, 2020; Weinrich and Gassler, 2021). Understanding how consumers perceive NFTs, and what drives adoption, is essential, as consumers often hesitate to try novel foods when new technologies merely supplement, rather than replace, existing ones (Siegrist and Hartmann, 2020). However, despite extensive work on individual drivers (Albertsen et al., 2020; Cavaliere and Ventura, 2018; Perrea et al., 2015; Siegrist and Hartmann, 2020), fewer studies examine the role of social and cultural structures, such as religiosity or cultural differences, in shaping group-level interpretations of NFT innovations (Abror et al., 2022; Giacalone and Jaeger, 2023).

2.2. Cultural uncertainty avoidance, religiosity, and adoption of novel food technologies

Understanding consumer adoption readiness of NFTs requires examining cultural and psychological factors such as risk tolerance, innovation attitudes, and social interactions (Siegrist and Hartmann, 2020; Tuorila and Hartmann, 2020). Hofstede's cultural dimensions theory identifies uncertainty avoidance as a key cultural factor shaping responses to unfamiliar technologies (Hofstede, 1983). High uncertainty avoidance cultures such as Japan tend to experience greater discomfort with ambiguity, preferring stability and displaying higher risk aversion, which can reduce openness to new food technologies (Chavas and Nauges, 2020; Tuorila and Hartmann, 2020; Ding et al., 2023). In contrast, low uncertainty avoidance cultures like Singapore are generally more tolerant of ambiguity and more receptive to technological change (Singh, 2006; Tuorila and Hartmann, 2020). These patterns suggest that cultural uncertainty avoidance is a meaningful driver of NFT acceptance (Chavas and Nauges, 2020; Siegrist and Hartmann, 2020), although its effects may differ across social groups—for example, depending on religious values and norms (Minton et al., 2019).

Religiosity, defined as adherence to religious values, beliefs, and practices (Worthington Jr et al., 2003), is a less explored yet important factor in shaping consumer responses to novel food technologies. It influences how individuals interpret uncertainty, and its effects vary across cultural contexts. In high uncertainty avoidance cultures,

religiosity can provide cognitive and emotional support, offering a sense of stability that increases openness to novel technologies despite broader cultural resistance to change (Sekerdej et al., 2018; Minton et al., 2019). Conversely, in low uncertainty avoidance cultures, high religiosity may strengthen preferences for tradition, heightening resistance to innovation (Minton and Cabano, 2021; Sekerdej et al., 2018). Social identity theory further explains these patterns: individuals derive identity and self-esteem from group membership, and religious norms strongly shape attitudes and behaviors (Stets and Burke, 2000; Tajfel et al., 1979; Hogg and Reid, 2006). For example, perceptions of halal value and willingness to purchase halal products differ depending on religious adherence (Jamal and Sharifuddin, 2015), illustrating how religiosity influences consumption decisions more broadly.

It is reasonable to expect that the effect of cultural uncertainty avoidance on NFT adoption varies with an individual's level of religiosity. In high uncertainty avoidance cultures such as Japan, highly religious individuals may draw cognitive and emotional support from their religious communities, which can help them embrace new technologies despite a broader cultural tendency toward resistance (Minton and Cabano, 2021; Sekerdej et al., 2018). In contrast, in low uncertainty avoidance cultures like Singapore, where consumers are generally more open to unfamiliar innovations, low religiosity tends to align with greater receptivity to NFTs (Siegrist and Hartmann, 2020). However, in these same contexts, higher religiosity can reinforce preferences for stability and tradition, increasing resistance to technological change (Minton and Cabano, 2021; Sekerdej et al., 2018). To examine these dynamics, this study investigates how uncertainty avoidance (high in Japan vs. low in Singapore) interacts with religiosity (low vs. high) to shape NFT adoption readiness:

Hypothesis 1. The effect of country (Japan vs. Singapore, reflecting differences in cultural uncertainty avoidance) on consumers' (a) willingness to pay for novel foods and (b) likelihood to support and encourage consumption of novel foods is moderated by religiosity (low vs. high).

2.3. Cultural uncertainty avoidance, religiosity, and symbolic value

One possible explanation for how country differences in uncertainty avoidance and religiosity interact to influence consumer readiness for adopting NFTs is their symbolic value. Symbolic value refers to the meanings people use to express identity, status, or alignment with core values through their choices (Bernritter et al., 2017; Perrea et al., 2015). In the context of novel food technologies, symbolic cues help consumers assess how these innovations fit with their self-concept or desired identity expression (Taufik et al., 2022). Consumers may therefore adopt NFTs when these technologies resonate with their values or support positive identity signaling. For example, choosing fair-trade products may communicate environmental consciousness and social responsibility (Connolly and Shaw, 2006). Individuals are more likely to adopt NFTs when the technologies carry symbolic meanings that align with their values or identities, as value-congruence strengthens motivation and supports identity expression (Taufik et al., 2022; Liu et al., 2021).

The formation of symbolic value is shaped by the interaction between cultural uncertainty avoidance and individual religiosity, which jointly affect acceptance of NFTs (Sekerdej et al., 2018). In high uncertainty avoidance cultures, symbolic value varies by religiosity: individuals with low religiosity may attach limited symbolic value to NFTs, focusing instead on practical considerations (e.g., safety, nutritional value, convenience) to manage uncertainty (Abror et al., 2022), while highly religious individuals may attribute greater symbolic significance to novel foods as expressions of belief systems that provide meaning and stability (Sekerdej et al., 2018).

In low uncertainty avoidance cultures such as Singapore, symbolic value follows a different pattern. Low-religiosity individuals may assign

higher symbolic value to NFTs, viewing them as markers of individuality, modernity, and innovation (Islam and Chandrasekaran, 2019), consistent with a broader cultural emphasis on flexibility and adaptability (Singh, 2006; Tuorila and Hartmann, 2020). In contrast, highly religious individuals may attach lower symbolic value to NFTs, favoring familiar choices that align with traditional and religious norms and perceiving novel foods as potentially conflicting with these values, especially within a broader cultural context of openness and flexibility (Perrea et al., 2017; Sekerdej et al., 2018). Based on this reasoning, we propose:

Hypothesis 2. The effect of the interaction between country (Japan vs. Singapore) and religiosity (low vs. high) on consumers' (a) willingness to pay for novel foods and (b) likelihood of supporting and encouraging consumption is mediated by the symbolic value of novel foods.

Based on the above concepts and hypotheses, the conceptual framework of this research is presented in Fig. 1.

3. Study 1

3.1. Procedure and measures

A total of 1201 participants located in Japan ($n = 601$; 53.7% female), and Singapore ($n = 600$; 51.5% female) were recruited through the Dynata consumer panel. Quota sampling was applied to achieve a sample balanced by gender and age, aligned with national population distributions. The demographic details are shown in Table 1. This study employed a 2 (country: Japan, Singapore) \times 2 (religiosity: low, high) factorial analytic approach. These two countries were deliberately chosen because both are largely secular societies where citizens with faith are highly committed to their chosen religion (Kavanagh & Jong, 2020; Neo, 2016). The research aimed to evaluate perceptions surrounding NFTs, willingness to pay for novel food products, and how individuals support and encourage others to consume products made with NFTs, with differing religiosity levels within each country.

Initially, participants were provided with a comprehensive explanation of NFTs,¹ adapted from (Schnack et al., 2024) to ensure a uniform understanding and applied concepts across the participants. Then, participants were asked about their willingness to pay for food produced using NFTs with the question, "How much more or less would you be willing to pay for a product grown using NFTs compared to a conventionally grown equivalent?", adapted from Duckworth et al. (2022). Responses were recorded on a slider scale ranging from -50 to $+50$, indicating the percentage decrease or increase in willingness to pay relative to the conventionally grown reference product. For ease of interpretation, responses were linearly rescaled to a 0–100 metric. Higher values indicate a greater willingness to pay a price premium relative to a conventional product, with the midpoint reflecting price parity.

They also completed a question on their likelihood to support and encourage others to consume novel foods: "how likely is it that you would encourage people to consider buying foods grown using the novel

¹ **Novel food technologies** refer to innovative methods designed to improve the way we produce food. These technologies include: **Controlled Environment Agriculture:** This method, like vertical farming, allows crops to be grown in controlled indoor environments. It protects plants from unpredictable outdoor conditions, such as extreme weather or pests, and optimizes their growth by carefully managing factors like light, temperature, and water; **Genetic Editing:** This technology enables precise alterations to the genetic material of plants, enhancing their characteristics. For example, it can make plants more compact or resistant to pests, providing better outcomes than conventional growing methods; **Cell-Cultured Food:** This approach grows edible parts of meat, fish, and fruits directly from animal or plant cells, without relying on traditional farming. It allows products like steaks, fish fillets, and fruit purees to be produced more sustainably.

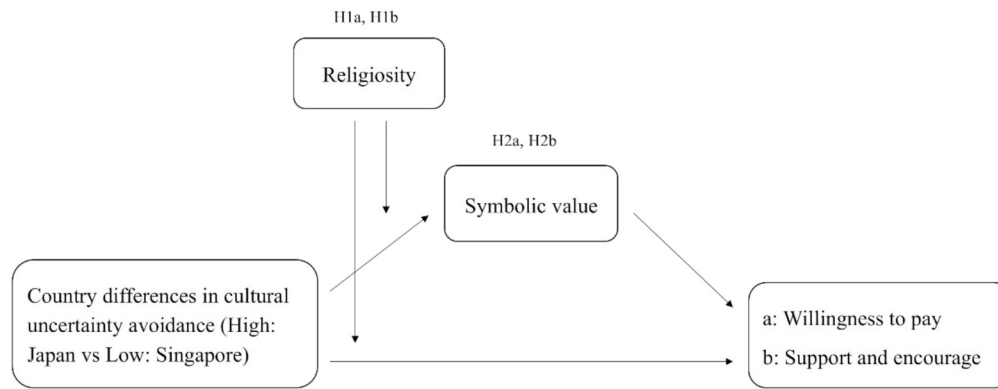


Fig. 1. Conceptual framework.

Table 1 Demographic information.

	Study 1		Study 2	
	Japan	Singapore	Japan	Singapore
Gender				
Male	276 (45.9)	290 (48.3)	285 (46.5)	268 (45.5)
Female	323 (53.7)	309 (51.5)	324 (52.9)	321 (54.5)
Gender diverse	2 (0.3)	1 (0.16)	4 (0.7)	0 (0)
Age				
18–24	69 (11.5)	78 (11.5)	69 (11.3)	70 (11.9)
25–34	111 (18.5)	127 (21.2)	134 (21.9)	122 (20.7)
35–44	123 (20.5)	149 (24.8)	135 (22.0)	138 (23.4)
45–54	145 (24.1)	140 (23.3)	130 (21.2)	141 (23.9)
55–64	153 (25.5)	106 (17.7)	140 (22.8)	116 (19.7)
65+	0 (0)	0(0)	5 (0.8)	2 (0.3)
Religiosity (M)	3.75 (SD = 0.78)	4.27 (SD = 0.87)	3.77 (SD = 0.8)	4.26 (SD = 0.81)

Note: Numbers in brackets show the percentage of respondents.

food technologies?”. The question was measured on a slider scale ranging from –50 (much less willing to encourage others) to +50 (much more willing to encourage others), with 0 indicating no change in willingness; responses were later rescaled to a 0–100 metric for ease of interpretation. Participants then completed a religiosity scale (Choi, 2010), which included items such as *the contribution of religious faith to mental health*, and *the likelihood of religious people maintaining moral standard*. The religiosity was measured on a scale from 1 to 7 (1 = strongly disagree, 7 = strongly agree), with higher scores denoting greater religiosity, and an average was calculated across items ($\alpha = 0.78$). To illustrate the differences between participants with varying levels of religiosity, values one standard deviation (SD) below and above the mean were used to represent low and high religiosity, respectively. This approach follows standard practice in moderation analysis, where conditional effects are estimated at the mean and at ± 1 SD of the moderator (Hayes and Rockwood, 2017). Afterwards, participants were asked demographic questions.

3.2. Results

3.2.1. Willingness to pay

A PROCESS macro (Model 1; 5000 bootstrap samples) was conducted (Hayes and Rockwood, 2017) with country as an independent variable (Japan coded 0 (baseline), and Singapore coded as 1), religiosity as a moderator (-1 below / $+1$ above SD), and willingness to pay as a dependent variable. There was a significant main effect of country on willingness to pay as reported against the baseline (Japan), $B = 24.26$, $t(1197) = 8.85$, $p < .001$. Religiosity also had a significant effect on willingness to pay ($B = 4.50$, $t(1197) = 2.99$, $p < .01$). More

importantly, there was a significant interaction effect between country and religiosity, $B = -3.80$, $t(1197) = -5.65$, $p < .001$. Thus, Hypothesis 1(a) is supported. Full moderated regression results are presented in Table 2.

A spotlight analysis, which helps examine group differences at specific values of a continuous moderator, was conducted to interpret the interaction between country and religiosity. In this study, the analysis assesses the effect of religiosity at low and high levels, using ± 1 SD from the mean as the cutoff points (Fig. 2). In Japan, individuals with low religiosity were significantly less willing to pay for novel food than those with high religiosity ($MJP\&lowreligiosity = 21.43$ vs. $MJP\&highreligiosity = 29.25$; $B = 4.50$ $t(1197) = 2.99$, $p < .01$). In contrast, in Singapore, those with low religiosity were significantly more willing to pay for novel foods than those with high religiosity ($MSG\&lowreligiosity = 58.41$ vs. $MSG\&highreligiosity = 46.44$; $B = -6.90$ $t(1197) = -5.13$, $p < .001$).

3.2.2. Support and encourage

A PROCESS macro (Model 1; 5000 bootstrap samples) was conducted (Hayes and Rockwood, 2017) with country as an independent variable (Japan coded 0 (baseline), and Singapore coded as 1), religiosity as a moderator (-1 below / $+1$ above SD), and support and encourage as a dependent variable. There was a significant main effect of country on support and encourage of novel foods as reported against the baseline (Japan), $B = 18.02$, $t(1197) = 7.59$, $p < .001$. Religiosity also had a significant effect on support and encourage of novel foods, $B = 3.73$, $t(1197) = 2.85$, $p < .01$. More importantly, there was a significant interaction effect between country and religiosity, $B = -2.59$, $t(1197) = -4.43$, $p < .001$. Hypothesis 1(b) is thus supported. Full moderated regression results are shown in Table 3.

A spotlight analysis showed the same pattern as willingness to pay. There was a significant interaction between countries and religiosity (Fig. 3). In Japan, individuals with low religiosity were significantly less willing to support and encourage novel food consumption than those

Table 2 Study 1 moderated regression results: willingness to pay.

Moderated Regression Results: Willingness to Pay			
Predictor	B	SE	t
Constant	7.29	5.77	1.26
Country (Japan, Singapore)	24.26	2.74	8.85***
Religiosity (low, high)	4.50	1.51	2.99**
Country * Religiosity	-3.80	0.67	-5.65***
Japan	4.50	1.51	2.99**
Singapore	-6.90	1.34	-5.13***

Note. Bootstrapping based on 5000 samples. B = unstandardized regression coefficient. SE = standard error.

*** $p < .001$.

** $p < .01$.

* $p < .05$.

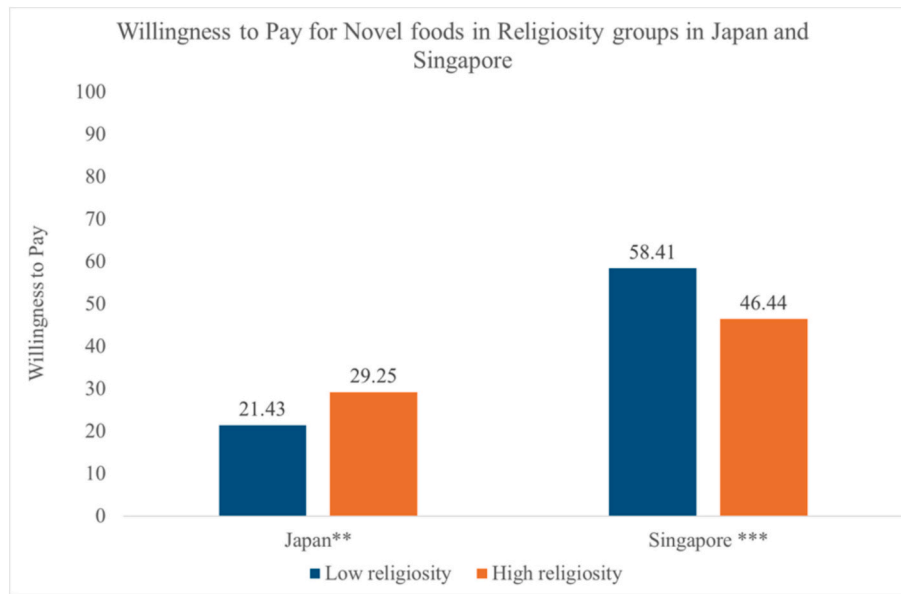


Fig. 2. Willingness to pay for novel foods in religiosity groups in Japan and Singapore.

Note: 0–100 rescaled willingness-to-pay index (higher values indicate greater willingness to pay relative to a conventional product); *** $p < .001$, ** $p < .01$, * $p < .05$.

Table 3

Study 1 moderated regression results – support and encourage.

Moderated regression results: support and encourage			
Predictor	B	SE	t
Constant	26.29	5.00	5.25***
Country (Japan, Singapore)	18.02	2.37	7.59***
Religiosity (low, high)	3.73	1.31	2.85**
Country * Religiosity	-2.59	0.58	-4.43***
Japan	3.73	1.31	2.85**
Singapore	-4.03	1.16	-3.46***

Note. Bootstrapping based on 5000 samples. B = unstandardized regression coefficient. SE = standard error.

*** $p < .001$.

** $p < .01$.

* $p < .05$.

with high religiosity ($MJP&lowreligiosity = 38$ vs. $MJP&highreligiosity = 44.46$; $B = 3.73$ $t(1197) = 2.85$, $p < .01$). In contrast, in Singapore, those with low religiosity were more willing to support and encourage novel food consumption than those with high religiosity ($MSG&lowreligiosity = 67.68$ vs. $MSG&highreligiosity = 60.68$; $B = -4.03$. $t(1197) = -3.46$, $p < .001$).

4. Study 2

4.1. Procedure and measures

In study 2, the purpose was to test the moderated mediation effect of religiosity through symbolic value. A total of 1202 participants were recruited for Study 2, including 613 from Japan (52.9% female) and 589 from Singapore (54.5% female) through the Dynata consumer panel. The sampling process is the same as in Study 1. The demographic information is presented in Table 1. A 2 (country: Japan, Singapore) \times 2 (religiosity: low, high) factorial analytic approach was used, with a different sample from Study 1. The research procedure was similar to Study 1. Participants were initially provided with an explanation of NFTs and were then asked to rate their willingness to pay for novel food products, rate their tendency to support and encourage novel food, rate the importance of symbolic value ($\alpha = 0.85$), and rate their level of religiosity ($\alpha = 0.77$). Symbolic value, adapted from Rahnama (2017)

and Yuan et al. (2022), was measured using five items on a – 50 to 50 slider scale. Higher scores indicated a stronger perception of symbolic value. Sample items include: “I think novel food technology may allow/not allow me to express my self-identity” and “I think novel food technology may help/not help me improve society.” Other measurements including religiosity, willingness to pay for novel food products, and support and encourage novel food are identical to those used in study 1.

4.2. Results

4.2.1. Willingness to pay

PROCESS macro (Model 7; 5000 bootstrap samples) was conducted for moderated mediation analysis with country as an independent variable (Japan coded 0 (baseline), and Singapore coded as 1), symbolic value as a mediator, religiosity as a moderator (–1 below / +1 above SD), and willingness to pay as a dependent variable (–1 below / +1 above SD). The moderated mediation was significant ($Index = -3.51$, $SE = 1.29$, 95% CI: –6.14, –1.06). These results support Hypothesis 2(a). Full moderated mediation regression results are shown in Table 4.

A significant interaction effect between country and religiosity on symbolic value was also identified, $B = -1.3$, $t(1198) = -3.22$, $p < .01$. There was a significant main effect of country compared to the baseline (Japan), $B = 7.41$, $t(1198) = 4.47$, $p < .001$. Religiosity showed a significant effect, $B = 1.96$, $t(1198) = 2.31$, $p < .05$. A spotlight analysis showed a significant difference in symbolic value between low and high religiosity levels (± 1 SD from the mean) (Fig. 4). In a country with a high-uncertainty culture (Japan), consumers with lower religiosity levels exhibit lower symbolic value compared to those with higher religiosity levels, ($MJP&lowreligiosity = 11.44$ vs. $MJP&highreligiosity = 8.13$; $B = 1.97$ $t(1198) = 2.31$, $p < .05$). In contrast, in a country with a low-uncertainty culture (Singapore), consumers with low religiosity exhibited higher symbolic value than those with high religiosity ($MSG&lowreligiosity = 18$ vs $MSG&highreligiosity = 14.74$; $B = -1.93$, $t(1198) = -2.25$, $p < .05$).

4.2.2. Support and encourage

A moderated mediation analysis was conducted using PROCESS macro (Model 7; 5000 bootstrap samples) with country as an independent variable (Japan coded 0 (baseline), and Singapore coded as 1), symbolic value as a mediator, religiosity as a moderator (–1 below / +1

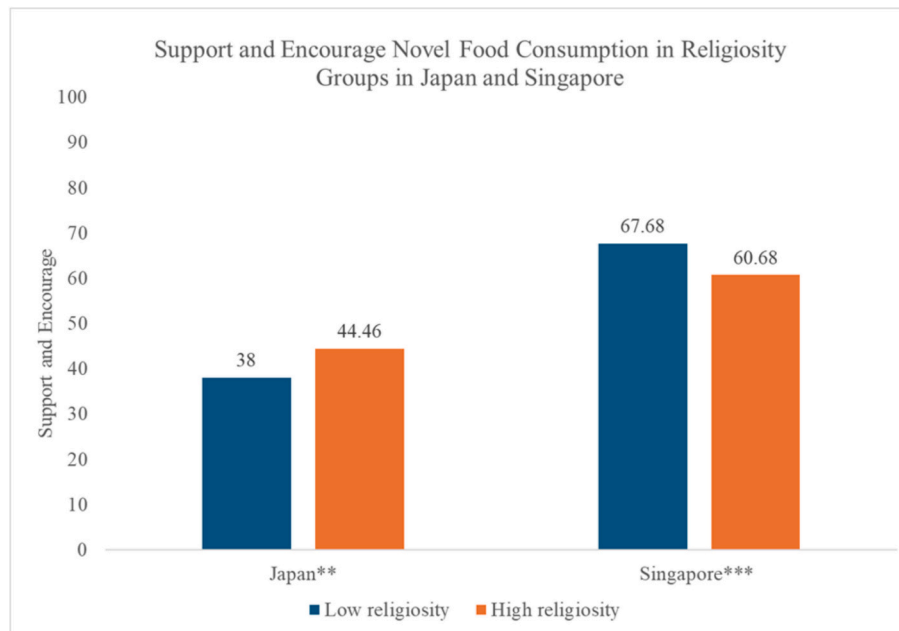


Fig. 3. Support and encourage novel food consumption in religiosity groups in Japan and Singapore Note: 0–100 rescaled willingness-to-encourage index (higher values indicate greater willingness to encourage others to buy foods grown using the novel food technologies); *** $p < .001$, ** $p < .01$, * $p < .05$.

Table 4
Study 2 moderated mediation results – willingness to pay.

	Regression Analysis		
	B	SE	t
<i>M: Symbolic Value</i>			
Country (X: 0 = Japan, 1 = Singapore)	7.41	1.66	4.47***
Religiosity (W: -1 below / +1 above SD from the mean)	1.96	0.85	2.31*
Country * Religiosity (X*W)	-1.3	0.40	-3.22**
<i>Conditional effects of focal predictor</i>			
Japan	1.97	0.85	2.31*
Singapore	-1.93	0.86	-2.25*
<i>Y: Willingness to Pay</i>			
Country (X)	0.52	5.94	11.41***
Symbolic Value (M)	0.05	0.81	17.93***
Index of moderated mediation	Index/ Indirect Effect	Boost SE	95% CI (LL, UL)
	-1.05	0.39	-1.86, -0.29

Note. Bootstrapping based on 5000 samples. B = unstandardized regression coefficient. SE = standard error. LL = lower limit; UL = upper limit.

*** $p < .001$.

** $p < .01$.

* $p < .05$.

above SD), and support and encourage novel food as a dependent variable. The results indicated a significant moderated mediation ($Index = -1.23$, $SE = 0.45$, 95% $CI: -2.13, -0.38$). Hypothesis 2(b) is thus supported. Details of these findings are presented in Table 5.

A significant interaction effect between country and religiosity on symbolic value was also found, $B = -1.3$, $t(1198) = -3.22$, $p < .01$. There was a significant main effect of country compared to the baseline (Japan), $B = 7.41$, $t(1198) = 4.47$, $p < .01$. Religiosity had a significant effect as well, $B = 1.96$, $t(1198) = 2.31$, $p < .05$. Spotlight analysis revealed notable differences in symbolic value between low and high

religiosity levels (± 1 SD from the mean) across different countries (Fig. 4). In Japan, a country with a high uncertainty avoidance culture, consumers with low religiosity exhibited lower symbolic value compared to those with high religiosity ($MJP&low\ religiosity = 11.44$ vs. $MJP\ \&\ high\ religiosity = 8.13$; $B = 1.97$ $t(1198) = 2.31$, $p < .05$). Conversely, in Singapore, which has the low uncertainty avoidance culture, consumers with low religiosity levels showed a higher symbolic value compared to those with high religiosity levels ($MSG&low\ religiosity = 18$ vs. $MSG&high\ religiosity = 14.74$; $B = -1.93$, $t(1198) = -2.25$, $p < .05$).

5. Discussion

5.1. General discussion

This research demonstrates that cultural context and religiosity jointly shape adoption readiness for novel food technologies, with symbolic value emerging as a key psychological mechanism. Consistent with our predictions, Study 1 showed that in Japan—a high uncertainty-avoidance context—more religious consumers were more willing to pay for and support NFTs, whereas in Singapore—a low uncertainty-avoidance context—fewer religious consumers showed greater support. These findings align with prior evidence that religiosity can provide stability under uncertainty, while lower religiosity can align with openness to innovation (Singh, 2006; Tuorila and Hartmann, 2020). Study 2 further revealed that symbolic value explains these patterns, highlighting how consumers use NFTs to express identity and align with culturally grounded values (Bernritter et al., 2017).

These results underscore the importance of understanding how cultural and religious contexts shape consumer interpretations of emerging food technologies. Rather than relying solely on perceptions of risk or unfamiliarity, consumers draw on deeper value systems to decide whether NFTs “fit” with their identities and cultural expectations. By demonstrating that symbolic value mediates these cultural differences, our findings highlight that adoption is not only a matter of technological understanding but also of meaning-making. This offers a more nuanced account of how consumers evaluate NFT innovations across diverse sociocultural settings.

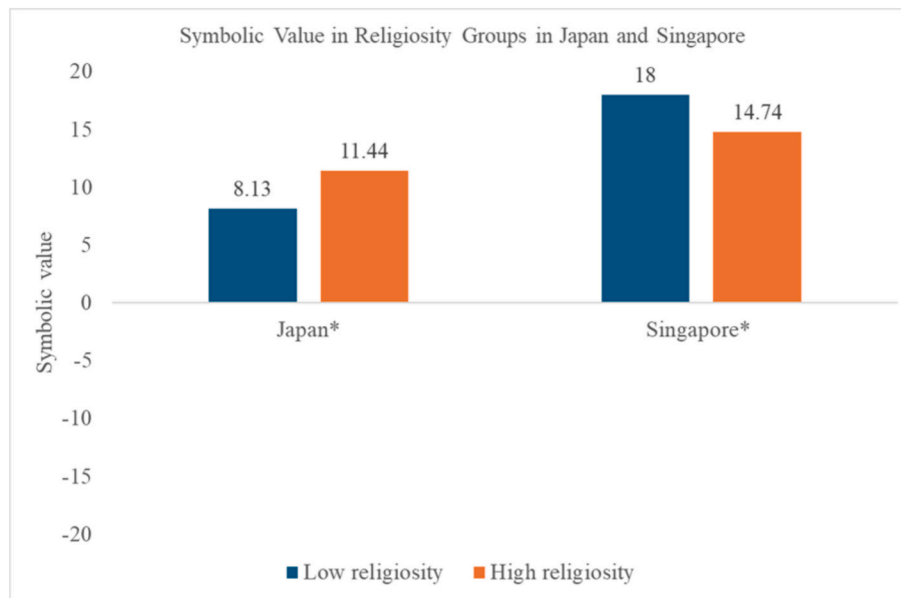


Fig. 4. Symbolic value in religiosity groups from Japan and Singapore
 Note: Scale ranges from -50 to 50; Higher scores indicate greater symbolic value; *** $p < .001$, ** $p < .01$, * $p < .05$.

Table 5
 Study 2 moderated mediation results – support and encourage.

	Regression Analysis		
	B	SE	t
<i>M: Symbolic Value</i>			
Country (X: 0 = Japan, 1 = Singapore)	7.41	7.41	4.47***
Religiosity (W: -1 below / +1 above SD from the mean)	1.96	1.96	2.31*
Country * Religiosity (X*W)	-1.3	-1.3	-3.22**
<i>Conditional effects of focal predictor</i>			
Japan	1.97	0.85	2.31*
Singapore	-1.93	0.86	-2.25*
<i>Y: Support and Encourage</i>			
Country (X)	4.86	0.38	12.95***
Symbolic Value (M)	0.95	0.03	29.12***
Index of moderated mediation	Index/ Indirect Effect	Boost SE	95% CI (LL, UL)
	-1.23	0.45	-2.13, -0.38

Note. Bootstrapping based on 5000 samples. B = unstandardized regression coefficient. SE = standard error. LL = lower limit; UL = upper limit.

*** $p < .001$.
 ** $p < .01$.
 * $p < .05$.

5.2. Theoretical implications

This research offers several important theoretical implications for understanding consumer adoption of novel food technologies. While much prior work has focused on individual-level factors, such as perceived benefits, risks, and familiarity, in predicting NFT acceptance (Bearth and Siegrist, 2016; Siegrist and Hartmann, 2020), broader sociocultural constructs have received less attention. By incorporating cultural uncertainty avoidance and religiosity, our study provides a more holistic perspective on adoption readiness and addresses calls for broader insights into the sociocultural influences shaping consumer responses to NFTs (Albertsen et al., 2020; Schnack et al., 2024).

Our findings also extend cultural dimensions theory by demonstrating how cultural uncertainty and religiosity interact to shape NFT adoption readiness. Prior studies emphasized the direct effects of cultural dimensions on technology acceptance (Barrena et al., 2015; Giacalone and Jaeger, 2023; Hwang, 2005), but the moderating role of religiosity has been less explored. Our results show that religiosity functions differently across cultural contexts: in high uncertainty-avoidance settings such as Japan, religiosity can help reduce uncertainty and increase acceptance (Minton and Cabano, 2021), whereas in low uncertainty-avoidance settings such as Singapore, higher religiosity may heighten resistance (Minton and Cabano, 2021; Sekerdej et al., 2018). These insights extend both cultural dimensions theory (Hofstede, 1983) and social identity theory (Tajfel et al., 1979) by illustrating how cultural norms and psychological orientations jointly influence responses to emerging food technologies.

Finally, examining symbolic value as a mediating mechanism deepens the theoretical understanding of how consumers attach meaning to novel technologies. Previous research has shown that symbolic value can influence acceptance of new foods and sustainable innovations (Perrea et al., 2015; Perrea et al., 2017). Studies also indicate that individuals with strong symbolic value orientations are more likely to value products that reinforce social status or identity expression (Taufik et al., 2022), which can enhance willingness to accept novel foods (Liu et al., 2021). Our findings contribute to this literature by demonstrating that symbolic value itself is shaped by the interaction of cultural uncertainty and religiosity. This advances the theory of consumption values (Sheth et al., 1991) by showing how symbolic meaning emerges through sociocultural influences and, in turn, guides adoption readiness for emerging food technologies.

5.3. Managerial implications

The advancement of food technologies, such as lab-grown meat and genetically edited foods, presents both opportunities and challenges. Understanding the factors influencing consumer adoption across diverse cultural contexts is essential for adoption success. Marketers and policymakers should account for cultural and religious factors when designing campaigns or regulations, because these factors shape how consumers interpret and respond to NFTs. For example, consumers with stronger religious beliefs in high uncertainty-avoidance cultures such as

Japan may be more likely to seek symbolic meaning in NFTs and to evaluate them through moral or spiritual lenses. Campaigns that emphasize alignment with religious or moral values, such as ethical sourcing, community well-being, or environmental stewardship, are likely to be effective. Regulatory communications could similarly highlight how NFTs comply with ethical or religious standards, reinforcing trust and social legitimacy. In addition, engaging with local communities through workshops or dialogues can help develop a better understanding of how NFTs reflect personal or collective religious values that convey symbolic meaning (Barrena et al., 2015).

In contrast, in lower uncertainty-avoidance cultures like Singapore, religious framing may be less impactful and could even reduce engagement, suggesting that campaigns should focus on other drivers such as food security, or health benefits. In fact, consumers with lower religiosity are more receptive to new technologies when they align with symbolic values. Promotional strategies should highlight future-oriented benefits while carefully considering potential backlash from strongly religious consumers in low uncertainty-avoidance countries. Understanding the differing attitudes between high- and low-religiosity groups within such cultural settings is therefore vital (Sekerdej et al., 2018).

Overall, a one-size-fits-all approach is ineffective for promoting NFTs. Strategies should account for cultural, religious, and symbolic factors to enhance acceptance and adoption across diverse markets (Counihan and Van Esterik, 2013). Ongoing education on cultural and religious sensitivity and consumer perceptions of emerging food technologies can further support the development of tailored approaches, ensuring that NFTs become more appealing to different audiences (Perrea et al., 2015).

5.4. Limitations and future research

First, our research focused on two specific countries (i.e., Japan and Singapore) to represent high and low uncertainty avoidance cultures. While the contrast between these countries provides meaningful insights, it is necessary to expand the geographic scope by investigating a more diverse set of countries and cultures to enhance the generalizability of the findings. For example, future research could examine how cultural and religious factors influence consumer trust and adoption of NFTs in Western, Middle Eastern, or other Asian countries.

Second, there may be additional factors that influence the interaction between cultural uncertainty and religiosity on the adoption of NFTs. Future research should explore other variables to provide a more holistic understanding of the factors driving acceptance. For example, integrating both individual and social-level factors into the research framework could offer deeper insights into how various elements interact to influence the acceptance of new food technologies. Moreover, researchers can examine other potential mediators or moderators such as personal values, ethical orientation and technological familiarity, to better understand why and under what circumstances consumers will embrace or resist these technologies (Hayes and Rockwood, 2017; Siegrist and Hartmann, 2020).

Third, this research is quantitatively based and aimed at identifying the relationships between constructs. As such, it may not fully capture the understanding of why consumers in different religiosity levels across various countries accept or reject NFTs. To address this limitation, future research could apply qualitative methods, such as interviews or focus groups, to gain a deeper understanding of how and why cultural and religious factors influence consumer attitudes toward these technologies (Bryman, 2017).

Finally, although this research provides novel insights into consumer attitudes and behaviors regarding NFTs, it did not focus on their perceptions at different time points. Given that NFTs will become more integrated into daily life, consumer attitudes are likely to evolve. For example, initial resistance to gene-editing foods might diminish as people become more familiar with the technologies and acknowledge

their benefits. A longitudinal approach would enable researchers to track consumers' perceptions and acceptance over time and identify trends and shifts in attitudes (Ployhart and Vandenberg, 2010). This approach would provide valuable insights into how evolving cultural and religious dynamics impact acceptance.

5.5. Conclusion

This research shows that readiness to adopt NFTs is jointly shaped by cultural uncertainty avoidance and religiosity, with symbolic value functioning as a central mechanism influencing consumers' willingness to pay and to support these foods. By examining adoption as a process of meaning construction rooted in identity and values, the study brings attention to influential yet underexamined drivers of consumer adoption of NFTs.

The results reveal that the role of religiosity is context dependent. In cultures characterized by high uncertainty avoidance, stronger religiosity can facilitate adoption by offering a sense of stability and strengthening symbolic interpretations of NFTs. In contrast, in low uncertainty-avoidance contexts, higher religiosity may intensify resistance when novel foods conflict with prevailing cultural openness. These findings indicate that fostering acceptance requires moving beyond assessments of risk or novelty and acknowledging the deeper value-based frameworks consumers use to judge whether NFTs are compatible with their identities and cultural norms.

By integrating sociocultural, psychological, and technological perspectives, this study offers a roadmap for future research to explore how belief systems condition technology adoption across contexts. It also provides actionable insight for practitioners and policymakers, showing that the acceptance of NFTs depends on aligning technological advances with the symbolic meanings and cultural priorities of specific consumer segments.

CRediT authorship contribution statement

Brian Lin: Writing – original draft, Methodology, Formal analysis.
Amy Errmann: Writing – original draft, Supervision, Formal analysis, Conceptualization.
Denise Conroy: Writing – original draft, Conceptualization.

Ethics statement

This project received ethics approval from the Institutional Review Board/Ethics Committee at Plant and Food Research Institution, reference number 139. All participants provided informed consent prior to data collection.

Declaration of competing interest

The authors declare no conflicts of interest.

Data availability

The authors do not have permission to share data.

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