

# The Emperor's Clothes in High Resolution: An Experimental Study of the Framing Effect and the Diffusion of HDTV

DIRKJAN JOOR and WILCO BEEKHUIZEN

Utrecht University

LIDWIEN VAN DE WIJNGAERT

Twente University

and

EVA BAAREN

Utrecht University

In this article, an experiment was conducted to measure the effect of framing a high definition television (HDTV) clip. One group of participants was told they were watching a brand new HDTV clip, while the other group was told they were watching a digital DVD clip. Both groups were in fact watching the same (low) quality DVD clip. After watching this clip, the beliefs of the participants and their viewing experiences were measured via a questionnaire. The people framed to watch the HDTV clip were found to have a significantly more positive viewing experience. This shows that participants were unable to discriminate properly between digital and high definition signals but were influenced by the frame set for them. This effect has been shown in many different situations, and has now been established when watching HD-quality television as well. The results still indicate that the HDTV-frame is already associated with a high-quality viewing experience, which may influence the selling strategy and/or speed in the adoption of this technology. In the following discussion we will pay attention to the different ways in which HDTV can be framed in the media.

Categories and Subject Descriptors: H.1.2 [Models and Principles]: User/Machine Systems—*Human factors*; H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems; H.5.2 [Information Interfaces and Presentation]: User Interfaces—*User-centered design*

General Terms: Experimentation, Human Factors, Performance

Additional Key Words and Phrases: High definition television (HDTV), digital DVD, HDTV-frame, high-quality viewing experience

Authors' addresses: L. Van de Wijngaert, Department of Media, Communication and Organization, Twente University; D. Joor, W. Beekhuizen, and E. Baaren, Dept. of Information and Computing Science, Utrecht University; contact author's; email: [lvandewijngaert@utwente.nl](mailto:lvandewijngaert@utwente.nl).

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies show this notice on the first page or initial screen of a display along with the full citation. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers, to redistribute to lists, or to use any component of this work in other works requires prior specific permission and/or a fee. Permissions may be requested from Publications Dept., ACM, Inc., 2 Penn Plaza, Suite 701, New York, NY 10121-0701 USA, fax +1 (212) 869-0481, or [permissions@acm.org](mailto:permissions@acm.org).  
© 2009 ACM 1544-3574/2009/09-ART40 \$10.00  
DOI 10.1145/1594943.1594952 <http://doi.acm.org/10.1145/1594943.1594952>

**ACM Reference Format:**

Joor, D., Beekhuizen, W., Van de Wijngaert, L., and Baaren, E. 2009. The emperor's clothes in high resolution: An experimental study of the framing effect and the diffusion of HDTV. *ACM Comput. Entertain.* 7, 3, Article 40 (September 2009), 13 pages.  
 DOI = 10.1145/1594943.1594952 <http://doi.acm.org/10.1145/1594943.1594952>

---

**1. INTRODUCTION**

High definition television (HDTV) is aimed to provide a noticeably higher quality level of display for observers, because HDTV offers a higher resolution signal compared to standard television. Compared to standard definition, which offers a video mode of 576i and an aspect ratio of 4:3 in PAL and SECAM countries; the HDTV standard offers a video mode of 720p, 1080i or 1080p with an aspect ratio of 16:9. Furthermore, HDTV is watched on a flat panel. As a consequence, HDTV should result in a higher quality and a better viewing experience for observers [Belgacem et al. 2005]. This research does not test whether there was a noticeable difference between a high definition television signal and standard digital signals, nor does it look for a noticeable difference in quality between different HDTV formats. This research is of a more psychological nature, as it investigates the relation between expectations, viewing experiences, and beliefs. It answers the question: “Will telling viewers that they are watching a HDTV signal lead to a higher quality viewing experience?” To answer this question, we use framing theory as described by Druckman [2001], Nelson et al. [1997], and Nelson and Oxley [1999]. Frames are principles of selection, emphasis, and presentation composed of modest, tacit theories about what exists, what happens, and what matters [Gitlin 1980]. The assumptions of framing theory state that to influence a person's attitude (perspective toward a specified target), the frame is a more direct change mechanism than belief (the psychological state in which an individual holds a proposition or premise to be true). The attitude is a result of both the frame and individual beliefs [Nelson et al. 1997; Nelson and Oxley 1999]. This experiment can be grasped intuitively by drawing a simile with the tale of the emperor's new clothes by Hans Christian Andersen. Setting a frame highlights certain aspects of reality to direct the attention of the information receiver to them. Previous research has focused on the participants' opinion of topics such as abortion [Nelson et al. 1997; Nelson and Oxley 1999] or free speech [Druckman 2001]. Most television-related research on framing is directed towards how television content is framed—for example, the way in which news [De Vreese 2003; McLeod and Detenber 2006] or political issues [Iyengar 1991] are framed. The relevance of this research is that framing theory is used to direct the participants in their attitude towards a viewing experience. The outcome will show whether the experience itself, or at least the assessment of this experience, is moderated by framing. From the perspectives of the user and consumer, the outcome of the experiment may also reflect on the ability of the term “HDTV” to influence consumers into expecting a higher quality viewer experience, and is therefore relevant when studying the individual decision process [Rogers 2003]. The ability to change the attitude of the consumer plays a role in the persuasion process that frames HDTV as a pleasant viewing

experience for users, whether this is true or not. Framing a viewing experience as HDTV shows the current ability of the HDTV concept to affect the attitude of possible consumers in the persuasion phase. If the framing effect could be proven, it would also emphasize a role for mass media in framing an innovation, and thereby increase interest in adopting an innovation [Le Book and Barnett 2006; Rogers 2003, p. 170]. Finally, from a provider perspective, it is interesting to see whether image improvement from a technical perspective is actually fully responsible for a perceived experience, or whether expectation alone influences the experience. In that case, other features of digital television may be more interesting to provide first, before the improved quality offered by HDTV.

## 2. THEORETICAL FRAMEWORK

While the quality of the television experience is measured relatively often [Rohali et al. 2000] in product reviews by either suppliers or consumers, and can be readily measured using quality attributes [Pécharde et al. 2006], the concept of expectancy cannot be grasped as directly, as it is of a more psychological nature. To form a conceptual model for measuring expectancy, the concepts of “belief,” “framing,” and “attitude” are used as the basis for the theoretical framework. These concepts are described in the research of Nelson et al. [1997] and Nelson and Oxley [1999]. The process of framing has been extensively researched in fields such as psychology, political science, and communications studies, but definitions differ. For clarity, the researches used an algebraic model to explain the relation between the underlying concepts of expectancy:

$$A = \sum v_i * w_i \quad (1)$$

In this formula, A stands for attitude, while the concept of attitude is not explicitly defined in Nelson et al. [1997] and Nelson and Oxley [1999]. In the context of this experiment, “attitude” is assumed to be the same as “expectancy”. Using this assumption, expectancy can be seen as the total sum of  $v$  (value beliefs) and  $w$  (weight) of each  $i$  (attitude object). Nelson et al. [1997] and Nelson and Oxley [1999] use the framing of a message as the factor that tells information receivers how to weight their beliefs. Following this reasoning, respondents who view an experience in the HDTV-frame should also increase the weight of their belief that the image is high quality, and thereby have a more optimistic expectation of the movie experience. This leads to the H1 hypothesis:

**H1:** *Individuals who have been convinced (framed) that they are watching a HDTV signal, will have a higher expectation, and therefore a better quality viewing experience than those who have been convinced (framed) to believe that they watched a standard digital signal.*

The first hypothesis measures the effect of increasing the weight ( $W$ ) of beliefs by means of the frame only. However, in accordance with this formula, respondents are likely to differ in their beliefs about HDTV. One respondent may believe that the quality of the color is better, while another believes that the color does not substantially differ, if at all, from that of an earlier version of television. When a respondent has a little belief in the greater quality of HDTV, the framing effect should cancel out. When a respondent does believe

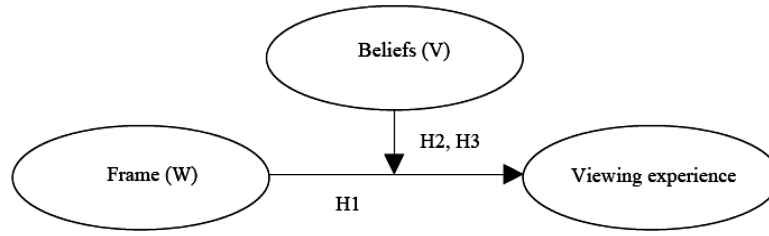


Fig. 1. Conceptual model for the relation between expectation and experience.

that HDTV offers better quality, it should be noticeable in the evaluation of the respondent's experience. This leads to the H2 hypothesis:

**H2:** *A greater belief in the greater quality of HDTV compared to standard digital television results in a higher appreciation of the viewing experience by the group that is framed to watch HDTV, while this result is not seen in the group that is framed to watch standard digital television.*

The second hypothesis does take into account both the beliefs *V* and frame *W* in the formula; but does not relate this to the individual attitude objects (*i*). Attitude objects in the context of HDTV are single quality attributes such as color. According to the formula, the added sum of each attitude object (belief \* frame) will result in the final attitude. This results in the third and final hypothesis:

**H3:** *The beliefs weighted by the HDTV-frame should have a positive relation to their identical experience item.*

An example of H3 can be shown in formula (2) by using the attitude object of “image color”.

$$A_{\text{color}} = V_{\text{color}} * W_{\text{color}} \quad (2)$$

Here the attitude (*A*) is measured indirectly through the viewing experience, the weight (*w*) is assumed to be a direct result of the HDTV-frame, and belief (*v*) is measured directly. Because attitude objects require the measurement of both the experience and the belief about the object, thus making it repetitive for participants, and only measuring the consistency in answering questions, this research limits itself to matching three beliefs and experience items only: color, motion, and realism.

Combining the previous three hypotheses with the underlying variables results in the conceptual model in Figure 1. The concepts of attitude and expectation, its synonym concept, are latent variables that result from combining belief and the frame, and influences the viewing experience.

Staples et al. [2001] elaborate on expectations (related to information systems) using disconfirmation theory. In summary, this theory measures perception compared to expectation. (Unrealistically high expectations will result in lower perceived benefits.) When framing backfires due to high expectations, this theory offers a possible explanation. However, to formulate the hypothesis, a positive effect for framing is assumed.

### 3. METHOD

In order to test the hypotheses, an experiment was set up using a design to compare the results between the participants. The viewing experiences and beliefs of participants were studied by inviting them to watch a DVD clip on a high definition television (full HD). One group of participants ( $N = 30$ ) was told they were watching a HDTV clip, others (also  $N = 30$ ) were told they were watching a standard digital DVD signal. Both groups were in fact watching the same-quality DVD signal. The DVD clip shown to both groups is a 90-second clip of “Life in the Blue: HD” [<http://www.apple.com/quicktime/guide/hd/bbc-blue.html>].

The first 90 seconds of this clip were shown to all participants. The clip shows the text “Live in the blue in HD”. The second group was told the truth: that the original version was converted to DVD for this research. The first group (framed to watch HDTV) was not made aware of this. The clip showed underwater footage; the demo was obtained through the procedure described in Appendix A.

*Experimental setting and stimuli.* All the participants were informed that they were watching a clip on a flat panel device. Both groups had the same flat panel and the same signal, but both groups were told they were watching either a HD signal or a DVD signal. All the participants sat about four meters away from the screen. We placed four posters indicating which signal the participants were framed to watch in the room. The group framed to watch HDTV had in their room a thick cable going from the television to a computer, as if the signal were coming from a source other than the DVD player. A strong determinant of the effectiveness of a frame is the credibility of the one setting the frame [Druckman 2001]. Credibility is defined in two dimensions: (1) that the speaker’s audience must believe that the speaker has relevant knowledge and (2) that the audience believes that the speaker reveals everything he or she knows that is relevant to the topic. Hence a credible story must be constructed and understood by those in charge of this experiment beforehand, so as to answer questions from the participants. Table I illustrates both frames; both were communicated through spoken language in Dutch, as all participants were Dutch.

*Participants and procedure.* In the experiment, there were 30 participants in each frame. All participants are Dutch media and communication students at the Dutch Polytechnic in Utrecht, Netherlands. Both male and female participants in this sample were between 19 and 25 years of age.

Participants were taken into a room individually, or with at most three others. They were requested to refrain from comment during the movie clip to prevent influencing the other participants during the session, at least verbally.

The questionnaire that was distributed after the film clip in both Dutch and English; all the participants used the Dutch version. The questionnaire asks questions regarding the viewing experience, television ownership, and beliefs about HDTV. Most items were measured on the seven-point scale ranging from low to high; the entire questionnaire is included in Appendix B. The questionnaire shows the items used to develop the construct. Cronbachs’ alpha reveals

Table I. The Two Frames Created for the Experiment

Frame	Text	Accessories
HDTV	“Welcome. You are about to watch a HDTV clip on a brand new HDTV. HDTV is the future of television as it promises a better television experience. We research the quality HDTV offers by letting you watch a new HDTV clip followed by a short questionnaire in which you can indicate how you experienced this clip.”	Flyers, ?fake cable connected to pc
Standard digital frame	“Welcome. You are about to watch a standard DVD signal on a brand new HDTV. HDTV is the future of television as it promises a better television experience. We research if the old DVD signal is still good enough on a new HDTV, or if you really need the newest HDTV signal for a pleasurable viewing experience. After watching a short DVD clip you will receive a questionnaire on which you can indicate how you experienced this clip.”	Flyers

that by leaving out sound and realism, a construct of four items can be formed for experience ( $\alpha = 0,74$ ). The data items for belief will be used separately, as no satisfying alpha was found.

#### 4. RESULTS

From the descriptive data, it was found that 20 of a total of 60 participants owned a flat screen, and 11 participants were expecting to buy one during the coming 12 months. Analysis shows that the experience does not differ significantly between owners of a flat screen television and non-owners, although owners did have a greater belief that HDTV was worth paying extra for ( $t = 2,69$ ;  $p < 0.01$ ). To analyze the difference in the experience of the group that watched HDTV and the group that watched the standard digital signal, the H1 hypothesis used an independent sample T-test. The standard digital group valued the experience construct by an average of 4,98, while the HDTV group valued it a full point higher at 5,98. This difference is significant ( $t = 4,56$ ;  $p < 0.01$ ). For the individual experience items, the difference between the groups is significant for color ( $t = 2,55$ ;  $p < 0.05$ ); for both movement ( $t = 2,99$ ;  $p < 0.05$ ) and sharpness ( $t = 3,26$ ;  $p < 0.05$ ); and for brightness ( $t = 4,57$ ;  $p < 0.05$ ). For the experience items of sound and realism, the difference between groups is not significant. The alpha value already indicated that sound and realism do not respond to the other experience items, and are not used to measure experience. Using the first four experience items, Hypothesis 1 can be accepted.

Hypothesis 2 is tested by measuring the correlation value of individual beliefs against the experience of each group. This is expected to be positive for HDTV, confirming H2; while it is expected that there will be no effect on correlation for the standard digital group regarding H3. The results of the analysis are shown in Table II. Although there is a significant correlation between belief and experience in the HDTV group, other values in Table II show that the values between groups are too similar to positively validate the combination of the framing effect and belief. This may be due to beliefs about the HDTV's signal and screen, while the frame only focused on the signal.

Table II. Correlations Between Belief and Experience for the Framed Groups

Frame	HDTV Sharpness Compared to Normal	HDTV Color Compared to Normal	HDTV Realism Compared to Normal	HDTV Quality Due to Signal	Belief in Improved Sound due to HDTV	Belief in Paying Extra
HDTV	0.129	0.379*	0.325	-0.122	0.016	-0.020
Standard	0.235	0.311	0.237	-0.172	0.122	0.146

N = 30 per group, \*Significant at the 0.05 level.

Table III. Correlations Values for Frames, Beliefs, and Attitude for Each Experience Item

Experience item/ Independent Variable	Color Experience	Sharpness Experience	Realism Experience
Corresponding belief item (color, sharpness, realism)	0.148	0.186	0.226
Frame: HDTV = 1.5 SDTV = 1.0	0.317*	0.393**	0.052
Expectancy (belief* frame)	0.344**	0.413**	0.203

N = 60, \*Significant at the 0.05 level, \*\*Significant at the 0.01 level (2-tailed).

Hypothesis 3 is another attempt to find evidence for the relation between the frame and belief, the value-expectancy formula is applied directly to the attitude objects: color, sharpness, and realism. For these attitude objects, corresponding experience items and belief items are measured in the survey. Hence the H3 hypothesis does not measure the effects of experience items of movement, sound, and brightness, as there are no corresponding beliefs in the survey to prevent repetition by respondents. The attitudes consist of multiplying the beliefs of each object with the frame. To create a scale based on the nominal frame variable, the HDTV frame is given an arbitrary value of 1,5 (a 2,0 value has similar results) and the standard digital a value of 1. To quantify the “correlation” of HDTV and standard digital for purposes of illustration, the HDTV cases are also given a value of 1,5 and standard digital a value of 1. Table III shows the predictive value of attitude (= expectancy) objects compared to the frame. As can be seen in Table III, the correlations increase slightly when frame and belief are combined. The exception is the correlation with realism, although the question that measures the experience item was reported as ambiguous by several participants (but was already taken out of the experience construct variable).

Although there is only a slightly stronger correlation between the expectancy product (belief\* frame) compared to just the frame, the attitude objects do have a reasonable correlation. Hence the H3 hypothesis can be accepted.

## 5. CONCLUSION

The group of participants that was told that they were watching HDTV indicated a higher appreciation of their viewing experience than the group that was told that they watched a DVD signal. The value-expectancy formula was the basis of this research, as the hypotheses were formed around the concepts in this formula. Using the concept of framing only, the H1 hypothesis proved the guiding effect of the frames for the participants' expectations. A limitation of the research is that we compared the HD signal to the DVD signal only. A topic for further research would be adding another experimental condition in

which the film clip would be provided in SD quality, comparable to what people actually see in their living rooms; also other types of clips could be shown in different experimental conditions.

The H2 hypothesis brought the beliefs of the participants about HDTV into the equation, and predicted that participants with a greater belief in the increase in quality due to HDTV, compared to standard television, appreciated the viewing experience better when told it was HDTV. Although a correlation was found with the belief of “better color than normal,” the correlating values were most similar to the group that was told that they watched standard digital television. The H2 hypothesis was rejected for this reason. An explanation for the belief that the frame combination did not have a strong predictive effect is that the beliefs questions measured the whole HDTV (signal + television) and the frame was only about the signal. The H3 hypothesis also measured the predictive effect of combining beliefs with the frame, but did so using individual attitude objects. Being a cross product of frames and beliefs, these attitude objects did show a stronger correlation to the viewing experience than the frame or beliefs alone. The limitation of H3 is that of H2: that the beliefs may not correspond with the frame, and hence limits the combining effect. Another H3 limitation is that there were only three attitude objects for which the beliefs matched the experience items. This was done to prevent measuring the “consistency” of participants, which may result in similar looking questions getting similar answers. This could have been prevented by using a pre-experiment questionnaire for beliefs, but this was not done due to time constraints. A final limitation of this research is the limited sample size and the measurement of demographic data. One aspect that could have been measured was the distribution of gender among groups during the experiment; estimated to be slightly higher for females in both groups, but not significant in either one. For future experiments, the addition of gender is suggested, as this could influence the framing effect.

The relevance of this experiment for framing theory is that the attitude or expectation was shown to be strongly affected by framing. This was proven before [Nelson et al. 1997; Druckman 2001]; but that research showed that framing could be used in the wide sense, as interpreting information from the outside world instead of just interpreting a communicated message. The information in this case was the movie fragment interpreted as being high quality due to the “HDTV-frame”. Although framing theory was chosen for its strong potential to influence people, this research did not apply it in the traditional way, that is, by presenting a message with an emphasis on one aspect. The experiment used the “HDTV-frame” as a collection of aspects that are associated with a viewing experience of high quality. Such an emphasis on reality might have been described as an “illusion” or similar a term. Due to time constraints, the exploration of literature was limited to the fields of communication and information. Hence there may be other theories from the fields of psychology or sociology that could have added to framing theory. One outcome of this research is that it is difficult for participants to objectively judge television quality. This research provides evidence that, without a reference, participants are generally unable to discern whether they are seeing high definition or standard digital signals. One application of framing for cable providers may be to frame people into believing

that digital cable is almost high definition, or at least of high quality in its own right. Cable providers can consider providing features such as interactivity to their users before delivering high definition content through their set-top boxes. That participants are unable to discriminate properly between HDTV and standard digital without having a reference does not detract from any real technical improvements due to HDTV that improve movie quality. It does however illustrate the role of framing on expectation, which gives a powerful role to the mass media during the persuasion phase in the consumers' decision process [Rogers 2003]. So advertisement may stimulate the early adoption process by providing a clear focus on those aspects that are of interest to the consumer, and thus stimulate a positive association with the new technology. The respondents were all students from institutions of higher education. When drawing on the H1 hypothesis, it can be said that the positive association with HDTV is already strong among this group, and their individual decision making is likely to focus on the later phases of the process. However, for consumers from a different demographics (age and education levels), this may differ. Another interesting addition is the backfire effect of framing. Although we mentioned that HDTV offers a major improvement in quality, we did not exaggerate this too much. It would be interesting to measure possible backfire effects by setting unrealistically high expectations. Finally, this research could be repeated after HDTV becomes more prevalent among consumers. Because the participants will be more used to HDTV, we expect that the frame will become less effective, and it will be easier to discriminate between the quality of an HD signal and a standard digital DVD signal.

## 6. DISCUSSION

Based on the research presented in this article, we conclude that the way in which HDTV is framed influences the way that it is perceived by viewers. This perception in turn may influence people's attitude towards HDTV. Due to the research of Baaren et al. [forthcoming], we know that the attitude towards HDTV influences the intention to adopt HDTV. From this, it can be argued that the success of a HDTV does not, or does not solely, depend on the technology itself; the success of HDTV also depends on the way in which its benefits and shortcomings are communicated.

Rogers [2003] states that two main sources influence people's attitude towards a new technology. One is due to personal communication and has a strong and direct effect; the other is due to the media and has a less strong, indirect effect. In this discussion we focus on the influence due to the (mass) media because the diffusion rate of HDTV is still very low, and so the effect of social influence will also be low. Consequently, it is relevant to investigate how technologies like HDTV are framed and represented in the media. We will shortly explore some of these frames for the case of HDTV in the Netherlands.

In this discussion we present four frames: the framing of HDTV in science; framing HDTV as a technological innovation; the problem of HDTV diffusion; and finally the selling of HDTV as a product. Each of these frames represents a way to look at HDTV, and each frame provides a different way to understand how this new technology can be perceived.

### HDTV in Science

A quick search in Google Scholar on the term HDTV yields 107.000 results. On the first pages of the list, the articles describe the technical aspects of HDTV. If we combine the term HDTV with other technical terms such as resolution, compression, standards, decoder, and transmission, we find approximately 15.000 hits for each combination. If we combine the term HDTV with user-oriented terms like adoption or diffusion, approximately 3.000 articles remain. From this we can conclude that the research focus has been on the technical aspects of HDTV-related issues. A research question that may emerge might be to examine how this compares to other technologies; an answer to that question might tell us something about the maturity of the technology.

### HDTV as Innovation

HDTV is quite a complex technological innovation. In order to watch HDTV, consumers not only need to invest in a screen, they also need a set-top-box as well as a subscription. There are several websites in Dutch dedicated to HDTV as a technological innovation (e.g., [hdtvnieuws.nl](http://hdtvnieuws.nl)). Such websites explain how HDTV works and what people need if they want to watch HDTV. Different screens and set-top-boxes are compared; functionality, quality, and price are discussed in detail. Many of these websites have a forum in which users can discuss their experience with this new technology. The meaning of this in terms of framing and attitude-building is that HDTV is still very much a gadget and not a commodity. Consequently, because HDTV is framed as “difficult” and “technical,” it is popular among a specific group of people who are interested in new technologies and gadgets.; this group largely consists of young, white, males.

### HDTV as a Problem

Occasionally, HDTV is part of the (national) television news. These news items usually last a few minutes and highlight that the diffusion of this new technology is problematic. Experts from the media business as well as science are called to provide insight into the process of diffusion. For example, the experts describe that there are few programs that are broadcast in HD-quality and that consumers need to purchase both a new screen and a set-top box before they can actually enjoy HDTV. A research goal might be to investigate the effect of such news items on the diffusion of HDTV.

### HDTV as a Product

Cable companies now offer subscriptions to HDTV and provide information about these subscriptions on corporate websites but hardly do so in advertising. Other than, for example, advertisements for cars which are aimed at creating a social image (buy this car and get a happy family along with it), the information provided on HDTV focuses on the improved capabilities such as image and sound quality. Another observation is that HDTV is mentioned along with subscriptions to other uses of digital television. The following quote from one of the biggest Dutch cable companies illustrates this.

HDTV (High Definition Television) has much more higher resolution than regular tv-programs. Your image will be up to five times sharper. The colors will also be more intensive and the sound is superior. If you want to watch HDTV, you will not only need the right HD-screen, you will also need programs broadcasted in HD-quality. You can receive these through our HDTV subscription. Not only does this subscription provide you with a 5-times sharper image and sublime sound, it also provides you with all the advantages of digital television such as delayed broadcast, more than 90 channels, Video on demand and a complete programming guide. You can also combine your HDTV subscription with the Digital Video Recorder ([www.upc.nl/televisie/hdtv](http://www.upc.nl/televisie/hdtv)).

From these four examples, we can conclude that the current framing of HDTV by several parties and through several media is rather complex. HDTV is still mostly seen as a technology that involves better image and sound quality. It is also presented as a form of digital television, which facilitates new services like video-on-demand. On the other hand, several media show its potential technical complexity and the lack of high definition content. Such mixed messages may be responsible for the slow diffusion of HDTV in the Netherlands. Similarly, diffusion and adoption processes of other innovations and/or in other societies can be understood by looking at the way these innovations are framed in the media.

## APPENDIX

### A. Video Clip

The video clip that was shown to both groups was downloaded from the Internet at <http://www.apple.com/quicktime/guide/hd/bbc-blue.html>. The film clip covers underwater life. It is shot in detail-rich high definition 1080i, the footage spans the globe, from the frigid waters of Norway to tropical ocean seas. Subjects include the venomous fish in Papua New Guinea, great white sharks in South Africa, and giant mantas in Mexico, plus whales and hundreds of other rarely seen creatures.

The original video is the 720p HD version. This video uses the H.264 codec with a frame rate of 16.216 per second. The video was converted to a standard PAL DVD format using open source programs. The following programs and versions were used to convert MPlayer (1.0rc2), transcode (1.0.2), ffmpeg (0.4.9-pre1), mjpegtools (1.9.0rc2), dvdauthor (0.6.11). The following commands converted the original HD movie to a DVD format:

```
mencoder bbc-blue_m720p.mov -ovc raw -oac pcm -MC 0 -o
bbcblue_m720p.mov.new

transcode -i bbc-blue_m720p.mov.new -y ffmpeg --export_prof dvd-pal
--export_asr 2 -o bbc-blue_m720p -D0 -E 48000,16,2 -b 224 -s2 --m
bbc-blue_m720p.ac3 --export_fps 25 -J modfps

mplex -f8 -o bbc-blue_m720p.mpg bbc-blue_m720p.m2v bbcblue_ m720p.ac3
dvdauthor -o DVD/ bbc-blue_m720p.mpg
dvdauthor -T -o DVD/
```

The conversion to DVD caused the frame rate to increase from 16.216 to 25 fps. To maintain the original video speed we used the modfps preprocessing filter of the transcode program. This filter shows some frames for a slightly longer period so as to fill up to 25 frames per second. This filter causes the

video to become slightly shaky or choppy. We found that this choppiness causes no significant negative viewing experience when framed to watch HDTV, as elaborated in the results.

## B: QUESTIONNAIRE

### The Future of Television

Thank you for participating in our research! The following questions will help us understand more about the quality of television. As a reward for participation, you can win a free cinema ticket!

#### *Viewing experience*

Please indicate the most appropriate answer.

1. How were the colors?	Faint	O O O O O O O	Clear
2. How did you experience the motion of the scene?	Shaking	O O O O O O O	Fluent
3. How did you experience the sharpness?	Blurry	O O O O O O O	Sharp
4. How would you judge the brightness?	Vague	O O O O O O O	Clear
5. What do you think about the sound quality?	Very bad	O O O O O O O	Very good
6. How real did the scene look to you?	Artificial	O O O O O O O	Natural

#### Your future of television

7. Do you have a flat screen at home?	Yes	/No
8. Do you think you will switch to a flat screen in the next 12 months?	Yes	/No

#### What do you think HDTV has to offer?

9. To what extent do you think HDTV has a sharper image than a regular television?	Little difference	O O O O O O O	Much sharper
10. To what extent do you think HDTV has better colors than a regular television?	Little improvement	O O O O O O O	Lot better
11. To what extent do you think HDTV has a more realistic image than a regular television?	Little extra realism	O O O O O O O	Lots of extra realism
12. To what extent do you think image and sound quality depend on the signal?	Little influence	O O O O O O O	Lots of influence
13. To what extent does HDTV influence sound quality?	Little influence	O O O O O O O	Lots of influence
14. Are you willing to pay extra for the possible quality improvement offered by HDTV?	Little	O O O O O O O	Lot

Thank you for filling in this questionnaire. To qualify for the free cinema ticket, please leave your phone number or e-mail address below.

## REFERENCES

- BAAREN, E., VAN DE WIJNGAERT, L., AND HUIZER, E. This is not a TAM paper. Submitted to the 2009 ICA Conference in Chicago.
- BELGACEM, B. Y., BIZZOCCHI, J., AND BOWES, J. 2005. The future of video: User experience in a large-scale, high definition video display environment. In *Proceedings of the International Conference on Advances in Computer Entertainment Technology*, vol. 265, ACM, New York, 204–208.
- DE VREESE, C. 2003. *Framing Europe: Television News and European Integration*. Aksant, Amsterdam.
- DRUCKMAN, J. N. 2001. On the limits of framing effects: Who can frame? *J. Politics* 63, 4, 1041–1066.
- GITLIN, T. 1980. *The Whole World Is Watching: Mass Media in the Making and Unmaking of the New Left*. University of California Press, Berkeley, CA.
- IYENGAR, S. 1991. *Is Anyone Responsible? How Television Frames Political Issues*. University of Chicago Press, Chicago, IL.
- LE BOOK, C. AND BARNETT, B. 2006. PCTV: Consumers, expectancy-value and likely adoption. *Int. J. Research New Media Technologies* 12, 3, 325–339.
- MCLEOD, D. M. AND DETENBER, B. H. 2006. Framing effects of television news coverage of social protest. *J. Communication* 49, 3, 3–23.
- NELSON, T. E., OXLEY, Z. M., AND CLAWSON, R. A. 1997. Toward a psychology of framing effects. *Political Behavior* 19, 3, 221–24.
- NELSON, T. E. AND OXLEY, Z. M. 1999. Issue framing effects on belief importance and opinion. *J. Politics* 61, 4, 1040–1067.
- PÉCHARD, S., SYLVAIN, S., CALLET, P., LE CARNEC, M., AND BARBA, D. 2006. Towards video quality metric for HDTV. In *Proceedings of the Second International Workshop on Video Processing and Quality Metrics for Consumer Electronics*, 1–6.
- ROGERS, E. M. 2003. *Diffusion of Innovations* (5th ed.), Free Press, New York.
- ROHALY, A. M., CORRIVEAU, P., LIBERT, J., WEBSTER, A., BARONCINI, V., BEERENDS, J., BLIN, J.-L., CONTIN, L., HAMADA, T., HARRISON, D., HEKSTRA, A., LUBIN, J., NISHIDA, Y., NISHIHARA, R., PEARSON, J., PESSOA, A. F., PICKFORD, N., SCHERTZ, A., VISCA, M., WATSON, A., WINKLER, S., NGAN KING, N., SIKORA, T., AND MING-TING, S. 2000. In *Proceedings of SPIE Visual Communications and Image Processing*, vol. 4067, 742–753.
- STAPLES, D. S., WONG, I., AND SEDDON, P. B. 2001. Having expectations of information systems benefits that match received benefits: Does it really matter? *Information & Management* 40, 115–131.

Received January 2008; revised March 2009; accepted April 2009