Plant-Based Meat and the Perceived Familiarity Gap Hypothesis: The Role of Health and Environmental Consciousness

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This study investigates the effect of motivational factors on the perceived familiarity gap in the context of plant-based meat alternatives (PBMAs). Through a nationally representative survey of 1,008 adults in Singapore, this study finds a perceived familiarity gap for PBMAs between less- and more-educated people and that attention to television news, newspapers, television programs, the Internet, and social media narrows the perceived familiarity gap. Furthermore, the study finds significant three-way interactions among newspaper attention, education, and environmental consciousness, as well as three-way interactions among television news attention, education, and environmental consciousness. Theoretical and practical contributions are discussed.

Keywords: plant-based meat, knowledge gap hypothesis, sustainable food, meat alternative, mass media, survey

Meat consumption has come under increasing scrutiny with rising concerns worldwide about the environment and sustainability, animal welfare, and human health. Meat-based diets have been found to be more taxing to the environment compared with plant-based diets due to the high emission of greenhouse gases and large consumption of fossil fuels and land and water resources during meat production (McMichael, Powles, Butler, & Uauy, 2007). Livestock production practices have also been subject to criticism from both governments and citizens, leading to policy and legislative reforms on animal welfare (Ingenbleek, Immink, Spoolder, Bokma, & Keeling, 2012; Thornton, 2010). Health-wise, high levels of meat consumption, particularly red or processed meat, have been associated with cancer, diabetes, obesity, and cardiovascular diseases (González, Marquès, Nadal, & Domingo, 2020). Due to these concerns about meat production and consumption, plant-based meat has been introduced as an alternative to conventional meat.

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Plant-based meat alternatives (PBMAs) are made from plant proteins structured to mimic the taste and texture of conventional meat (He, Evans, Liu, & Shao, 2020). While PBMAs have existed for decades, they have not achieved mainstream adoption among meat consumers (Slade, 2018). Recently, technological developments in the food sector have led to innovations in PBMAs, increasing their similarities with the overall experience of eating conventional meat. Still, consumer acceptance of PBMAs remains low (He et al., 2020). While modern PBMAs like Impossible and Beyond Meats have generated plenty of media attention in recent years due to their inclusion in restaurants and fast-food menus (Piper, 2019), information barriers remain one of the reasons why the public does not adopt PBMAs (He et al., 2020).

Recent studies have shown that knowledge and information influence consumer adoption of PBMAs. Bryant, Szejda, Parekh, Deshpande, and Tse (2019) revealed that consumers in the United States and India who are more familiar with PBMAs are more likely to purchase them. In Finland, exposure to plant-based food information made consumers reduce red meat consumption and increase PBMA consumption (Vainio, Irz, & Hartikainen, 2018). Similarly, consumers in South Korea who have prior knowledge of PBMAs have a higher willingness to buy PBMAs (Hwang, You, Moon, & Jeong, 2020). Informing consumers about PBMAs plays an important part in shaping public support for government policies on meat consumption reduction to address environmental, animal welfare, and health concerns (Whitley, Gunderson, & Charters, 2018).

While information dissemination may be done to increase the knowledge and awareness of the public and inform their decision-making (Ajzen, Joyce, Sheikh, & Cote, 2011), there may be unequal acquisition of knowledge in different groups even if they were exposed to the same amount and type of information. This phenomenon can be explained by the knowledge gap hypothesis, which posits that as the level of media attention on an issue increases, people with a higher socioeconomic status (SES) will absorb knowledge at a higher rate compared with those with a lower SES, thereby increasing the knowledge gap between these segments of the population (Tichenor, Donohue, & Olien, 1970).

As there is no knowledge gap study yet on PBMAs, this study will investigate whether media attention on PMBAs results in differential rates of knowledge gain among different SES groups. This study will contribute to the literature on the knowledge gap hypothesis in two ways. First, by measuring knowledge as perceived familiarity (i.e., subjective knowledge, which is the knowledge possession people perceive; Brucks, 1985). Focusing on perceived familiarity in a knowledge gap study helps assess the processing and absorption of media messages by consumers, especially in connection with recent food technology innovations such as PBMAs, where factual knowledge acquisition is still in the early and uneven stages. Second, this study will investigate "contingent conditions" (Ettema & Kline, 1977, p. 181), specifically "motivational factors" (Kwak, 1999, p. 386) that influence the knowledge gap in an individual perspective rather than a social one as originally hypothesized with SES. In this article, the motivational factors will be environmental and health concerns, which are the two most common reasons behind the push for PBMA adoption (He et al., 2020; Whitley et al., 2018).

Thus, with information and knowledge being factors that affect the likelihood of consumers adopting PBMAs (Bryant et al., 2019; Hwang et al., 2020), identifying whether a knowledge gap exists between different groups will aid in deciding message characteristics (e.g., content and frequency) of media messages on PBMAs, thereby assisting in both product advertising and public policy education initiatives.

Study findings will also contribute to theoretical knowledge on the relationships between media attention and perceived familiarity and the effects of SES and motivational factors on these relationships.

Literature Review

Perceived Familiarity Gap

Perceived familiarity, also known as subjective knowledge, is an individual's perception of the amount of knowledge they possess (Brucks, 1985). Although factual knowledge has gained wide interest in science communication as an outcome variable (Yang, Chuah, Lee, & Ho, 2017), some studies prioritize subjective knowledge as a predictor of individual behaviors over factual knowledge because factual knowledge was found to have an indirect relationship with behavioral intentions while perceived familiarity was significantly and directly related to behavioral intentions (Ai, Li, & Yang, 2021; Pieniak, Aertsens, & Verbeke, 2010). Additionally, given that PBMA is an emerging technology, people may not have had enough exposure to PBMAs; thus, their factual knowledge of PBMAs may still be limited in scope and depth. Therefore, this study applies perceived familiarity as the indication of PBMA knowledge to investigate the knowledge gap regarding PBMA.

The perceived familiarity gap hypothesis was raised by Lee and Ho (2015), based on the knowledge gap hypothesis (Tichenor et al., 1970). The "knowledge gap" means the difference in knowledge possession between higher-SES groups and lower-SES groups. Usually, for public affairs and science knowledge, the higher-SES population has a higher knowledge level. More importantly, this classical communication theory indicates the role of media in widening such a gap:

> As the infusion of media information into a social system increases, segments of the population with higher socioeconomic status tend to acquire this information at a faster rate than the lower status segments, so that the gap in knowledge between these segments tends to increase rather than decrease. (Tichenor et al., 1970, p. 159)

Correspondingly, the perceived familiarity gap hypothesis indicates media will widen the difference in perceived familiarity between low- and high-SES populations (Lee & Ho, 2015).

Typically, education is adopted as an indicator of SES (Chang, Kim, Kang, Shim, & Ma, 2018). Though a positive relationship between factual knowledge and SES is consistently present across various empirical studies (e.g., Chang et al., 2018; Ho, Looi, Leung, Bekalu, & Viswanath, 2020; Yang & Ho, 2017), the relationship between perceived familiarity and SES is inconsistent. For example, Su, Cacciatore, Scheufele, Brossard, and Xenos (2014) found that SES is positively associated with subjective knowledge, while the findings of Chang and colleagues (2018) did not show SES positively predicts perceived familiarity. Similarly, Lee and Ho (2015) did not find a significant relationship between education on and perceived familiarity with nanotechnology in Singapore. One reason that may cause such an inconsistency is the difference in the context within which each of the three studies was situated: Chang and colleagues (2018) investigated the perceived familiarity toward general science knowledge in Korea, while the other two studies focused on nanotechnology (Lee & Ho, 2015; Su et al., 2014). Lee and Ho (2015) investigated the

perceived familiarity gap of nanotechnology among Singapore citizens, whereas Su and associates (2014) conducted the survey in the United States. Furthermore, in terms of the study subject, the novelty of nanotechnology distinguishes it from general science knowledge. The culture and ideology toward science and new technology of the three countries vary as well (Ho et al., 2020; Su et al., 2014).

These differences may contribute to the factors behind the mixed results of previous knowledge gap studies on perceived familiarity and SES. While we cannot pinpoint exactly how perceived familiarity with PBMAs in Singapore differs with SES due to mixed empirical evidence, nevertheless, based on the knowledge gap hypothesis (Tichenor et al., 1970) and meta-analysis studies (Hwang & Jeong, 2009; Lind & Boomgaarden, 2019), we can still assume that more-educated individuals have more capacity to gain knowledge of novel technologies such as PBMAs. Thus, more-educated people will think they are more familiar with PBMAs than less-educated ones. Hence, we propose the following hypothesis:

H1:   Education is positively related to perceived familiarity with PBMAs.

Media Use and Perceived Familiarity

Media are one of the main sources of science communication (Brossard & Scheufele, 2013; Wade & Schramm, 1969). The relationship linking media attention and knowledge acquisition has been implied by communication theories. For example, according to the uses and gratification theory, one of the essential functions of using media is to fulfill the cognitive needs of individuals (Katz, Haas, & Gurevitch,1973). In addition, the cognitive mediation model suggests that media exposure is related to elaborative information processing, resulting in knowledge acquisition (Eveland, 2001).

The positive effects of mass media, typically newspapers and television, on knowledge are well-documented (e.g., Ho et al., 2019; Nisbet et al., 2002; Su et al., 2014). As for perceived familiarity, the positive correlation between mass media attention and perceived familiarity has been revealed by research. For example, Su and colleagues (2014) found that attention to science information in both newspapers and television positively predicted individuals' perceived familiarity with nanotechnology. Chang and associates (2018) showed that traditional newspaper attention positively relates to perceived familiarity with science. Ladwig, Dalrymple, Brossard, Scheufele, and Corley (2012) found attention to television coverage of science positively predicted perceived familiarity with nanotechnology. Since mass media are one of the dominant channels that deliver science knowledge to the public (Ho et al., 2020), we posit that newspaper attention and television attention are positively related to perceived familiarity with PBMAs. In addition, we separate television attention to news from non-news programs. This is due to the possible diverse levels of entertainment value of different television programs and because entertaining content is said to be more effective for learning and knowledge absorption (Ljubojevic, Vaskovic, Stankovic, & Vaskovic, 2014; Singhal & Rogers, 2002). One type of television program that does not aim to entertain is the news program (Edgerly, 2017; Prior, 2005). This traditionally clear-cut dichotomy between news and entertainment (Baym, 2009; Edgerly & Vraga, 2019) thus leads to a natural point of distinction for television programs in this study: news and non-news programs. As such, we separate television attention to news and non-news programs to gain a more detailed understanding of how television attention relates to knowledge acquisition and the perceived familiarity gap.

Apart from mass media, the Internet and social media have become useful tools for individuals to gain knowledge. Not only does the Internet provide a channel for people to gain knowledge from various sources (e.g., science blogs and vlogs) but it also enables users to actively seek information. Similarly, social media are a composite media channel with the functions of interpersonal communication, passive information viewing, and information seeking (Frison & Eggermont, 2015). Though user-generated content on the Internet and social media may impede the acquisition of factual knowledge (Chang et al., 2018), the more attention people pay to PBMAs on the Internet and social media, the more likely they will feel familiar with PBMAs. Empirical studies on scientific knowledge provide support for the positive association between Internet attention/social media attention and perceived familiarity. For example, the results of Ladwig and colleagues (2012) support the positive relationship between Internet attention and perceived familiarity, and such a positive relationship is also found between social media attention and perceived familiarity (Ai et al., 2021; Chang et al., 2018). Therefore, we propose the following hypotheses:

H2:   *Attention to PBMA content in (a) newspapers, (b) television news, (c) television programs, (d) the Internet, and (e) social media is positively related to perceived familiarity with PBMAs.*

Media Use and Perceived Familiarity Gap

As the knowledge gap hypothesis suggests, media attention has the potential to change the knowledge gap between groups of people with different SES (Tichenor et al., 1970). According to Tichenor et al. (1970), media will widen the knowledge gap for five reasons: (1) "communication skills"—more-educated individuals have superior ability than less-educated ones in acquiring knowledge from media; (2) "the amount of stored information"—well-informed individuals are likely to have higher topic awareness and have more understanding of a topic when mass media feature it; (3) "relevant social contact"—the social networks of more-educated people make the discussion of public affair topics among them and others more likely; (4) "selective exposure, acceptance and retention of information"—these are the results of educational differences; and (5) "the nature of the mass media system that delivers information"—print media display the most scientific and public affairs information, and higher-SES individuals consume more print media (Tichenor et al., 1970, p. 162). It is worth noting that the original knowledge gap hypothesis is based on print media (Tichenor et al., 1970), thus it may or may not be as applicable to other types of media; therefore, a review of previous studies with different media modalities follows.

Newspaper is text-based. With text information requiring more cognitive capacities to process (Lind & Boomgaarden, 2019), processing newspaper information may be easier for more-educated people. Hence, more-educated individuals can benefit more from newspaper attention in gaining knowledge, thus widening the knowledge gap (Hwang & Jeong, 2009; Tichenor et al., 1970). Such a widening effect is supported by a meta-analysis conducted by Lind and Boomgaarden (2019) and Chang and colleagues' (2018) study where it was found that traditional newspaper attention widened the gap in perceived familiarity with scientific knowledge. Aligned with previous studies, we posit that newspaper attention will amplify the perceived familiarity gap between less- and more-educated populations because more cognitive resources and basic knowledge are needed for possessing scientific knowledge, especially for emerging technologies like PBMAs. Besides, more-educated people are more likely to pay attention to or adopt innovation (Boahene, Snijders, & Folmer, 1999; Korda, Clements, & Dixon, 2011). Thus, with more-educated individuals having a higher

likelihood of gaining more knowledge from newspapers and having higher perceived familiarity with PBMAs, we raise the following hypothesis:

H3:   *Attention to PBMA content in newspapers widens the perceived familiarity gap between more- and less-educated populations.*

In contrast, literature revealed that television narrows the knowledge gap (Chang et al., 2018; Kwak, 1999; Yang & Ho, 2017). The less cognitive demands of watching television compared with those required for print media (e.g., newspaper) explains this finding, that is, watching television entails lower levels of background knowledge and cognitive skill and effort, making knowledge transfer to the audience, especially to the less-educated segment of the population, more effective (Lind & Boomgaarden, 2019; Yang & Ho, 2017). Moreover, due to the entertaining feature of television content, television can help people with less education learn more (Su et al., 2014). However, not all empirical evidence supports that exposure to television narrows the knowledge gap. For example, the meta-analysis of Lind and Boomgaarden (2019) did not find a significant narrowing effect of television on the knowledge gap. Similarly, a more recent study on the COVID-19 knowledge gap did not find television exposure significantly influencing the knowledge gap (Gerosa, Gui, Hargittai, & Minh Hao, 2021). This may be because television is easier to understand (Salomon, 1984; Walma van der Molen & Van der Voort, 2000); thus, television may equally increase knowledge levels across differently educated groups. Another reason may be that previous studies did not differentiate television news and non-news programs. Less-educated people may benefit less from television news because it requires higher motivation and higher cognitive skills. In comparison, non-news programs may be an easier way for less-educated people to gain knowledge due to their comparably more entertaining nature, which enhances learning (Ljubojevic et al., 2014; Singhal & Rogers, 2002). Nevertheless, based on the argument that video-audio information requires less cognitive effort and ability, this study posits that less-educated individuals may benefit more from watching television. Thus, the following hypotheses are raised:

H4:   *Attention to PBMA content in (a) television news and (b) television programs narrows the perceived familiarity gap between more- and less-educated people.*

Current research suggests that the Internet augments the knowledge gap. First, more active and skilled users can use the Internet more effectively (Hargittai & Hinnant, 2008); therefore, less-educated people may have a harder time acquiring knowledge from the Internet due to a lack of skills. More importantly, compared with traditional media whose content is relatively homogeneous, content on the Internet is more heterogeneous and more personalized (Wei & Hindman, 2011). Since more-educated individuals may have higher motivation to engage in public affairs, they are more likely to seek and gain related knowledge from highly heterogeneous and personalized information pools (Wei & Hindman, 2011); thus, people with more education may gain more knowledge from the Internet compared with less-educated individuals, leading to a widening of the perceived familiarity gap. Since the content characteristics of social media can be inaccurate and superficial (Chang et al., 2018), the effects of social media attention on the perceived familiarity gap should be the same as that of Internet attention as more-educated people might be able to discover false information. Furthermore, as the knowledge gap hypothesis states, interpersonal communication among more-educated people leads to a widening of the knowledge gap (Tichenor et al.,

1970); with social media facilitating interpersonal communication, social media attention may augment the perceived familiarity gap as well. Thus, this study proposes the following hypotheses:

H5:   *Attention to PBMA content on (a) the Internet and (b) social media widens the perceived familiarity gap between less- and more-educated people.*

Motivation and Perceived Familiarity Gap

Scholars have considered the moderating effect of "contingent considerations" (Ettema & Kline, 1977) on the knowledge gap. These contingent considerations are "situation-specific" factors (Lovrich & Pierce, 1984, p. 416) that may allow low-SES persons to widen or narrow the knowledge gap when the information is functional or nonfunctional for them (Ettema & Kline, 1977; Lovrich & Pierce, 1984). One example of these situation-specific factors is motivation, which is underscored in the landmark article on the knowledge gap hypothesis (Tichenor et al., 1970). The role of motivation in knowledge acquisition can be explained by the heuristic-systematic model, which indicates that motivation impacts people's information processing (Chaiken, 1980). That is, as individuals are more motivated to know a specific topic, they will be more likely to engage in systematic information-processing routes, and thus gain more knowledge (Eveland, 2001).

Studies have considered motivation in the examination of the knowledge gap hypothesis. For example, Kwak (1999) found a significant three-way interaction among education, campaign interest, and newspaper attention and that there was a significant knowledge gap between less- and more-educated individuals. Among the more-educated ones, motivation did not significantly moderate the relationship between newspaper attention and knowledge, while among the less-educated population, highly motivated individuals gained more knowledge from newspaper attention. However, the three-way interaction of education, media attention, and elaboration on perceived familiarity with nanotechnology has different effects (Lee & Ho, 2015). It was found that more-educated people with high elaboration levels benefited the most from newspaper attention, while less-educated people with high elaboration level benefited most from television attention (Lee & Ho, 2015). Meanwhile, when individuals' elaboration level was low, the effects of both newspaper and television attention on the perceived familiarity gap decreased (Lee & Ho, 2015).

As stated previously, PBMAs address the problems that conventional meat poses to the environment and human health. As such, people might be motivated to know more about PBMAs because of their concerns for their own health or the environment. Therefore, health or environmental concerns may modify the effects of media use on the perceived familiarity gap between low- and high-SES groups. Nevertheless, due to the inconsistency of previous findings on three-way interaction effects regarding the knowledge gap hypothesis, and the differences in motivation type, context, and knowledge form, we construct the following research questions:

RQ1:   *How will health consciousness modify the effect of (a) television news, (b) television programs, (c) newspapers, (d) online media, and (e) social media use on the perceived familiarity gap regarding PBMAs between high- and low-SES groups?*

RQ2:   *How will environmental consciousness modify the effect of (a) television news, (b) television programs, (c) newspapers, (d) online media, and (e) social media use on the perceived familiarity gap regarding PBMAs between high- and low-SES groups?*

Method

Participants and Study Procedure

An online survey was conducted in February 2021 in Singapore with 1,008 respondents through Rakuten Insights. Only Singaporean citizens and permanent residents above 21 years of age were included. Quotas for three demographic factors (i.e., age, ethnicity, and education level) were implemented to help obtain a representative sample of Singapore's population. Participation in the survey was completely voluntary. We first obtained informed consent from all participants before collecting data. Participants were provided with a brief introduction to PBMAs to help them assess their attention to information on PBMAs more accurately. After completion of the questionnaire, participants were awarded points that corresponded to compensation (i.e., e-points) from the survey panel and data-collection providers.

Measures

Perceived Familiarity

Participants' familiarity with PBMAs was measured by three items adapted from Ho, Looi, Leong, and Leung's (2019) work with a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). Participants were asked to rate their agreement on the following statements: (a) "I know what plant-based meat means"; (b) "I know why we need to develop plant-based meat"; and (c) "I know the advantages and disadvantages of plant-based meat" (Cronbach's a = 0.83, M = 3.42, SD = 0.87).

Media Attention

In today's media environment, newspapers, television news, and television programs all have online versions. Also, the traditional forms of these media types are declining. Thus, we operationalized each media type according to Singapore's media environment. Newspapers were operationalized as newspapers either in print or online. Television news refers to attention to news telecasts on traditional television or through online platforms, while television programs were operationalized as television programs (excluding news telecasts) either on traditional television or online platforms. Internet use excluded visiting news websites, while social media use excluded viewing news content and watching television programs. With these operationalizations, we attempted to ensure that the media attention variables were exclusive to avoid overlap among different media use.

Participants' attention to PBMA content in newspapers, television news, television programs, the Internet, and social media were each measured by six items on a 5-point scale (1= no attention at all; 5 = a lot of attention) adapted from Lee and Ho (2015). The contents were (a) "Science, health, and technology," (b) "Health benefits of plant-based meat," (c) "Sustainability benefits of plant-based meat," (d) "Food security benefits of plant-based meat," (e) "Health risks of plant-based meat," and (f) "Health risks of conventional meat." We created composite indices for attention to each medium by averaging the six items.

The mean, standard deviation, and Cronbach's *a* are presented in Table 1. The wording of each item is presented in Appendix Table A1.

Table 1. Descriptive Statistics of Attention to PBMA Content in Media.

	M	*SD*	Cronbach's *a*
Newspaper	3.20	0.98	0.94
Television news programs	3.25	0.90	0.93
Television non-news programs	3.22	0.95	0.94
Internet	3.14	1.03	0.95
Social media	2.94	1.07	0.96

Motivation Variables

Motivation variables include health consciousness and environmental consciousness. Health consciousness was measured using seven items on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree) as adapted from Hong (2009). The items were (a) "I am very self-conscious about my health"; (b) "I am generally attentive to my inner feelings about my health"; (c) "I reflect about my health a lot"; (d) "I am concerned about my health all the time"; (e) "I notice how I feel physically as I go through the day"; (f) "Living life without disease and illness is very important to me"; and (g) "Living life in the best possible health is very important to me" (Cronbach's $a = 0.89$, $M = 3.78$, $SD = 0.74$). Likewise, environmental consciousness was measured with six items on a 5-level Likert scale (1 = strongly disagree; 5 = strongly agree), as adapted from Dunlap, Van Liere, Mertig, and Jones (2000). The items were (a) "We are approaching the limit of the number of people the Earth can support"; (b) "Humans are severely abusing the environment"; (c) "Plants and animals have as much right as humans to exist"; (d) "The earth is like a spaceship with very limited room and resources"; (e) "The balance of nature is very delicate and easily upset"; and (f) "If things continue their present course, we will soon experience a major ecological catastrophe" (Cronbach's $a = 0.77$, $M = 3.72$, $SD = 0.66$).

Demographic Variables

Demographic variables in this study include education (no formal education = 0.4%, primary 6 or below = 1.5%, some secondary education = 4.1%, N-level/ITE = 5.7%, O-level = 17.6%, A-level = 4.5%, diploma and professional qualification = 27.3%, bachelor's degree or equivalent = 29.0%, master's degree/postgraduate = 8.8%, doctoral degree = 1.3%; *Mdn* = 7.00, or diploma & professional qualification, *SD* = 1.76), age ($M = 46.95$, $SD = 14.86$), gender (male = 49.1%, female = 50.9%), average monthly household income (*Mdn* = S$6,001–S$7,000, *SD* = 5.86), and vegetarian or not (vegetarian = 9.2%).

Results

The results of the regression model are displayed in Table 2. The model accounted for 41.22% of the variance of individuals' perceived familiarity with PBMA.

Table 2. Hierarchical Regression Results.

Independent Variables	Standardized Coefficient		
	Model 1	Model 2	Model 3
Block 1: Demographic variables			
Education	.20***	.09**	.06†
Age	−.05	−.09**	−.11**
Gender (male = 1)	.10**	.10**	.08**
Income	.08*	.01	.02
Vegetarian (vegetarian =1)	.06	−.04	−.04
Incremental R^2 (%)			8.12***
Block 2: Communication variables			
Newspaper attention		.17**	.15*
TV news attention		.36***	.24***
TV program attention		−.09	−.08
Internet attention		.20**	.17**
Social media attention		−.13*	−.08
Incremental R^2 (%)			21.98***
Block 3: Motivations			
Health consciousness			.13***
Environmental consciousness			.25***
Incremental R^2 (%)			9.21***
Block 4: Two-way interactions			
Newspaper attention × Education			−.08**
TV news attention × Education			−.08**
TV program attention × Education			−.07*
Internet attention × Education			−.07*
Social media attention × Education			−.06*
Incremental R^2 (%)			0.68
Block 5: Three-way interactions			
Newspaper attention × Education × Health consciousness			−.02
TV news attention × Education × Health consciousness			.07
TV program attention × Education × Health consciousness			.02
Internet attention × Education × Health consciousness			.02

Social media attention × Education × Health consciousness			.01
Newspaper attention × Education × Environmental consciousness			−.07[*]
TV news attention × Education × Environmental consciousness			−.07[*]
TV program attention × Education × Environmental consciousness			−.06
Internet attention × Education × Environmental consciousness			−.03
Social media attention × Education × Environmental consciousness			−.03
Incremental R^2 (%)			1.22
Total R^2 (%)	8.12	30.10	41.22

*Note.* [1]p =.055; [*]$p < .05$; [**]$p < .01$; [***]$p < .001$.

Main Effects

Education was positively associated with perceived familiarity (β = .20, p < .001). After controlling for communication variables and two motivational variables, it was found that the relationship between education and perceived familiarity remained positive and was significant under the 0.1 level (β = .06, p =.055). As such, H1 was supported. Media attention was not consistently positively associated with perceived familiarity. Among the five variables, attention to newspapers (β = .13, p = .010), television news (β = .36, p < .001), and the Internet (β = .14, p = .007) were significantly associated with perceived familiarity. In contrast, attention to television programs was not significantly associated with perceived familiarity (β = −.08, p = .223). Attention to social media was not significantly associated with perceived familiarity (β = −.07, p = .113) after controlling for two motivation factors. As for the motivation factors, both health consciousness (β = .13, p < .001) and environmental consciousness (β = .25, p < .001) were positively associated with perceived familiarity. Therefore, only H2a, H2b, and H2d were supported.

Interaction Effects

The results revealed that the interaction terms of education and media attention were all significantly related to perceived familiarity. The results showed that all five types of media attention narrowed the knowledge gap. However, the narrowing effects were present in different ways. Specifically, the positive relationship between newspaper attention and perceived familiarity was stronger among less-educated individuals (β = −.08, p = .008). Similarly, the positive association between television news attention and perceived familiarity was stronger among the less-educated group (β = −.08, p = .006). The positive relationship between Internet use and perceived familiarity also increased as educational level decreased (β = −.07, p = .012). In comparison, the association between television programs and perceived familiarity was less negative among less-educated individuals (β = −.07, p = .024). A similar pattern was also observed in social media. That is, the negative relationship between social media and perceived familiarity was weaker among less-educated individuals (β = −.06, p = .033). The results supported H4(a) and H4(b) while failing to support H3, H5(a), and H5(b) on the interaction between media attention and education. Specifically, as displayed in Figure 1, as the attention to PBMAs in newspapers, television news, and the Internet increases, perceived familiarity increases less among more-educated people. In contrast,

as the attention to PBMAs in television programs and social media increases, perceived familiarity decreases less among less-educated people.
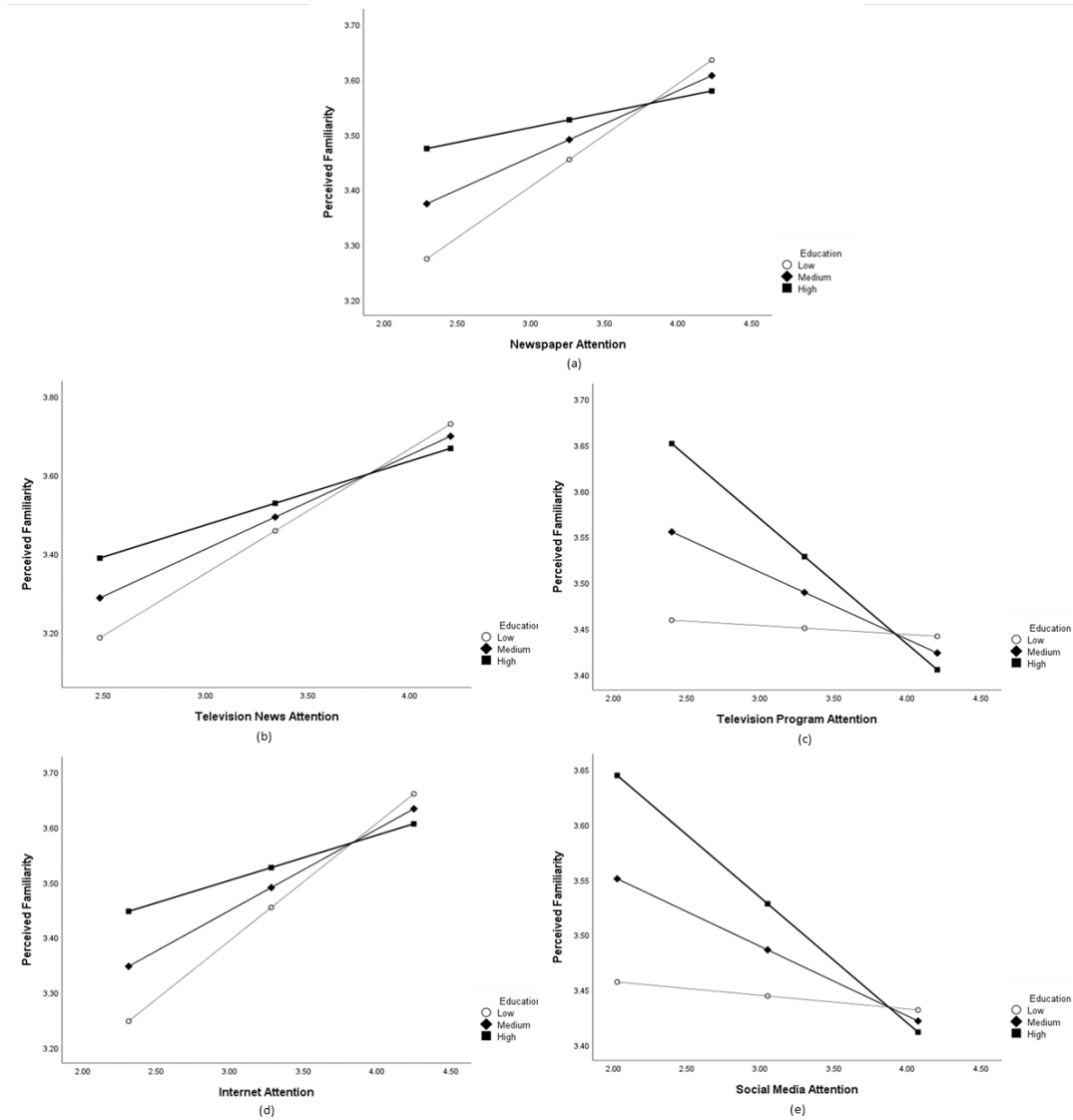
Figure 1. Two-way interactions.

As for RQ1 and RQ2, we examined the three-way interactions of media attention, education, and health/environmental consciousness on the perceived familiarity with PBMAs. The results revealed that the interactions of media attention, education, and health consciousness were not related to perceived familiarity. The interactions of media attention, education, and environmental consciousness also were not related to perceived familiarity except for television news attention ($\beta = -.07$, $p = .026$) and newspaper attention ($\beta =$

−.07, *p* = .031). Specifically, as presented in Figure 2, as environmental consciousness increased, the moderating effect of education on the relationship between television news attention and perceived familiarity also increased. Similarly, the moderating effect of education on the relationship between newspaper attention and perceived familiarity increased as environmental consciousness increased. That is, among people whose environmental consciousness was high, the less-educated ones benefitted more from television news and newspaper attention, while among those whose environmental consciousness was low, there was no sizeable interaction between perceived familiarity, education level, and media attention, with the perceived familiarity gap not narrowing as attention to television news and newspaper increased.
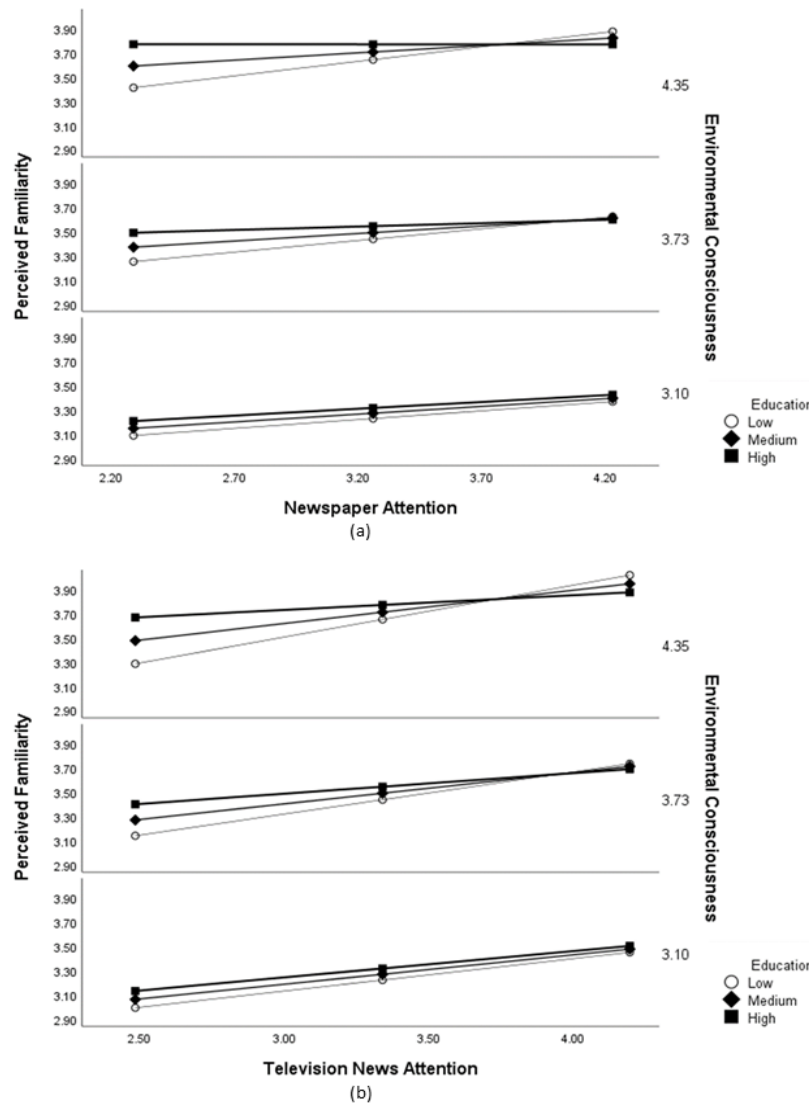
Figure 2. Three-way interactions.

Discussion

Conclusion

This study investigated the relationships among media attention, education level, environmental and health consciousness, and perceived familiarity with PBMAs through the lens of the knowledge gap hypothesis (Tichenor et al., 1970). This study contributes to the literature by examining (1) PBMAs from a new perspective—perceived familiarity gap as the theoretical framework in the setting of Singapore; (2) the significance of media attention as a factor that affects perceived familiarity gain, specifically factoring in the difference between news and non-news sources, or which may be seen as the contrasting use of authoritative and credible, and non-authoritative and non-credible sources (Karlsen & Aalberg, 2021; Tandoc, 2019); and (3) the role of motivation in the knowledge gap and the difference between environmental and health consciousness, both of which are particularly salient factors for PBMA adoption (He et al., 2020; Whitley et al., 2018).

Theoretical Contributions

The main effects found in this study are mostly in line with extant literature. Education level was found to be positively related to perceived familiarity (Su et al., 2014), thus illustrating uneven PMBA knowledge distribution where those with more education have more perceived knowledge versus those with less education. Individuals paying more attention to select media formats like television news, newspapers, and the Internet perceived PBMAs as more familiar (Ho et al., 2019; Ladwig et al., 2012), while those who paid more attention to social media showed a decrease in what they thought they knew about PBMAs. This may be due to individuals seeing social media content as mostly user-generated and unverified information (Karlsen & Aalberg, 2021; Tandoc, 2019), leading them to question the knowledge they had on PBMAs—in contrast to the effect of authoritative sources usually found in television news, newspapers and websites that can enhance a person's perceived familiarity with PBMAs.

All the two-way interactions are significant, thus lending support to the claim that exposure to media affects the knowledge gap between less- and more-educated individuals. Consistent with existing studies (Ladwig et al., 2012; Su et al., 2014), attention to PBMAs in television news narrow the perceived familiarity gap between the less- and more-educated groups. This may be explained by news content on television requiring less cognitive effort to process (Lee & Ho, 2015), which could be due to TV news report formats being short and direct, thereby allowing those with less education to acquire knowledge more effectively.

Similarly, both newspaper and Internet attention narrow the perceived familiarity gap between less- and more-educated groups. Though this result is in contrast with earlier knowledge gap study results (e.g., Hwang & Jeong, 2009; Lee & Ho, 2015; Lind & Boomgaarden, 2019) where newspaper and Internet attention both widen the knowledge gap, it is similar to the result of a study that also used Singaporean participants (Ho, 2012), where newspaper attention was shown to narrow the knowledge gap due to Singapore's "homogenous state-owned media system" and the public's "high levels of confidence with the government and the mass media" (Ho, 2012, p. 710). This may occur due to having both less- and more-educated groups exposed to the same content from the uniform and a limited number of media organizations in Singapore, which enjoy the trust of the general public regarding their news coverage (Wu, 2020). The narrowing of the knowledge gap because of Internet attention may be explained by previous studies' discussion of Internet access quality as an important

factor to be considered (Bonfadelli, 2002; Wei & Hindman, 2011). Singapore's wide Internet coverage, high Internet quality, and high Internet use rate (i.e., 92% in 2022; Kemp, 2022) may allow the less-educated population to catch up with the more-educated group in terms of gaining perceived familiarity with PBMAs as they experience the same level of speed and convenience in accessing information on the Internet as that of the more-educated group, especially since Internet connection quality has been cited as a factor that improves learning outcomes (Chen & Liu, 2013; Lelkes, 2020).

For television programs and social media attention, both the less- and more-educated groups experience decreasing perceived familiarity with PBMAs the more they pay attention to television programs and social media, with those in the less-educated group experiencing a smaller decrease compared with those in the more-educated group. This may be happening because (1) both television programs and social media contain information not as authoritative and credible as those shown on journalist-produced television news programs and newspaper articles, and (2) those from the more-educated group may be more discerning and critical of these content types compared with the less-educated group, leading to a bigger decrease in their perceived familiarity with PBMAs, which subsequently narrows the perceived familiarity gap.

The three-way interactions in this study involve motivation, specifically environmental and health consciousness. Results show that health consciousness has no significant effect on the perceived familiarity gap. This may be because PBMAs are not regarded as a much healthier option versus unprocessed food like vegetables and legumes due to PBMAs' processed nature and the addition of high levels of sodium (He et al., 2020; Hu, Otis, & McCarthy, 2019). However, environmental consciousness significantly affects the influence of media attention on perceived familiarity between groups with less and more education, specifically with regard to television news and newspaper attention. The implication of this result is twofold. First, this further strengthens the discussion above on the effectiveness of authoritative and credible media sources like television news and newspapers versus social media and television programs in increasing knowledge in the population. Second, this suggests that messaging on PBMAs should focus on their environmental benefits rather than their health benefits to augment the knowledge gain of those in the less-educated group and to further enhance the narrowing effect on the gap in the perceived familiarity with PBMAs.

Practical Implications

Perceived familiarity is an important antecedent of behavior (Ai et al., 2021; Pieniak et al., 2010). By examining the disparities in perceived familiarity with PBMAs, this study pinpoints the less-educated groups as the ones who need more information. Practitioners can put more effort into disseminating related information and knowledge among this population to narrow the perceived familiarity gap between the less- and more-educated groups. With the investigation of two-way interactions, this study suggests that the choices of media channels are essential in disseminating knowledge about PBMAs.

Though the five media forms explored in this study narrowed the perceived familiarity gap, greater attention to newspapers, television news, and the Internet was seen to help close the gap by increasing familiarity across all education levels—this is in contrast with television programs and social media that closed the gap by actually reducing perceived familiarity. Thus, newspapers, television news, and the Internet are better channels for practitioners to use in raising people's perceived familiarity with PBMAs, and more importantly, in narrowing the perceived familiarity gap among all education groups. Additionally,

companies and the government can deliver knowledge about PBMAs more through newspapers, television news, and the Internet to achieve improved educational outcomes.

Finally, this study shows that not all kinds of motivations can help in narrowing the knowledge gap. Health consciousness, a self-serving type of motivation, is unhelpful in reducing such a disparity. In contrast, environmental consciousness, an altruistic type of motivation, can interact with education and both newspaper and television news attention. Thus, practitioners can consider emphasizing the environmental benefits of PBMAs (e.g., protecting animals and reducing carbon emissions) on news channels to increase perceived familiarity and decrease the disparities in perceived familiarity with PBMAs.

However, we must acknowledge that the increased explained variances by the two-way and three-way interaction terms are relatively small compared with the main effects. This suggests that although media play a role in altering the perceived familiarity gap between the less- and more-educated groups, the effect size is small. Therefore, to bridge the perceived familiarity gap regarding PBMAs, merely relying on providing information through newspapers, television news, and the Internet is not enough. Other potential approaches, such as direct education to the less-educated group through community-level efforts, could be used to decrease the perceived familiarity gap.

Limitations and Future Research

Though this study has several theoretical and practical contributions, it is not without limitations. First, knowledge was operationalized as perceived familiarity considering the newness and innovative nature of PBMAs, which means that factual knowledge of PBMAs could still be at an insufficient level and is not yet widespread across the population. Therefore, factual knowledge can be added as another dimension of knowledge when PBMAs become more established and prevalent. Moreover, since there could be a discrepancy between perceived familiarity and factual knowledge—defined as "the illusion of knowing"—in future studies (Park, 2001, p. 419), it would be interesting to explore the interaction effects among education, media use, and motivation on this illusion of knowing.

Second, this study only investigated five types of media (television news, television programs, newspapers, the Internet, and social media). Future research can investigate other media types and information sources, like online videos, microblogging, and interpersonal communication, to shed light on the effects of new media and direct personal interactions on the knowledge acquisition of different population segments. Besides, though considering two types of motivations specific to the context of PBMAs in perceived familiarity gap is novel, there are other types of motivation like interest, involvement, and risk perceptions. Future studies should investigate these motivations, which will help in crafting better messaging with more effective content for PBMAs, thus benefiting low-SES groups by narrowing the gap in knowledge gain between them and those with high SES.

Furthermore, this study adopted a cross-sectional design, making it inadequate to fully explain the causal relationship between education, media use, and perceived familiarity. Future research can use panel data or experiments to improve the examination of the knowledge gap. Finally, choosing a different geographic and cultural context from that of Singapore will further enhance our understanding of the effects of motivation and media attention on the knowledge gap between different SES segments of the population.

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Appendix

Table A1. The Wording of Media Attention Measures.

Variable	Wording
Newspaper attention	On a scale of 1 to 5 (1 = no attention at all; 5 = a lot of attention), when reading newspapers, either in print or online, how much attention do you pay to news on: a) Science, health, and technology b) Health benefits of plant-based meat c) Sustainability benefits of plant-based meat d) Food security benefits of plant-based meat e) Health risks of plant-based meat f) Health risks of conventional meat *Note.* The PBMA content on the six items is the same across all the media attention measures.
Television news attention	On a scale of 1 to 5 (1 = no attention at all; 5 = a lot of attention), when watching news telecasts, either on traditional TV or online platforms, how much attention do you pay to messages [on the PBMA content].
Television programs attention	On a scale of 1 to 5 (1 = no attention at all; 5 = a lot of attention), when watching television programs, either on traditional TV or online platforms (excluding news telecasts), how much attention do you pay to messages [on the PBMA content].
Internet attention	On a scale of 1 to 5 (1 = no attention at all; 5 = a lot of attention), when using the Internet, excluding visiting news websites, how much attention do you pay to articles [on the PBMA content].
Social media attention	On a scale of 1 to 5 (1 = no attention at all; 5 = a lot of attention), when using social media, excluding viewing news content and watching TV programs, how much attention do you pay to the following [the PBMA content]?