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ORIGINAL ARTICLE

Past Debates, Fresh Impact on Nano-Enabled Food: A Multigroup Comparison of Presumed Media Influence Model Based on Spillover Effects of Attitude Toward Genetically Modified Food

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Informed by the notion of spillover effects between two phenomena, this study examines how differences in prior attitudes would influence the relationships posited by the influence of presumed media influence (IPMI) model. Specifically, this study examines how pre-existing favorable and unfavorable attitudes toward genetically modified (GM) food are associated with audiences' intention to consume nano-enabled food. The results of a nationally representative survey with 1,000 respondents found general support for the IPMI from media attention to behavioral intentions, through attitude and social norms. Further, a multigroup analysis of the IPMI provided evidence for differences in the IPMI effects between the audiences with favorable and unfavorable pre-existing attitudes toward GM food. These results contribute to a stronger theoretical understanding of the IPMI in terms of how pre-existing attitudes toward a preceding food technology can have a spillover effect on how audiences make decisions regarding a newer food technology.

Keywords: Influence of Presumed Media Influence, Spillover Effects, Pre-existing Attitudes, Nano-enabled Food, Genetically Modified Food

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The influence of presumed media influence (IPMI; Gunther & Storey, 2003) postulates that media viewers tend to assume that others would pay attention to the same content that they do. The viewers would continue to extrapolate that the same

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messages would influence others (i.e., presumed media influence). People's presumptions of media influence on others would then guide them to think about others' thoughts and actions (Gunther, 1998). Finally, this would motivate them to adapt by altering their own attitudes and behaviors. For instance, Paek and Gunther (2007) found that when adolescents presumed anti-smoking messages to influence their peers, the adolescents had less favorable attitudes toward smoking and weaker intentions to smoke. Further studies expanded the IPMI, proposing that the media has indirect effects on people's perceptions of descriptive norms, subjective norms, injunctive norms, and personal norms, which would then shape behavioral outcomes (Ho, Poorisat, Neo, & Detenber, 2014; Ho, Lee, Ng, Leong, & Tham, 2016). In essence, the IPMI, a model of indirect media effects, highlights how individuals' attention to media messages would influence their attitudes and behavioral intentions, as mediated through their presumed others' attention, attitude, and perceived social norms.

However, extant IPMI studies primarily looked at viewers as a homogenous group without considering that media effects could differ among viewers with different characteristics. Informed by the notion of audience segmentation (Grunig, 1997) and the idea that people heuristically process media content (Puligadda, Ross, & Grewal, 2012), this study proposes that the indirect media effects articulated in the IPMI may differ among audience groups. Specifically, we speculate that when audience groups view media content related to an unfamiliar issue, they may draw on their previously formed mental schemas on a similar issue to guide their thought processes.

Therefore, this study asked, "How do people's pre-existing attitudes toward a phenomenon influence the IPMI effects in a related context?" To address this question, this study conducted a multigroup analysis of the IPMI to examine if the overall model would differ across people with different pre-existing attitudes. Gunther, Perloff, and Tsfati (2008) noted that depending on people's perceptions of media influence in various contexts, they may comply with or withdraw from an action after developing presumptions of media influence on social norms. For instance, Liao, Ho, and Yang (2016) found that people who presumed that pro-environmental behaviors were prevalent among others (i.e., descriptive norms) and that referent others expect them to carry out pro-environmental acts (i.e., subjective norms) were more likely to carry out pro-environmental actions themselves. The current study furthers this line of research on different reactions to presumed media influence by examining how two related contexts would modify the behavioral outcomes of the indirect media effects of the IPMI.

This study seeks to answer the above-mentioned question in the context of nano-enabled food and genetically modified (GM) food. Since the introduction of GM food, consumers have expressed concerns about the ethicality of gene-editing and the possibility of GM organisms disturbing the ecological balance (Phillips, 2008). People were wary about the threats that GM food would pose to their health (Bawa & Anilakumar, 2013; Cui & Shoemaker, 2018) as they perceive that GM food

can produce toxins and cause allergies and illnesses (Popek & Halagarda, 2017). Moreover, people perceive that GM food can be harmful to the environment, threaten the natural order of things, and pose a threat to future generations (Costa Font, 2011; Rose, Brossard, & Scheufele, 2020). As a result of these risk perceptions, a large proportion of the population in the European Union have indicated that they would avoid purchasing GM food (Costa Font, 2011). However, experts hold vastly different views from the public (Savadori et al., 2004). They believe that GM crops are able to alleviate food shortage (Wu & Butz, 2004) and reduce the destruction of useful organisms in the soil when more pesticide is being used (Bao-Rong, 2006). Overall, experts believe that the public has over-assessed the risks associated with GM foods (de Boer, McCarthy, Brennan, Kelly, & Ritson, 2005). The prevailing disagreements on GM food indicate that it is a highly controversial food for which people may hold strong attitudes. As a type of engineered-food, nano-enabled food contains ingredients and additives that are made using nanotechnology (Chaudhry, Watkins, & Castle, 2017). These substances are believed to improve the nutritional value, taste, color, shelf-life, and safety of food products. However, there are fears that the nano-engineered products may cause diseases when they penetrate cells and tissues and accumulate in unintended parts of the human body (Chaudhry et al., 2017). The similarity between these two types of engineered-food provides people with a basis for comparison.

The prevailing disagreements about GM food signal that negative opinions toward engineered-food may influence evaluations of other technology-enabled food. Nano-enabled food may be a target of a spillover effect from GM food since the lay public is likely to draw some similarities between the two types of food items. Besides, it is plausible for people to understand a new technology based on prior understandings of science and technology (e.g., Vandermoere, Blanchemanche, Bieberstein, Marette, & Roosen, 2010; Visschers, Meertens, Passchier, & Devries, 2007). Ebbesen (2006) called on studies that examine acceptance of emerging food technologies to consider the potential influence of public opinions toward GM food. Therefore, the current study of nano-enabled food in Singapore considers how the public's pre-existing attitudes toward GM food may affect people's intentions to consume nano-enabled food. This is a timely consideration to help gauge consumption in a country where the product has not reached the mass market (e.g., Choo, 2018). Without experience from direct consumption, the public is likely to lack comprehensive knowledge of its risks and benefits. In this case, the media, in its varied forms, would serve as the main source of information (Brossard, 2013; Chuah, Leong, Cummings, & Ho, 2018; Cummings, Chuah, & Ho, 2018).

This article takes a two-step approach to answer the guiding question, "How does people's pre-existing attitudes toward a phenomenon influence the IPMI effects in a related context?" First, we apply the IPMI to examine how indirect media effects would influence people's intention to consume nano-enabled food. Second, we examined the spillover effect by conducting a multigroup analysis to examine if the IPMI differs across groups with different pre-existing attitudes toward GM food.

Therefore, the objective of this study is to examine how pre-existing attitudes, a spillover effect, toward a phenomenon might influence outcomes posited by the IPMI.

Influence of presumed media influence

Whereas direct-effect models point at potent effects of the media, models of indirect media effects recognize that there are practical barriers to effective dissemination (Petty, Brinol, & Priester, 2009). Valkenburg, Peter, and Walther (2016) highlighted that most media effects are indirect rather than direct. In addition, Price and Roberts (1987) argued that behaviors are influenced by factors such as the communicative environment and human psychology. Examining indirect media effects would provide more comprehensive explanations of the relationships between key variables of concern (Raykov & Marcoulides, 2012). As mentioned earlier, one of the foci of this study is to examine how attention to media content on nano-enabled food as an independent variable would indirectly influence intentions to consume as an outcome variable. We apply the IPMI to examine how psychological, attitudinal, and normative factors would explain the theoretical pathways between the initial independent variable of interest and the outcome variable.

The first proposition of the IPMI is people's presumption of others' attention. According to the persuasive press inference (Gunther, 1998), people assume that the media content that they have been viewing has broad reach to many others and also has strong influence on others' opinions and attitudes. Without knowing others' opinions, audiences would rely on media representations as accurate reflections of public opinion. The concept of pluralistic ignorance (Merton, 1968; O'Gorman, 1975) and the law-of-small-number bias (Gunther, 1998) further explain that making inferences of extensive influence of the media from available information is a mental shortcut that people take when they form judgments. While media exposure refers to having seen some media content, paying attention to media messages indicates that people devote cognitive effort into processing the content (McGuire, 2001). Past studies found that media attention, rather than mere media exposure, was a better proxy of cognitive effects (Chaffee & Schleuder, 1986; McGuire, 2001). Chia (2006) found that the more late adolescents were exposed to sex-related content on TV, the higher the estimations of their peers' consumption of the same type of content gets. Likewise, Wen, Chia, and Hao (2017) found that young people's attention to cosmetic surgery-related media was positively associated with their perceptions of their peers' exposure to the same content. Presumption of others' attention accounts for the perceptual component of the IPMI.

A content analysis[1] of Singapore's most widely read newspaper outlet revealed that the media was generally supportive of nanotechnology. *The Straits Times* published 155 news stories on nanotechnology between January 2013 and September 2018. Only three of the news stories adopted a negative tone toward

nanotechnology; the majority of the news stories adopted a positive or neutral tone. Due to the lack of negative media attention on nano-enabled food, this study focused on how attention to the benefits of nano-enabled food shaped public intention to consume the food in the application of the IPMI.

Based on the preceding propositions of the IPMI and the coverage of nanotechnology in Singapore, we hypothesize:

> H1: Attention to the news on the benefits of nano-enabled food is positively associated with presumed others' attention to news on the benefits of nano-enabled food.

Figure 1 depicts the hypothesized IPMI.

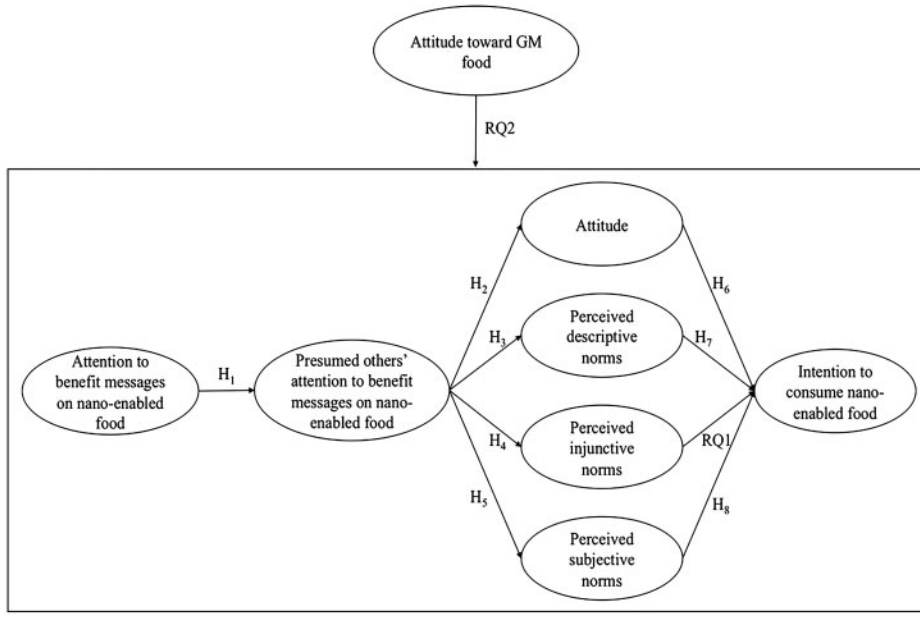

Figure 1 The hypothesized IPMI.

The behavioral component of the IPMI posits that presumptions of others' attention will inform people's attitudes. Another notion of the persuasive press inference posits that after making presumptions of media influence on other individuals, audience would perceive a change in aggregated public opinion (Gunther, 1998). This theoretical development lays the basis for later examinations of how individuals' perception of media content will predict how the individuals would think in reaction to their presumptions of public opinion. Gunther and Storey (2003) posited the relationship between presumed influence on others and one's attitude. They found that the stronger the clients of health workers presumed programs on improving service standards to impact the workers, the more likely they would develop

positive attitudes toward the workers. Clients' expectations of improved professionalism among the health workers could have made them feel obliged to accommodate with the positive changes in others (Gunther et al., 2008).

Existing IPMI research also provides strong support for the relationship between presumed media influence on others and attitude change. Liao et al. (2016) found that perceived others' attention to pro-environmental media messages shaped people's positive attitudes toward pro-environmental behaviors. Ho et al. (2014) found that presumed others' attention to anti-drinking messages was predictive of attitude toward drinking among the non-drinkers through perceived norms of drinking. Likewise, Gunther (1995) found that presumed peer exposure to anti-smoking messages was negatively associated with perceived prevalence of smoking among peers, which in turn positively predicted their own attitudes toward smoking. In the context of this study, it is likely that people's perception of others' attention to media messages on the benefits of nanotechnology would influence people to assume that others have a favorable attitude toward nanotechnology and nano-enabled food. As such, people would adopt similar positive attitudes toward consuming nano-enabled food.

> H2: Presumed others' attention to news on the *benefits* of nano-enabled food is positively associated with favorable attitudes toward nano-enabled food.

The cognitive explanation of presumed media influence accounts for the phenomenon with an assumption that people are naïve social scientists who attempt to make estimations of how the world functions (Eveland, Nathanson, Detenber, & McLeod, 1999). According to this argument, when people pay attention to a particular media content, they would intuitively assume the effects of media on others. Estimation of the effects of media on norms is one such instance. This happens via two paths: First, people tend to perceive the media as a reflection of reality (Eveland & Glynn, 2008). Second, they perceive that the media possess the ability to influence behaviors (Bandura, 2001). The ability to shape perceptions of reality and future behaviors implies that the media has the potential to influence people's perceptions of what behaviors are common and acceptable.

People leverage on their perceptions of social norms to guide behaviors. Perceptions of social norms inform people what behaviors are pervasive, rewarded, or punished within a community (Gavac, Murrar, & Brauer, 2016). There are three forms of social norms, namely descriptive norms, injunctive norms, and subjective norms. Descriptive norms reflect people's presumptions of the pervasiveness of a certain behavior or attitude among a group of people. Injunctive norms indicate people's presumptions of the extent to which their referent others would approve or disapprove of them behaving in a certain manner. Finally, subjective norms reflect people's presumptions of the degree to which their referent others would expect them to carry out certain behaviors (Rimal & Lapinski, 2015). The fear of public censure (Boyd, Gintis, Bowles, & Richerson, 2003) and the desire for social

acceptance (Asch, 1956) propel people to adhere to their perceptions of social norms. Together with the argument on presumed reach, people would assume that the social norms set by the media are adopted extensively across society.

Past studies provided support for the notion that presumed others' attention shapes perceived social norms. Gunther and colleagues (2006) found support for the relationship between youths' perceived peer exposure to pro-smoking media content and their perceived descriptive norms of smoking among their peers. Similarly, Ho et al. (2014) found that perceived peer attention to pro-drinking media messages was predictive of adolescents' perceived descriptive, subjective, and injunctive norms of drinking behaviors. For the same context, Ho et al. (2014) found that perceived subjective norms and injunctive norms were predictive of drinking among the non-drinkers, whereas perceived descriptive norms and perceived injunctive norms were predictive of drinking among the drinkers. Pertaining to health, Ho et al. (2016) found that personal norms—intrinsic moral compulsion to behave in a certain manner—toward physical activity and healthy dieting were predictive of both manners of healthy lifestyles. Hence, we hypothesize:

> H3: Presumed others' attention to news on the benefits of nano-enabled food is positively associated with perceived descriptive norms of consuming it.
> H4: Presumed others' attention to news on the benefits of nano-enabled food is positively associated with perceived injunctive norms of consuming it.
> H5: Presumed others' attention to news on the benefits of nano-enabled food is positively associated with perceived subjective norms of consuming it.

Attitude can shape behavioral intentions (Ajzen & Fishbein, 1973). Attitude toward a behavior refers to an overall evaluation of the behavior; it can adopt a positive or negative valence (Eagly & Chaiken, 1993). When people hold positive evaluations of a behavior, they are more motivated to perform the behavior. Prior studies suggest that attitude was significantly associated with people's intention to consume organic food (Yazdanpanah & Forouzani, 2015) and insect-based products (Menozzi, Sogari, Veneziani, Simoni, & Mora, 2017). Lee and Yun (2015) found that attitude toward organic food was positively associated with people's intention to purchase this type of food. People's positive evaluations of food fuel their intention to support the new food technologies and consume them to reap the benefits promised by the food items. Therefore, we hypothesize:

> H6: Favorable attitude toward nano-enabled food is positively associated with intention to consume nano-enabled food.

The IPMI also acknowledges that media content can shape perceived social norms as people presume that others' judgments of what is acceptable or unacceptable are altered by the media content. People feel compelled to adhere to their perceived social norms as they desire to gain favor from the people around them (Tajfel & Turner, 1985). Eating is a communal act that is bounded by norms (Stok, de Ridder, de Vet, & de Wit, 2014). Within a group, people's perceptions of others'

eating behaviors (perceived descriptive norms) provide information on what the group considers to be appropriate eating practices. People would modify their own eating behaviors to be aligned with the perceived descriptive norms (Higgs, 2015). Regarding perceived subjective norms for eating, Stok et al. (2014) found that perceived peer encouragement of healthy eating habits and discouragements of unhealthy eating behaviors were positively related to adolescents' healthy eating intentions. In this case, others' expectations successfully motivated people to consume certain types of foods or adopt certain diets. Therefore, we posit:

> H7: Perceived descriptive norms of consuming nano-enabled food is positively associated with intention to consume nano-enabled food.
> H8: Perceived subjective norms of consuming nano-enabled food is positively associated with intention to consume nano-enabled food.

However, studies have found the influence of perceived injunctive norms on eating behaviors to be inconsistent (e.g., Lally, Bartle, & Wardle, 2011; Robinson, Fleming, & Higgs, 2014; Smith et al., 2008; Stok et al., 2014). Smith et al. (2008) explained that perceived injunctive norms signal support from referent others to purchase certain food items. Yet, there are studies that indicate the limited applicability of perceived injunctive norms on food consumption behaviors. For instance, Stok et al. (2014) argued that people might be resistant to conform to others' views on what is acceptable. To support their point, they found that perceived injunctive norms was not significantly associated with intention to consume sufficient portions of fruits. Given the inconclusive findings on the role of injunctive norms in influencing intention to consume food, we pose the following research question:

> RQ1: How is perceived injunctive norms toward consuming nano-enabled food associated with intention to consume nano-enabled food?

A multigroup analysis of IPMI effects based on attitudes toward GM food

Recent studies have established the notion that people process one technology in relation to another. According to Brunel et al. (2018), anchoring occurs when people make references to new technologies using similar objects. Kronberger, Holtz, and Wagner (2012) explained that anchoring is a means for symbolically coping with new technologies. People take the mental shortcut to build fundamental knowledge of new technologies. Likewise, Akin et al. (2019) found a "spillover effect" from GM organisms to nanotechnology when people's risk perceptions of the former positively influenced their support for labeling nanotechnology products. Mehta's (2004) documentation of how expert panels prevented food regulators from making swift regulatory decisions on the basis of technological similarities pointed to the susceptibility of higher authorities to the spillover effect. Essentially, when people

draw technologies together, they form psychological bridges that have the potential to influence their behaviors toward related ones.

The extent of media attention on biotechnology and nanotechnology in Asia can shape how the public thinks about these technologies. As media coverage on nanotechnology in Asia tends to focus on its potential for nation-building (Fisk, Fitzgerald, & Cokley, 2014) rather than provide technical information, it is likely that the Singapore public does not have sufficient technical knowledge to form independent judgments of nano-enabled food. Hence, they are likely to rely on their pre-existing attitudes and beliefs toward similar preceding food technologies, such as GM food, to evaluate nano-enabled food (Grunert, Bredahl, & Scholderer, 2003; McCluskey & Swinnen, 2004). Meanwhile, studies showed that although the press coverage of biotechnology in the Asia Pacific tends to be positive, there were still considerable amount of reports of potential risks and public backlash (Du & Rachul, 2012; Hibino & Nagata, 2006; Navarro, Panopio, Malayang, & Amano Jr., 2011; Salleh, 2008). When the public is equipped with information on the risks and benefits of biotechnology while lacking balanced knowledge on nanotechnology, it is likely that what they know about the former would inform how they perceive the latter.

The similarity between these two types of engineered-food provides a basis for people to heuristically evaluate the risks and benefits involved in consuming nano-enabled food (Visschers et al., 2007). Based on research conducted in Denmark, Germany, Italy, and the United Kingdom, Scholderer and Frewer (2003) found that people's prevailing attitudes toward GM organisms influence their interpretations of new GM food. Besides, prior attitudes can shape acceptance of technologies even when the prior attitudes pertain to general or different domains. For example, Vandermoere et al. (2010) found that prior attitudes toward science and technology predicted Germans' attitude toward learning about nanotechnology. As prior attitudes toward science and technology can be sufficiently strong to inform attitudes toward similar and newer innovations, there is strong likelihood that an even more specific attitude toward GM food can spillover to their intentions to consume nano-enabled food in the IPMI.

> RQ2: Does the IPMI differ among people with different pre-existing attitudes toward GM food?

Method

We engaged a market research company to administer 1,000 face-to-face, interviewer-led, and computer-assisted surveys using tablet devices. The interviewers were trained prior to the commencement of fieldwork in order to ensure standardization and quality of interviews. The questionnaire was designed in English and translated into Mandarin, Malay, and Tamil such that all four official languages in Singapore were represented. To ensure the quality of translations, all translated

questionnaires were back translated and checked against the English questionnaire. Conducting the questionnaire in all four official languages allowed this study to be inclusive of individuals who do not speak English. Data collection took place between 28 June 2018 and 10 August 2018. Participants were given a S$10 shopping voucher upon completion of the questionnaire. The study attained an AAPOR response rate of 38.7%, calculated using Formula 3.

Sampling

The sampling strategy was probability proportionate stratified random sampling based on gender, age, ethnicity, and household type to select households nationwide to participate in the survey. To do so, we used the Department of Statistics (DOS) Singapore's listings to generate a sample frame. The DOS listing uses a two-step sampling method. First, general geographical locations of households were randomly selected. Second, household units within the geographical locations were then randomly selected. Specific participants were identified within each household using the next-birthday method. If the desired participant was not available at the time of the visit, the interviewers made at least two more visits to the household at a later time.

Sample

Only Singapore citizens and permanent residents who were 21 years old and above were eligible to participate in the study. The breakdown of the sample's age, gender, race, and household type closely reflected that of the national population. Of the 1,000 respondents, 48.5% were male and 51.5% were female. For ethnicity, 76.2% were Chinese, 12.4% were Malay, 9.2% were Indian, and 2.2% were from other ethnic groups. Participants' age ranged from 21 years to 88 years, and the median age was 44.0 years ($M = 46.3$, $SD = 16.2$), slightly higher than the nation's median age of 40.8 years. This is most likely because only individuals above 21 years old were eligible to participate in the questionnaire. The median annual household income was "S$60,000 to S$74,999" and the median education level was the completion of secondary school education, with most participants attaining a diploma and professional qualifications.

Measures

The exact item wordings, factor loadings, and descriptive statistics are presented in Table S1 (see Supporting Information). All items were measured using a 5-point Likert scale unless otherwise stated.

Attention to benefit messages on nano-enabled food. Participants answered four items on how much attention they paid to benefit messages on nano-enabled food on different media channels. The four media channels included television, newspapers, the Internet (excluding news websites), and documentaries. A higher score

represents greater attention to benefit messages on nano-enabled food ($M = 1.54$, $SD = .80$).

Presumed others' attention to benefit messages on nano-enabled food. Participants answered four items to measure presumed attention to the benefit messages on nano-enabled food of referent groups adapted from Liao et al. (2016). The referent groups included family members, friends, and the Singapore public. A higher score represents greater presumed others' attention to benefit messages on nano-enabled food ($M = 1.56$, $SD = .80$).

Attitude toward nano-enabled food and GM food. We used the same set of items to measure attitude toward nano-enabled food and GM food. Participants answered four 5-point semantic differential scale items measuring attitude toward each type of food. Items were adapted from past studies (Gil, Gracia, & Sánchez, 2000; Lee & Yun, 2015). A higher score represents a more positive evaluation of the food (Nano-enabled food: $M = 2.78$, $SD = .95$, Cronbach's $\alpha = .93$; GM food: $M = 2.86$, $SD = .94$; Cronbach's $\alpha = .94$).

Perceived descriptive norms. Participants answered three items adapted from Liao et al. (2016) on how much they perceive referent groups to consume nano-enabled food. Referent groups included family members, friends, and the Singapore public. A higher score represents stronger perceived descriptive norms regarding nano-enabled food consumption ($M = 2.77$, $SD = 1.01$).

Perceived subjective norms. Three items were adapted from Liao et al. (2016) to measure perceived expectations from referent others to consume nano-enabled food. Referent groups included family members, friends, and the Singapore public. A higher score represents stronger perceived subjective norms regarding nano-enabled food consumption ($M = 2.93$, $SD = .98$).

Perceived injunctive norms. Three items were adapted from Liao et al. (2016) to measure how much participants viewed referent groups to approve of them consuming nano-enabled food. Referent groups included family members, friends, and the Singapore public. A higher score represents stronger perceived injunctive norms regarding nano-enabled food consumption ($M = 2.93$, $SD = .98$).

Intention to consume nano-enabled food. Participants answered three items adapted from Menozzi et al. (2017) measuring intention to consume nano-enabled food in the next 3 months. A higher score represents greater intention to consume nano-enabled food ($M = 2.59$, $SD = 1.13$).

Analytical approach

Overall IPMI. Data analysis was conducted with *MPlus version 6.0*. We used structural equation modeling to test model fit and the relationship between variables. To account for non-normal data distribution, we used the robust maximum likelihood estimator (MLM) for the analysis. We included gender, age, education, and ethnicity as control variables in the model. Model fit was assessed based on the following criteria: (a) the maximum likelihood chi-square (χ^2) value obtained should be

nonsignificant ($p > .05$), (b) the relative chi-square ratio (χ^2/df) should not exceed 5 (Wheaton, Muthén, Alwin, & Summers, 1977), (c) the root mean square error of approximation (RMSEA) value yielded should fall below .08 (MacCallum, Browne, & Sugawara, 1996), (d) the standardized root-mean-square residual (SRMR) should fall below .08 (Bentler, 1995), and (e) the values obtained for both the comparative fit index (CFI) and Tucker–Lewis Index (TLI) should exceed .95 (Hu & Bentler, 1999). Items with factor loadings under .40 were dropped in order to ensure that the resulting items had good reliability (Stevens, 1992).

Multigroup analysis. To test if the IPMI differed among people with different pre-existing attitudes toward GM food, we divided the participants into three groups according to their attitudes toward GM food (i.e., unfavorable: $M_{\text{attitude}} \leq 3.0$, neutral: $M_{\text{attitude}} = 3.0$, and favorable: $M_{\text{attitude}} \geq 3.0$). The distribution of the respondents across the three groups was fairly equal (i.e., unfavorable: $N = 305$; neutral: $N = 409$; favorable: $N = 286$). To answer RQ2, we focused on comparing the group with unfavorable pre-existing attitudes toward GM food and the group with favorable pre-existing attitudes toward GM food. We removed the group with neutral pre-existing attitudes toward GM food so as to compare the two groups with polarized attitudes.

We conducted a multigroup comparison analysis to test if the IPMI differed across these two groups. Procedurally, we first conducted a multigroup model with the two groups—those with unfavorable pre-existing attitudes toward GM food and favorable pre-existing attitudes toward GM food. Next, we ran another similar multigroup model but with all paths constrained to be equal. Using the *DIFFTEST* command in *Mplus*, we performed a chi-square difference test to compare the unconstrained and constrained multigroup models. For groups that are statistically different, the chi-square difference test should yield a significant change (Yuan & Bentler, 2004).

Subsequently, we conducted a series of multigroup models that included equality constrained for only a particular path. We compared these constrained multigroup models with the unconstrained multigroup model by performing a series of chi-square difference tests to examine if the differences are located at a particular individual path within the model.

Results

Table S1 (see Supporting Information) presents the correlations among the variables. The results showed that attitude toward GM food was significantly and positively correlated with all the variables in the IPMI model. Table S2 (see Supporting Information) reports the standardized factor loadings and the exact item wordings. All factor loadings were significant ($p < .001$).

Testing the hypothesized IPMI model

The hypothesized IPMI had acceptable fit (MLM$\chi^2 = 749.18$, $df = 277$, $p < .001$; MLM$\chi^2/df = 2.70$; CFI = .97, TLI = .96, RMSEA = .04, SRMR = .03; see Table S3

in the Supporting Information), suggesting that the proposed model was supported by the data. The model accounted for 43.8% of the variance in intention to consume nano-enabled food.

The results showed that individuals' attention to benefit messages on nano-enabled food was positively associated with presumed others' attention to benefit messages on nano-enabled food ($\beta = .62$, $p < .001$), thus supporting H1. Presumed others' attention to benefit messages on nano-enabled food was positively associated with attitude toward nano-enabled food ($\beta = .18$, $p < .001$), perceived descriptive norms ($\beta = .26$, $p < .001$), perceived injunctive norms ($\beta = .17$, $p < .001$), and perceived subjective norms ($\beta = .32$, $p < .001$). Hence, the findings supported H2, H3, H4, and H5.

Meanwhile, attitude toward nano-enabled food, perceived injunctive norms, and perceived subjective norms was positively associated with intention to consume nano-enabled food (attitude: $\beta = .36$, $p < .001$; perceived injunctive norms: $\beta = .21$, $p < .001$; perceived subjective norms: $\beta = .20$, $p < .001$), thereby answering RQ1 and showing support for H6 and H8. Perceived descriptive norms was not significantly associated with intention to consume nano-enabled food ($\beta = .06$, $p > .05$). Hence, H7 was not supported. Overall, with the exception of H7, the findings supported all the proposed hypotheses. Figure 2 presents the results visually.

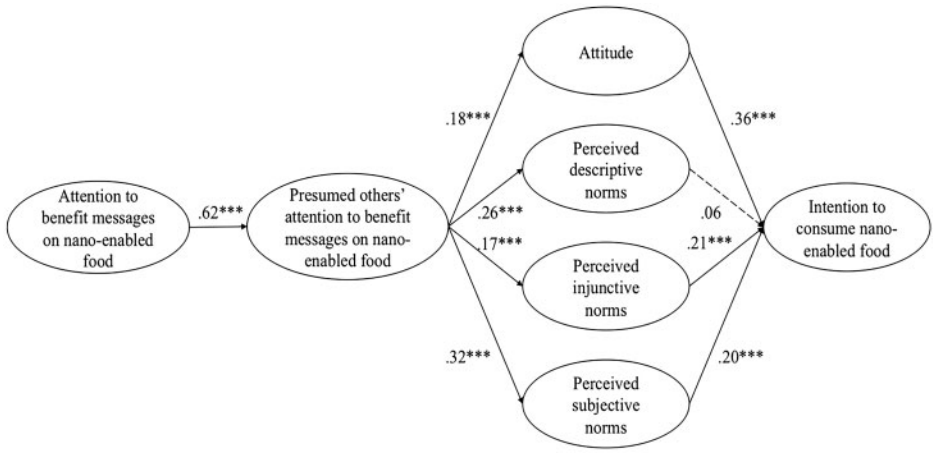

Figure 2 The IPMI ($N = 1{,}000$).

Note. The coefficients in the figure were standardized beta coefficients. Relationships between latent variables were assessed. Error terms among common latent factors (i.e., attitude, perceived descriptive norms, perceived injunctive norms, and perceived subjective norms) were allowed to correlate. Dotted lines reflect nonsignificant paths; solid lines reflect significant paths. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$ are standard denotations to reflect statistical significance.

Table 1 Multigroup Analysis ($N = 591$)

Multigroup models	χ^2	*df*	χ^2/df	CFI	TLI	RMSEA	SRMR
Unconstrained	819.384	597	1.37	.95	.95	.04	.05
Constrained (*all paths*)	903.267	634	1.42	.94	.94	.04	.10
Chi-square difference test	$\Delta\chi^2$ (1) = 132.01, $p = .00$						
Unconstrained	819.384	597	1.37	.95	.95	.04	.05
Constrained (*attitude—intention to consume*)	820.293	598	1.37	.95	.95	.04	.05
Chi-square difference test	$\Delta\chi^2$(1) = 1.67, $p = .20$						
Unconstrained	819.384	597	1.37	.95	.95	.04	.05
Constrained (*Descriptive norms—intention to consume*)	821.465	598	1.37	.95	.95	.04	.05
Chi-square difference test	$\Delta\chi^2$ (1) = 4.04, $p = .04$						
Unconstrained	819.384	597	1.37	.95	.95	.04	.05
Constrained (*Injunctive norms—intention to consume*)	820.079	598	1.37	.95	.95	.04	.05
Chi-square difference test	$\Delta\chi^2$ (1) = .16, $p = .69$						
Unconstrained	819.384	597	1.37	.95	.95	.04	.05
Constrained (*Subjective norms—intention*)	820.038	598	1.37	.95	.95	.04	.05
Chi-square difference test	$\Delta\chi^2$ (1) = .16, $p = .69$						
Unconstrained	819.384	597	1.37	.95	.95	.04	.05
Constrained (*Presumed other's attention—attitude*)	819.965	598	1.37	.95	.95	.04	.05
Chi-square difference test	$\Delta\chi^2$ (1) = 1.20, $p = .27$						
Unconstrained	819.384	597	1.37	.95	.95	.04	.05
Constrained (*Presumed other's attention—descriptive norms*)	820.478	598	1.37	.95	.95	.04	.05
Chi-square difference test	$\Delta\chi^2$ (1) = 1.11, $p = .29$						
Unconstrained	819.384	597	1.37	.95	.95	.04	.05
Constrained (*Presumed other's attention—injunctive norms*)	820.090	598	1.37	.95	.95	.04	.05
Chi-square difference test	$\Delta\chi^2$ (1) = 1.36, $p = .24$						
Unconstrained	819.384	597	1.37	.95	.95	.04	.05
Constrained (*Other's attention—subjective norms*)	820.105	598	1.37	.95	.95	.04	.05
Chi-square difference test	$\Delta\chi^2$ (1) = .21, $p = .65$						
Unconstrained	819.384	597	1.37	.95	.95	.04	.05
Constrained (*Attention—presumed other's attention*)	820.300	598	1.37	.95	.95	.04	.05
Chi-square difference test	$\Delta\chi^2$ (1) = 1.01, $p = .32$						

Multigroup analysis

Table 1 shows the results of the multigroup analysis of the IPMI between the groups with favorable and unfavorable pre-existing attitudes toward GM food. The results of the chi-square difference test revealed that there was a significant group

difference between the two models ($\Delta\chi^2$ (1) = 132.01, $p < .001$). This implies that the IPMI differs between people with favorable and unfavorable attitudes toward GM food. Hence, answering RQ2.

The subsequent series of chi-square difference tests revealed that the group difference was located at the path between perceived descriptive norms and intention to consume nano-enabled food ($\Delta\chi^2$ (1) = 4.04, $p < .05$). In other words, the direct effect of perceived descriptive norms on intention to consume nano-enabled food was a variant between the two groups with unfavorable and favorable attitudes toward GM food. This indicates that there is a spillover effect of attitude toward GM food on the relationship between perceived descriptive norms and intention to consume nano-enabled food.

Discussion

This article started with the question, "How do people's pre-existing attitudes toward a phenomenon influence the IPMI effects in a related context?" To answer this question, this study applied the IPMI to examine the indirect effects of media attention on individuals' intention to consume nano-enabled food in the first step. We found that all the proposed relationships in the IPMI were supported, except for the relationship between perceived descriptive norms and intention to consume nano-enabled food. This study proceeded with a multigroup analysis of the IPMI for the respondents with polarized pre-existing attitudes toward GM food (i.e., favorable and unfavorable). Through this, we answer RQ2: whether the IPMI differs among people with different pre-existing attitudes toward GM food.

In the overall IPMI, we found that the relationship between attention to benefit messages on nano-enabled food and intention to consume nano-enabled food was mediated by presumed others' attention to benefit messages on nano-enabled food, attitude toward nano-enabled food, perceived injunctive norms, and perceived subjective norms, but not perceived descriptive norms. One possible explanation is that people may generally be wary of consuming engineered-food, such as nano-enabled food. Simply observing that others are consuming the food cannot convince them to do the same. Rather, more explicit approvals from their referent others in the form of subjective norms and injunctive norms are required to help them overcome their uncertainty and mental hurdle so that they can develop sufficiently strong intention to consume such uncommon food.

Through the multigroup analysis, we found that the IPMI model significantly differs between the groups with favorable and unfavorable pre-existing attitudes toward GM food. In other words, anchoring (Brunel et al., 2018) is likely to have occurred as individuals made references to GM food when forming opinion toward nano-enabled food. Our finding was consistent with Akin et al.'s (2019) argument that a "spillover effect" can occur between GM organism and nanotechnology. Our study further supported this argument with the finding that individuals' pre-existing attitudes toward GM food have spilled over to their intentions to consume

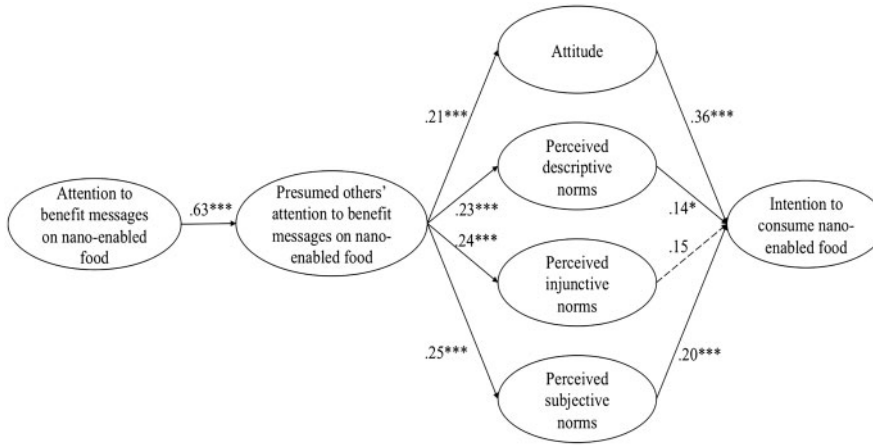

Figure 3 Multigroup analysis: Hypothesized IPMI among people with favorable attitude toward GM food ($N = 286$).

Note. The coefficients in the figure were standardized beta coefficients. Relationships between latent variables were assessed. Error terms among common latent factors (i.e., attitude, perceived descriptive norms, perceived injunctive norms, and perceived subjective norms) were allowed to correlate. Dotted lines reflect non-significant paths; solid lines reflect significant paths. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$ are standard denotations to reflect statistical significance.

nano-enabled food. In other words, individuals' prior attitudes toward a food technology could inform attitudes toward another similar food technology.

Subsequently, we found that the difference existed in the relationship between perceived descriptive norms and intention to consume nano-enabled food. Specifically, perceived descriptive norms was significantly and positively associated with intention to consume nano-enabled food among those with a favorable pre-existing attitude toward GM food ($\beta = .14$, $p < .05$; see Figure 3). In contrast, perceived descriptive norms was not significantly associated with intention to consume nano-enabled food among people with an unfavorable pre-existing attitude toward GM food (see Figure 4 and Table 1).

A relevant schema (Kim, 2009) that the group with favorable attitude toward GM food holds between GM food and nano-enabled food offers a plausible explanation to their intention to consume nano-enabled food. Relevant schema refers to people's cognition or emotion about an entity that is evoked and transferred into subsequent evaluations of similar entities. In this case, the positive schemas that these individuals have of GM food could have a favorable spillover effect on the related nano-enabled food, in terms of developing positive perceptions of its acceptance among the people around them. This in turn influenced individuals' intention to consume nano-enabled food. Conversely, the nonsignificant relationship between these two variables for the group with unfavorable pre-existing attitude toward GM

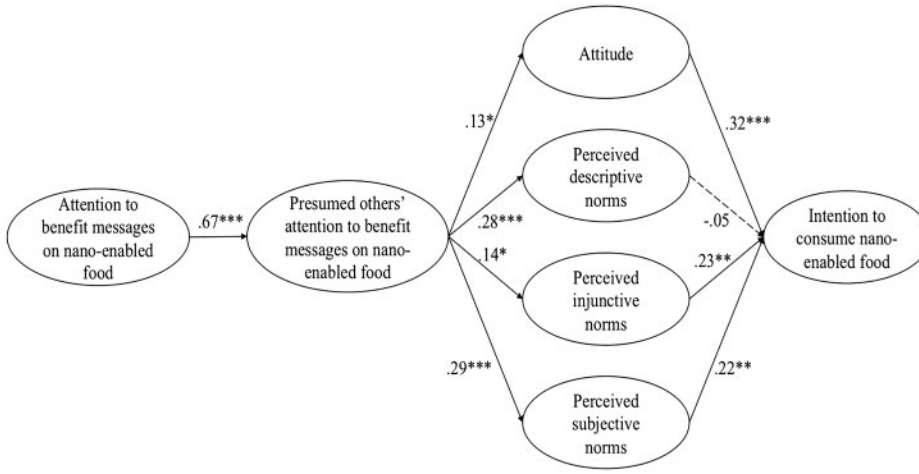

Figure 4 Multigroup analysis: Hypothesized IPMI among people with unfavorable attitude toward GM food ($N = 305$).
Note. The coefficients in the figure were standardized beta coefficients. Relationships between latent variables were assessed. Error terms among common latent factors (i.e., attitude, perceived descriptive norms, perceived injunctive norms, and perceived subjective norms) were allowed to correlate. Dotted lines reflect non-significant paths; solid lines reflect significant paths. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

food can potentially be attributed to a general rejection of technology-enabled food and other notions associated with it. Therefore, perceiving others to consume nano-enabled food may not be sufficient to shape this group of individuals with unfavourable attitude toward GM food to do the same.

Theoretical and practical implications

The objective of this study is to examine how pre-existing attitudes toward a phenomenon might influence a reaction that is posited by the IPMI. This study achieved this on two levels. First, we found that there is an overall group difference in how people with different pre-existing attitudes process the information that they receive from media platforms. Second, we also found that the overall group differences could be due to how social norms might act differently among people with different pre-existing beliefs. Overall, this study supports Akin et al.'s (2019) proposition of a spillover effect. The study also takes on Holbert and Park's (2019) recommendation to examine the conditional effects in established theories. We argue that the mental associations that people make between similar technologies may influence their behaviors toward a newer technology. This spillover effect is likely to occur in cases when the technology from which they draw cues from is socially contestable.

Notably, this study found that the relationship between descriptive norms and behavioral intention varies between two groups of people with favorable and unfavorable pre-existing attitudes toward a similar food technology. The theoretical implication of this finding to the IPMI is that some dimensions of social norms may play more prominent roles as mediators than other dimensions among groups of people with different pre-existing attitudes. This study showed that the descriptive norms was predictive of behavioral intention only under the condition that there was a favorable pre-existing attitude toward GM food. This finding contributes to existing knowledge on the role of social norms as mediators of the relationships between the perceptual and the behavioral components of the IPMI. The multigroup approach across groups with different characteristics enables research to identify the unique contribution of a mediator to the outcomes posited in IPMI studies.

The findings highlight the need for communication practitioners to identify issues that are salient in the minds of the public and understand their pre-existing attitudes toward these issues before implementing any campaigns. Communicators could further segment their target audience according to their pre-existing attitudes and develop messages using normative messages that convey the norms of an intended behavioral outcome. For instance, for audiences who already hold strong attitudes toward an issue, policymakers and communication practitioners could make references to the prevalence of a behavior in society to bring about the intended outcome. In other words, organizations that wish to publicize novel food technologies need to be aware that audiences' pre-existing attitude can pose challenges to their communication campaigns and therefore circumvent the situation strategically. Leveraging on credible news outlets to cover novel food technology as a whole is a feasible way of improving audiences' pre-existing attitudes prior to the actual communication campaigns for their target products.

Limitations of study and directions for future research

As with all research, this study has a few limitations. First, we were unable to trace the development of IPMI effects among the sample for an extended period of time with cross-sectional data. This precludes any statement of causality. Future studies can consider carrying out experiments to determine the causality between the factors. Second, this study was only able to measure people's intention to consume nano-enabled food and not actual consumption. As it is challenging to measure actual behavior across a large sample, we believe that intention, as a proximate indicator of actual behavior (Ajzen, 1991), provides a sufficiently strong measure of actual behavior.

We propose three directions for future IPMI studies. First, future studies that examine the spillover effect from one technology to another may consider other pre-existing attitudes or beliefs (e.g., eco-consciousness). Second, our approach points to future undertakings in important contexts such as politics and social affairs where people's pre-existing stance on an issue may impinge on the indirect effects of the

IPMI. Third, future studies should further examine the IPMI by including other conventional behaviors (i.e., prevention, coordination, and correction) as the outcomes, and examine whether a similar spillover effect of pre-existing attitude would influence the extended IPMI.

Conclusion

This study was a first step in IPMI research in undertaking a multigroup analysis of the indirect media effects among viewers with different pre-existing attitudes toward a related phenomenon. We conclude that there are indeed differences in the relationships that the IPMI posits when we segment viewers on a specific characteristic. Spillover effects of pre-existing attitudes do exist. Past debates, and in this case, pre-existing attitudes toward a related phenomenon, do matter.

Supporting Information

Supporting information on the inter-item correlations (Table S1), item wordings, factor loadings, and descriptive statistics of questionnaire items (Table S2), and fit indices for the IPMI (Table S3) is available as Supplemental Material to this manuscript.

Additional Supporting Information may be found in the online version of this article.

Please note: Oxford University Press is not responsible for the content or functionality of any supplementary materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.

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Notes

1. Using LexisNexis, we identified 155 news stories on nanotechnology that were published by *The Straits Times* between 1 January 2013 and 30 September 2018. We ran the search using "nanotechnology" as the keyword to understand the general reporting of nanotechnology. Two coders were hired to identify if the news stories adopted a positive, neutral, or negative tone when reporting on nano-enabled food in Singapore. A high intercoder reliability was achieved (Cohen's kappa = .89). *The Straits Times* is used as a proxy for other media as it is the most widely read newspaper in Singapore.

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