

## **Effects of Multipart Media Framing on Consumer Attitudes Toward Biotechnology**

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This study explores whether and how people with a negative biotechnology-related perception can change their attitudes when they are exposed to a positive message in two different frames. The two frames differ in terms of the medium, the language used, and the general tone. A frame is thus conceptualized as unified symbolic entities, rather than just words or positioning in terms of valence (positive/negative). An exploratory stage was conducted through in-depth interviews, which resulted in three audience categories. Results of the experimental study indicated that it is, in fact, possible to turn negative attitudes into positive attitudes for people with intuitive perceptions. People with analytical and ideological perceptions change their attitudes only when the frame is scientific.

*Keywords: biotechnology, food safety, framing, GM food, health marketing, medium*

### **Introduction**

People may behave and respond differently when a particular issue is presented in a different frame (Iyengar, 1991; Tversky & Kahneman, 1981). Many studies that concentrate on framing theory assume that when certain aspects are highlighted in a news story, associated cognitive nodes will be activated (Price & Tewksbury, 1997; Price, Tewksbury, & Powers, 1997). Emphasizing some aspects more, therefore, channels the audience to think in certain ways.

Intrigued by the notion that one can influence the audience to think in a certain way, we presume that framing cannot be reduced only to the wording of a statement but also involves various factors manifest in the environment or in the medium of communication. If framing is selecting particular elements or aspects of reality to call attention to a problem (Entman, 1993; Griffin, 2003; Scheufele & Tewksbury, 2007), then the inclusion of several elements to define and construct a frame is theoretically

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possible. Framing in this sense, namely, structuring the message in different ways using more than words and visuals, would contribute to the understanding of how different frames can affect audience attitude.

The present study aims to measure the effects of framing by operationalizing it as a combination of several elements, and not only the words or the valence (positive/negative). This study focuses on the context of food produced by biotechnological techniques, which has been a controversial issue where framing becomes even more important. Drawing from the idea that perceptions about food are highly shaped by the media (Tucker, Whaley, & Sharp, 2006) and that perceptions of safe food can differ among people (Boodhu, Badrie, & Sookdhan, 2008), the study explores whether and how people with a negative biotechnology-related perception can change their attitudes when they are exposed to a positive message in two different frames. A frame, therefore, is assumed to be a multipart construct, which contains several components. This study also takes into account preexisting audience characteristics so that their responses can be more critically elaborated. The following section discusses extant literature on news framing and the audience, and then continues with a particular focus on contexts related to health and food.

### **News Framing**

Framing theory has been studied in various contexts such as consumer behavior (e.g., Duhachek, Agrawal, & Han, 2012; Keller, Lipkus, & Rimer, 2003; Maheswaran & Meyers-Levy, 1990), political persuasion (e.g., Kim, Rao, & Lee, 2009; Maoz, 2012), and health behavior (e.g., Chandran & Menon, 2004). It has been discussed either as a way of conceptualizing how the media selectively covers already existing issues or news (e.g., Xu, 2013; Yang & Ishak, 2012) or how the audience communicates around a specific product or service (e.g., Stevens & Bell, 2012; Zhang & Ding, 2014), sometimes in the social media (Zeri, 2014). More recent studies have attempted to combine the effects of framing using multiple factors, such as endorsers and rewards (Wu, Linn, Fu, & Sukoco, 2012), source quality (Coleman, Thorson, & Wilkins, 2011), or source credibility (Grewal, Gotlieb, & Marmorstein, 1994; Jones, Sinclair, & Courneya, 2003). However, less attention has been paid to understanding situations where the essence of the message is kept the same but the medium and the frame setting are varied. Studies mainly look at whether picking up particular pieces of information or changing the wording of the news creates a difference, while it is also important to see if other components of a frame are influential in shaping audience attitude.

This neglected but important concept of frames as unified symbolic entities that include a variety of different constituents is one of the basic tenets of this study. Concern has been voiced about the inconsistencies in terms of how frames have been conceptualized and measured (Scheufele, 1999; Scheufele & Tewksbury, 2007). In various studies, frames have been operationalized based on content (i.e., whether the text is about finance or health), which does not directly contribute to the concept of framing per se. In order to understand if two sets of frames create a difference, we need to incorporate more elements in what we define as a frame.

The first contribution of this study is thus conceptualizing the frame as the totality of its prominent elements, together creating a gestalt structure, which cannot be predicted by looking at the

individual elements. The components of the frame in this study are the medium (where the message appears), the expressions used (which words and terms are used), and the general tone of the message (the degree of significance loaded in the message), whereas the general content (what the message actually is about) and the source (who is communicating the message) were kept the same, although one would expect that the content and the source would be perceived differently because of the influence of other components. Therefore, instead of conceptualizing the frame based on one chosen variable (or one subject area), we argue for a more unified version of frames, which would include all relevant factors. This is why we prefer to refer to frames as multipart, reflecting their multifaceted but integrated nature.

### **Audience Characteristics**

According to Entman (1993), frames make a piece of information more salient; that is, more noticeable, meaningful, or memorable. In this conceptualization, salience is a product of the interaction of texts and receivers (Entman, 1989, 1993; Graber, 1988). In other words, news and information are received and interpreted by a certain group of people, and different audiences would respond to the same text in different ways. Similarly, Scheufele (1999) argued for an interaction between the news frame and the frames that individuals have in their mind. Congruity between the frame and the way the audience thinks creates more affirmative results, whereby people engage in significantly more frequent behavior as intended (Sherman, Mann, & Updegraff, 2006). Pan and Kosicki (2001) asserted that frames serve to build discursive communities, which are themselves subject to change according to time and place. Therefore, the audience is also an integral part of framing, making it an inseparable part of the perception process.

Building on the idea that individual frames also affect how the audience perceives the news, several researchers have investigated different audience characteristics as either dependent or independent variables (Scheufele, 1999). Some researchers were interested in knowing whether time orientation (Kees, 2010; Tangari, Folse, Burton, & Kees, 2010; Zhao, Villagran, Kreps, & McHorney, 2012), construal level (White, MacDonnell, & Dahl, 2011), or emotions (Kim & Cameron, 2011) are effective in shaping news perception. Cole and Greer (2013) recently found that involvement is a very important audience-related variable affecting how respondents react to brand actions. The person's information-processing strategy was also found to mediate the relationship between the media and perceptions in health-related contexts (Fleming, Thorson, & Zhang, 2006). Overall, the type of frame and the type of the audience have been in a significantly important relationship (Vishwanath, 2009).

One particular audience-related characteristic is the level of knowledge. For example, Jin and Han (2014) recently found that if a person has less knowledge about an issue prior to receiving a message, then it is likely that she or he will respond to the message in a more dramatic way. Similarly, Garcia-Retamero and Galesic (2010) found that people with low numeracy are more susceptible to the effects of framing. One of the conclusions here might be that knowledge would decrease the framing effect. Garcia-Retamero and Galesic (2010) concluded that when people do not exactly understand a complicated health message, visual aids counteract the effects of framing, even among patients with low numeracy. General education level is another factor, which counteracts the effects of framing in general (Armstrong, Schwartz, Fitzgerald, Putt, & Ubel, 2002). However, Moerbeek and Casimir (2005) found no significant

relationship between information and framing effects. In other studies, general education was found to increase frame diversity (Huang, 2009), which may further complicate this issue. Although the literature is not very clear about the effects of knowledge and education, we believe this stems from the fact that perceptions are highly dependent on the context. We presume that specific knowledge (about biotechnology) is very influential in the way the audience perceives news and information. In this study, we look at the level of audience knowledge; more specific hypotheses will be established during the exploratory stage, where the contextual framework is exposed to a greater extent.

### **Framing Biotechnology and Food Consumption**

Health-related information has largely been formed based on gain versus loss framing (Lee, Lee, Park, Eillis, & Cameron, 2013; Levin, Schneider, & Gaeth, 1998; Maheswaran & Meyers-Levy, 1990; Wong & McMurray, 2002), and health messages usually work as a "warning act" (Osimani, 2010) and hence have a negative or even fearful tone (Sheer & Chen, 2008). There is considerable literature on whether gain or loss frames are more effectual in changing patient behavior. For example, studies have found that gain frames are more effective for promoting exercise (Jones et al., 2003), whereas loss frames are more effective for promoting self-examination for breast cancer (Williams, Clarke, & Borland, 2001). Bartels, Kelly, and Rothman (2010) recently found that when the audience perceives high risk associated with the particular health behavior, loss-framed messages can be more effective. Despite Tversky and Kahneman's (1981) well-known conclusion that more people would choose the choice option phrased as a gain rather than as a loss, in many health-related cases, communicating a negative message is found to be more persuasive (Edwards, Glyn, Covey, Matthews, & Rolsin, 2001; Goodall & Appiah, 2008; Levin et al., 1998). A recent meta-analysis by Coleman and Major (2014) revealed that 80% of public service announcements communicate health messages in which individuals are blamed, and the second most frequent frame involves negative emotions such as fear.

As a major source of information, the media are crucial in shaping public opinion about healthy food consumption (Jin & Han, 2014; Lupton, 2004). One particular area where framing is influential is the context of biotechnology. Biotechnology reflects the application of technology on living organisms to make or modify products or processes for specific human use (United Nations, 2014). It includes a range of technological procedures for modifying organisms according to human purposes, such as genetic engineering, biorobotics, and chemical engineering. The literature suggests that people are affected by the media on this issue (Frewer, Miles, and Marsh, 2002) and they generally have negative perceptions toward biotechnology (Bredahl, 1999). Researchers have drawn attention to the fear among consumers that biotechnology is harmful and that governments lie about the truth (e.g., Laros & Steenkamp, 2004; Quinn & Hencke, 1999). Everyday discourse about biotechnology reflects views that equate biotechnology to poison or radiation, namely, things that people cannot visibly identify or avoid. This nearly mysterious side of biotechnology is particularly worthy of note.

Some studies have investigated whether positive information can change these negative attitudes. For example, Lusk (2003) found that when people are provided with information about specific benefits related to genetically modified food, they become willing to pay a premium for it, although Scholderer and Frewer (2003) found that people may become even more negative after receiving positive

information. Curtis, McCluskey, and Wahl (2004) found that information may be positively perceived in a developing country because of an immediate need for food.

In other words, changing perceptions of biotechnology is a matter, not only of providing scientific information (e.g., Shaw, 2002), but also of communicating the message in an appropriate frame. Therefore, there is a need to distinguish between those who are afraid to consume biotechnology based on their personal judgment and those who are critically against biotechnology because they "know" about the issue, relating back to our initial premise that the audience may illustrate different characteristics depending on the level of their knowledge. Therefore we first attempt to understand if there are different audience groups with varying levels or intensities of biotechnology-related perceptions. The next section summarizes this exploratory stage.

### Exploratory Interviews and Hypotheses

In addition to findings from the literature, it was necessary to obtain opinions that were context- and culture-dependent (Pan & Kosicki, 2001) regarding the specific issue of biotechnology. The questions asked during the exploratory stage inquired about people's perceptions of biotechnology (specifically, genetically modified food), sources of information, and their intentions and behavior regarding this issue. Table 1 illustrates sample characteristics.

**Table 1. Characteristics of the Qualitative Sample.**

	<b>Age</b>	<b>Gender</b>	<b>Education</b>	<b>Job</b>	<b>Biotechnology</b>
<b>1</b>	53	Female	University	Retired	Intuitive
<b>2</b>	52	Female	University	Retired	Political
<b>3</b>	34	Female	Ph.D.	Teacher	Analytical
<b>4</b>	50	Female	Primary	Cleaning personnel	Intuitive
<b>5</b>	23	Female	Master's	Research assistant	Intuitive
<b>6</b>	22	Male	Master's	University student	Analytical
<b>7</b>	23	Female	Master's	Research assistant	Intuitive
<b>8</b>	33	Male	Ph.D.	Assistant professor	Analytical
<b>9</b>	35	Male	Ph.D.	Assistant professor	Political
<b>10</b>	26	Female	Master's	Graduate student	Political
<b>11</b>	26	Female	Master's	Research assistant	Political

The exploratory stage was conducted with 11 participants, who were visited at work or at home. Participants were selected on a convenience and voluntary basis. Average duration of an interview was 45 minutes. Interviews were conducted throughout four weeks during fall 2012. All interviews were analyzed using open and axial-coding procedures (Strauss & Corbin, 1998) with the purpose of categorizing people based on latent types of perceptions toward biotechnology.

The results show that the most important sources of information are *popular*, such as television shows and everyday news. However, some informants did not know or did not remember why they feel negative about biotechnology, and they explained their situation with statements such as, "Somehow I happen to know it's risky," or "Probably it's bad because everyone is talking about it." They usually had their own ways of understanding whether food is healthy or not, such as looking at the shape of grapes or smelling tomatoes. In this study, this group is described as having an *intuitive perception* because their perceptions do not depend on a detailed, conscious elaboration on the topic (Kim & Kim, 2003).

On the other hand, some people were personally interested in biotechnology: they actively searched for information (Kolodinsky & Narsana, 2003) and investigated the issue from more scientific sources, such as academic articles or more "trustworthy" sources, such as *The New York Times Science News* or documentary films. They read articles published by medical experts, sector leaders, and scientific reports related to agriculture and nutrition. This group could be described as having an *analytical perception* because their perception relied on academic articles and reports.

Last, some people were not receptive to new information (Ha, 2011). They were quite selective regarding the sources of information and they were best described as "politically sophisticated" (De Vreese & Boomgarden, 2006; De Vreese, Boomgarden, & Semetko, 2011). As an example, the 2nd interviewee mentioned that biotechnology is not totally bad, but she was still against it. The 11th interviewee, a member of the environmental group Greenpeace, actively protested against biotechnology. It was thus expected that positive information would not affect their attitudes because they would find this information biased anyway. They saw biotechnology as a threat to national security, biological variety, and nature, and they even perceived it a weapon of war. This last group of people is described as having a *political perception* because the perception relies on their ideological views.

Based on the literature discussion and exploratory results (briefly explained in the previous pages), we used one type of framing. Frames are bounded by either a scientific or a popular framework, containing (a) a message with a positive tone, written in almost the same sentences, except for a few terms and scientific phrases, (b) a source, who is a doctor in both frames, and (c) a medium, which is television in the popular scenario and a science magazine in the scientific scenario. Therefore, the expressions used, the tone of the message, and the medium were manipulated, whereas the source and the message content remained the same. In the scientific scenario, the expressions were more technical, the tone was more dominant and austere, and the medium was a science magazine. In the popular scenario, the expressions were simpler and more ordinary, the tone was more affable, and the medium was a popular TV show. The source, namely, the doctor who is providing the speech, was the same in both conditions, as was the content of the message, which basically talked about several advantages of food produced through biotechnological methods.

Based on these two frames, we formed the following hypotheses.

*H1: A positive message in a popular context will turn a negative biotechnology attitude into a positive one if the audience has (a) intuitive perception but it will have no significant effect on the audience with (b) analytic or (c) political perception.*

*H2: A positive message in a scientific context will change a negative biotechnology attitude into a positive one if the audience has (a) intuitive or (b) analytical perception but it will have no significant effect if the audience has (c) political perception.*

This study exemplifies the benefits of relying on interview data to categorize the audience based on their perceptions, before using the experimental methodology, although it is still restricted by the sample chosen. We believe that this multistage approach to understanding responses to communicative messages in a food safety context improves the validity of the results (see Redmond & Griffith, 2003, for a discussion on different research methods in food safety research).

### **Experimental Procedure and Measures**

The dependent variable in this study is the perception toward biotechnology after reading positive information. The aim is to arrive at the magnitude and the direction of a change in negative attitudes in response to positive information presented through different scenarios. In other words, we expect respondents to differentially change their negative attitudes into positive ones, depending on the experimental condition. For this purpose, an experimental procedure was followed. Respondents were tested in a natural setting (classroom, office, or home), based on their consent, where they answered questions on a piece of paper and on a self-report basis.

The positive information was presented to be taken from either a doctor who appears in a TV show (popular scenario) or a doctor who provides a commentary for a scientific magazine (scientific scenario). Both scenarios contain positive information about the benefits of biotechnology, such as using it for vaccination purposes, intake of additional vitamins, and lessening the need for pesticides. A pretest among 30 people was conducted to see whether the scenarios were perceived as intended. The statements in the relevant scale ranged from "This script is written in scientific language," to "This script is written in everyday, popular language," and from 1 to 5 points, respectively. The mean for the popular scenario was 3.56 and the mean for the scientific scenario was 2.58. The mean difference was significant ( $p < 0.00$ ). In addition, 10 people read both scenarios and took notes on biotechnology benefits, where the notes highlighted almost the same benefits. Therefore, we had sufficient evidence to believe that the essence of the message is the same, whereas one scenario was perceived to be more scientific than the other one.

The questionnaire used in the experiment consists of five Likert questions, which were developed for the purposes of this study. An initial four questions measured the level of perception negativity (two items), the level of biotechnology knowledge (one item), and the level of political refusal (based on an item asking whether the person would attend a protest against biotechnology). Following these questions, one of two scenarios was introduced on a random basis, with either popular or scientific content. This scenario was followed by one last question measuring (the updated) attitude toward biotechnology.

Experimental data were collected, after the qualitative phase, throughout two months in 2013, from a sample of 261 participants living in three different places in Turkey, İzmir, Bandırma, and Ankara.

Convenience sampling was adopted in the experimental phase, with particular attention paid toward reaching a satisfactory and comparable sample in each group. Among 261 informants, those who had a positive initial perception toward biotechnology were taken out of the sample. The two groups, both consisting of those who had a negative initial perception toward biotechnology, were comparable on key demographic variables (Table 2).

**Table 2. Characteristics of the Sample in the Experimental Stage.**

Characteristic	Popular Scenario	Scientific Scenario
Sample Size	98	93
Female	48%	43%
University or Higher	44%	44%
Average Age	34 years	33 years
Average Income	\$6,132/year	\$8,532/year

## Results

The data obtained from the experimental 2 x 3 factorial design (Popular/Scientific Context x Intuitive/Analytic/Political Perception) was analyzed using SPSS 19.00. Descriptive results for the popular and scientific scenarios are summarized in Table 3.

**Table 3. Summary Statistic**

	Intuitive	Analytical	Political	Total
Popular Context	$n = 34$	$n = 24$	$n = 33$	$n = 91$
Scientific Context	$n = 37$	$n = 26$	$n = 37$	$n = 100$
Total	$n = 71$	$n = 50$	$n = 70$	$n = 191$
Perception	mean = 4.45	mean = 4.28	mean = 4.56	mean = 4.45
Level of Knowledge	mean = 1.13	mean = 3.64	mean = 3.73	mean = 2.74

Note: Includes only those with negative perceptions toward biotechnology.

Median levels were used to determine participants with intuitive, analytical, and political perceptions. The median value for negative perception was 4 where the question was asked in positive language, so 70 people who had a score higher than 4 points were excluded from the study because they were not "sufficiently" negative toward biotechnology. The median value for the level of biotechnology knowledge was 3, therefore those with a knowledge score of less than 3 were assumed to have an intuitive perception because their negative perception did not depend on knowledge. Those with a knowledge score higher than 3 were assumed to have an analytical perception. Among these knowledgeable people, the median value for negative ideological orientation was 4 for the popular message scenario and 3 for the scientific message scenario. Therefore, if a knowledgeable person scores higher than the median value, she or he was assumed to have a political negative perception.

In order to see the effects of a positive message in two different contexts, *t* test comparisons were conducted. The results are summarized in Table 4.

**Table 4. *t* Test Result.**

	<b>Positive Message in a Popular Context</b>	<b>Positive Message in a Scientific Context</b>
<b>Change in Intuitive Negative Perception<sup>a</sup></b>	-0, 83**	-1, 70**
<b>Change in Analytical Negative Perception<sup>a</sup></b>	-0, 41	-1, 19**
<b>Change in Political Negative Perception<sup>a</sup></b>	-0, 25	-0, 92**

<sup>a</sup>A negative result indicates that the person is more positive toward biotechnology.

\*\* The result is significant at .05.

Table 4 shows that a positive message would significantly change intuitive negative perceptions in both popular and scientific contexts, supporting Hypotheses 1a and 2a. The results also show that a positive message in a popular context would not change an analytical negative perception, supporting Hypothesis 2a; and a positive message in a scientific context would change an analytical negative perception, supporting Hypothesis 2b. Finally, although we expected that people with a political negative perception would not change their minds on the basis of any information provided, results show that they can actually change their minds based on positive information communicated in a scientific context. Therefore, Hypotheses 1c is supported but Hypothesis 2c is not supported.

An independent-samples *t* test was conducted to compare the initial attitudes and the subsequent attitudes between the two samples to see if initial attitudes were already different. A paired-samples *t* test was conducted to see if initial and subsequent attitudes differed under each condition. Categories based on level of knowledge were disregarded in this analysis.

Table 5 shows that subsequent attitudes were significantly higher in both the popular and scientific scenarios, which was our original premise in this study. Initial attitudes did not significantly differ between two samples and only subsequent attitudes were different. This test also indicates that the scientific scenario yielded more positive outcomes.

**Table 5. Independent and Paired Samples t Test**

	Initial Attitude	Posterior Attitude**
Popular Scenario**	1, 3367	1, 8469
Scientific Scenario**	1, 3158	2, 5895

\*\* The difference is significant at .000.

These results highlight three important conclusions. First, people with intuitive perception tend to “forget” about their negative feelings toward biotechnology when they come across a positive message, regardless of the medium. This finding is important because, arguably, it shows that it is easy to change people’s minds about biotechnology (and perhaps about other questionably risky consumer products) through a casual TV show. Second, as expected, people with analytical perception change their negative attitude only when the context is appropriate, that is, scientific. Although the content of the message reflects almost the same benefits, the mean values in popular and scientific message situations differ significantly. This raises implications for frame credibility, as different from source credibility, since the messenger was a doctor in both situations. In this case, framing is not related to whether the information is positive or negative, and not even related to the source communicating the message, but rather is related to an arrangement of multiple elements.

Last, and contrary to our expectations, people with high political perception are also inclined to change their negative perception after reading scientific evidence. A “politically loaded” audience can actually have a generalized, and sometimes biased, attitude toward biotechnology; therefore, they may be surprised by the new and scientific information, and become convinced when they hear about tangible benefits for the public (Hossain, Onyango, Schilling, Hallman, & Adelaja, 2003). In other words, they may be biased against biotechnology without actually knowing much about it. This last finding therefore shows that even people with strong beliefs can change their minds if the appropriate person or organization can reach them through a “proper” frame.

### Discussion

Although people with intuitive perceptions tend to change their negative attitudes more easily, people with a greater level of knowledge tend to rely on only scientifically framed information. Those who hold an ideologically negative position can also perceive biotechnology more positively, although this change was smaller compared to other groups. It is interesting to see that scientifically framed information always creates a difference, even for the ideologically opposed group, contrary to some previous accounts (e.g., Lusk et al., 2004), which claim that people with initial negative attitudes tend to put less weight on new information that contradicts their beliefs. In our study we found that information can be framed in more than valence-based distinctions (i.e., positive/negative), so much so that the same, but scientifically framed, information can change negative attitudes to positive ones.

We believe that the framing literature needs more inductive and issue-specific frames to see if different, and previously neglected, elements of a frame are capable of composing issues in better ways. Although the source and the content are the same in two contexts studied, these and other elements

*together* create different symbolic meaning structures for participants, similar to using metaphors in framing issues (Williams, 2013). In order to avoid some "frame pollution," with no explanation for how they might be related (i.e., to avoid frames that only function as scaffolds fitting only the particular research), a more workable definition is needed. In this study, we believe we have made an attempt by defining frames as more general "structures of perception," and by calling for further empirical studies that would investigate more frames of this kind.

In fact, a very recent overview by Souders and Dillard (2014) suggests that different traditions of studying frames can be effectively combined. We believe that Burke's (1984) understanding of frames as macro categories and Goffman's (1974) conceptualization of frames in which experiential factors play a considerable role are both incorporated in this study, by also "thickening" the methodological approach (Kinder, 2007), through the inclusion of individuals' prior perceptions and their attitudinal responses to experimental stimuli. A multipart framing idea may still remain as a loose theoretical connection to strongly existing theories (such as Goffman's, 1974, understanding in which "schemata of interpretation" allows individuals to perceive issues in a certain way); however, it promises a more practical understanding of how a frame can be defined and operationalized. It becomes very hard to theoretically improve the concept of framing once it is defined as a *tacit* way of emphasizing and presenting (Maher, 2001), while this study has tried to conceptualize frames as structures that are more actively created and applied, reflecting the notion of conscious selection of frames (Reese, 2001).

Considering the fact that several studies have found no significant effects of framing on attitude change (e.g., Coleman et al., 2011), we still need to know whether and how audience attitude might change in response to different frames. However, we also need to discuss whether there is a need to frame issues, especially in the area of health- and food-related issues. Some researchers assume that framing is manipulation of the audience (Edwards et al., 2001) and suggest that it should be avoided in the health area. Some researchers claim that especially for patients with low numeracy or who are uneducated or illiterate, enhanced methods of framing can be used if the purpose is to encourage healthy behavior (Almashat, Edelstein, & Margrett, 2008), such as by using visuals (Garcia-Retamero & Galesic, 2010; Goodyear-Smith et al., 2008). We found convincing evidence that knowledge does not directly interfere with the framing process since people with analytical and ideological perceptions can also start to perceive biotechnology more positively; however, we still do not know the details of this perceptual process, namely, whether the participants have used new information in light of existing knowledge, or whether they have been really amazed by the positive information presented in a scientific frame, which has changed their minds about biotechnology altogether.

Depending on the empirical findings identified in this study, future studies should be cautious when considering the credibility of scientific sources in health-related messages (Masatu, Kvåle, Klepp, 2003; McCallum, Hammond, & Covello, 1991; Ostman & Parker, 1987) and should take into account other variables such as those we mentioned previously. One of the limitations in this study is the small size of the samples, especially for the exploratory stage, which involved selecting respondents on a convenience basis. Although attention was paid to include people with varying demographics and the samples were comparable under two conditions, future studies may want to enlarge the samples to better reflect diverse characteristics and possible new categories of consumers. Moreover, this study only looked at attitude

change through one instance of information delivery, whereas attitude change may involve several instances of positive and negative information exchange between and among the media and the audience.

It is also a good idea to single out the effects of each contextual element and discuss separate and combined effects. Also, the message can contain both positive and negative information as well as competing frames (Chong & Druckman, 2007; Wise & Brewer, 2010) or mixed-framed messages (Chang, 2007), resembling real life situations where people are bombarded with different sorts of information from a variety of sources. Finally, future studies can use a similar experimental design to test whether it is possible to change attitudes in other contexts where information might be confusing, such as plastic surgery, use of hormones and pesticides in agricultural products, caffeine intake, use of ultrasound technology, or overconsumption of specific vegetables and fruits. In the case of biotechnology, instead of assuming people's lack of knowledge, their actual perceptions can be appreciated (Yeung & Morris, 2006) and informative messages can be created as to *why* people should change their attitudes. If the message can be designed in an appropriate way, "clear patterns across diverse settings" (Horlick-Jones & Prades, 2009, p. 425) can be attainable.

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