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# A psychophysiological approach to fear appeals. Autonomic, subjective and behavioral responses to health promotion messages

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**Título:** Un enfoque psicofisiológico de los mensajes de miedo. Respuestas autónomas, subjetivas y conductuales a los mensajes de promoción de la salud.

**Resumen:** Se diseñó un estudio para analizar los efectos que tienen las apelaciones al miedo sobre las respuestas psicofisiológicas, subjetivas y conductuales en la población diana. Para ello, se presentaron, a 98 mujeres de 49-50 años de edad, tres mensajes sobre el cáncer de mama promoviendo la realización de mamografía regularmente. Los mensajes fueron elaborados de manera similar a los utilizados por los programas de promoción de la salud. Los tres tenían la misma longitud, formato y estructura, pero variaban en determinadas claves que diferenciaban su carácter (Amenaza, Sorpresa y Estándar/control). Durante la exposición a estos mensajes, se registraron, de manera continua, las respuestas psicofisiológicas (frecuencia cardíaca y frecuencia de respuestas electrodérmicas inespecíficas). Después de ver los estímulos, se tomaron medidas de autoinforme y de personalidad (STAI y EPQ-A). Se encontraron respuestas significativas a los mensajes para todas las medidas psicofisiológicas. Independientemente del mensaje presentado, el patrón de respuesta psicofisiológica se relacionó significativamente con la conducta preventiva de detección del cáncer.

**Palabras clave:** Apelaciones al miedo. Mensajes de promoción de salud. Respuesta Autonómica. Respuesta de orientación. Atención. Cáncer de mama. EPPM.

**Abstract:** A study was designed in order to analyze the effects of fear appeals on psychophysiological, subjective and behavioral responses on the target audience. Three messages on breast cancer, promoting regular mammography screening, elaborated in a similar way to those used by health promotion programs, were presented to ninety-eight women aged 49-50. Messages were of equal length, format and structure but varied in specific clues which distinguished their character (Threat, Surprise, and Standard/control). Psychophysiological reactions (heart rate and frequency of non- specific skin conductance responses) were recorded continuously during message exposure. Self-report measures and personality traits (STAI and EPQ-A) were obtained after viewing the stimulus. There were significant responses to the messages for all psychophysiological measures. The pattern of psychophysiological response, independent of the eliciting message, was significantly related to cancer preventive/detection behavior.

**Keywords:** Fear appeals. Health promotion messages. Autonomic response. Orienting response. Attention. Breast cancer. EPPM.

## Introduction

The use of messages threatening people with adverse consequences as a means to induce adherence to recommended behaviors has a long history, especially though not limited to, the public health domain. Yet the effectiveness and efficacy of this strategy to promote an increase in frequency or intensity of specific cognitions, attitudes, behavioral intentions, or actual behaviors, remain controversial (Fishbein & Ajzen, 2010; Green & Witte, 2006; Ruiter, Verplanken, Kok, & Werrij, 2003; Ooms, Jansen, Hommes, & Hoeks, 2017) and there is considerable room for further scrutiny. Among the models that have been proposed to explain the processing and effects of fear appeals and the relationship between the level of threat and efficacy in the message and the acceptance of the recommendation contained in it, the Extended Parallel Process Model (EPPM; Witte, 1992a) has a fundamental theoretical and practical role, during the last decades. The EPPM integrates previous research on fear appeals, being able to reconcile apparently contradictory predictions and findings; it addresses specifically the question of why this communication strategy sometimes appears to fail and sometimes appears to succeed; and it has a structure oriented to the translation of theoretical constructs into practical decisions, which facilitates its application to public communication campaigns. Finally the EPPM provides a theoretical framework that fosters research and it has served as a foundation for a great number of empirical studies (Chen, Yang, Fu, Liu & Yuan, 2019; Doyore, Birhanu, Kebede, Dejene & Jara, 2013; Keller, Austin & McNeill, 2017; McKay, Berkowitz, Blumberg & Goldberg, 2004; Zonouzy, Nicknami, Ghofranipour & Montazeri, 2019).

### Fear in Fear Appeals

Fear is not only part of the name in fear appeals. It represents, along with efficacy, a key concept in the field and, specifically for the EPPM. According to the EPPM, fear would be the result of the threatening information contained in the message. If a first appraisal of the information produces the perception of threat, fear is elicited, what would initiate and motivate message processing. If the threat is not perceived to be high enough, fear is not elicited and there would be no motivation for further processing of the message, what means that no action would be taken. However, when threat is perceived, the subject would experience fear and such fear would motivate a second appraisal about the efficacy of the recommendations to avert the threat and, consequently, reduce the intensity of the unpleasant emotion of fear. Depending on the result of this second appraisal, the subject may engage in either danger control processes (e.g.,

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actively reduce the risk), when efficacy is perceived high; or fear control processes (e.g., deny the risk) if efficacy is perceived low (Witte, 1992a; 1994). Further, threat communication should only instil a moderate amount of fear in the intended recipient. Should the amount of fear become overwhelming, people tend to ignore the details and, instead of rationally determining how to manage the potential threat (i.e., danger control processes), opt to become defensive and deny the threat exists (i.e., fear control processes) (Marett, Vedadi & Durcikova, 2019).

Therefore, according to the EPPM, threatening communications only appear to work when the amount of fear produced is not insurmountable and efficacy of recommendations to avert the threat, and reduce fear, is high in the relevant behavior- population combination, either at baseline or introduced by the message. If not, or when mere recommendations at best enhance response efficacy, but without high self- efficacy, threatening communication will have no effect, or worse, it may backfire diverting attention automatically from the message (Carrera, Muñoz & Caballero, 2010; Chen et al., 2019; Kessels, Ruiter & Jansma, 2010; Marett, Vedadi & Durcikova, 2019; Peters, Ruiter & Kok, 2013).

In summary, fear is the fuel of the system and its presence would be needed for the whole process to take place. But fear is not a mere activating system acting as a reflex, that can be switched on and off easily. Fear is a complex emotion, and most researchers use the concept of fear, acknowledging its multifactorial (cognitive, physiological and behavioral) character (Lang, Davis, & Öhman, 2000; Sánchez-Navarro, Martínez-Selva, Torrente, & Román, 2008). Yet the measurement itself of this variable in the fear appeal literature frequently has not taken into account such character. Induction of emotions like fear has been widely used in human research to investigate the nervous system response to different material presented as stimulus (Bradley & Lang, 2007; Chadwick, Zoccola, Figueroa & Rabideau, 2016; Davydov, Zech, & Luminet, 2011; Hagenaars, Roelofs & Stins, 2014; Kessels, Ruiter & Jansma, 2010; Kreibig, Wilhelm, Roth, & Gross, 2007; Palomba, Sarlo, Angrilli, Mini, & Stegagno, 2000; Seligowski et al., 2019). However, despite several authors having stressed that research should include continuous monitoring of physiological responses during the whole study (Carey, McDermott & Sarma, 2013; Dillard, 1994; Popova, 2011; Ruiter, Abraham, & Kok, 2001; Witte, 1998), to the best of our knowledge, psychophysiological reactions to fear appeals have been nearly absent of the field for the last three decades.

Two early studies within the fear-appeal literature gathered objective indicators of autonomic arousal during the exhibition of the stimulus (Mewborn & Rogers, 1979; Watson, Pettingale, & Goldstein, 1983). Both found an increase in the physiological measures associated to the high fear stimulus. Additionally, Mewborn and Rogers found that physiological (cardiovascular and electrodermal activity) and self-report measures of fear were correlated. This single and non-replicated result led to the neglect of a promising research line on psychophysiological reactions to fear appeals, and to assume that "…for the purpose of measuring fear as a result of the EPPM based interventions, self-report measures of fear have the highest utility because they have high validity and are the easiest to administer" (Popova, 2011, p. 3). Thus, most of the research in this area uses simple self-report measures to analyze fear appeals (Carrera et al., 2010; Doyore et al., 2013; Gore & Campanella, 2005; McKay et al., 2004; Ooms et al., 2017).

## A Psychophysiological Perspective

None the less, psychophysiological responses associated with emotional reactions to fear appeals offer a more complex perspective. The above mentioned approach seems to assume that fear appeals should necessarily provoke an intense arousal reaction, characterized, among others, by increased hear rate (HR) and skin conductance responses (SCR) (Witte, 1998). Thus, early studies used either an extremely unpleasant film (Mewborn & Rogers, 1979) or a high-involvement stimulus (Watson et al., 1983), in an attempt to elicit fear in the subjects, which was regarded as an increase in these autonomic measures. However, despite intense psychophysiological research over the last century, there is no clear evidence of such emotional specificity of autonomic response (Bradley & Lang, 2007; Kreibig, 2010; Sánchez-Navarro et al., 2012). Actually psychophysiological literature has consistently found that response to unpleasant pictures or films leads to an increase in electrodermal activity (Bradley, Codispoti, Cuthbert, & Lang, 2001; Gomez, Zimmermann, Guttormsen-Schär, & Danuser, 2005; Lang, Greenwald, Bradley, & Hamm, 1993; Sánchez-Navarro et al., 2008; Verschuere, Crombez, De Clercq, & Koster, 2004). Parallely, this kind of stimuli tend to elicit heart deceleration, instead of prompting a defensive HR acceleration (Christie & Friedman, 2004; Gomez et al., 2005; Hagenaars et al., 2014; Palomba et al., 2000; Sánchez-Navarro, Martínez-Selva & Román, 2006), which would need very intense stimulation to appear. In this sense, Lang, Bradley, and Cuthbert (1997) proposed a model of *defence cascade*, according to which different physiological systems change at different rates depending on the emotional intensity of the stimulus, the available contextual support and the organism's learning history (Bradley & Lang, 2007).

This defence cascade is characterized by a chain of reactions starting with a bradycardia, signaling an attentional response, that usually appears to both new and aversive stimuli (Sánchez-Navarro et al., 2006). This attentional response has an evolutionary meaning for its objective is the detailed evaluation of the stimulus potential risks (Lang et al., 1997; Bradley & Lang, 2000).

Within this frame, a more recent study designed to reintroduce a psychophysiological perspective to the study of fear appeals obtained a less straightforward figure reflecting the complexity of this issue (Ordoñana, González- Javier, Espín-López, & Gómez-Amor, 2009). Subjective and autonomic responses to a health promotion stimulus -tetanus vaccination- with varying levels of threat (low vs. high) and efficacy (low vs. high) were analyzed. Additionally, the effect of these variables over subsequent behavior was ascertained to evaluate the persuasive quality of the message. The results showed that high threat stimuli produced an autonomic pattern of response consisting of a significant heart rate decrease accompanied by higher skin conductance (i.e., an orienting response pattern; OR), concomitantly with an increase in self-reported fear and perceived threat. This pattern of psychophysiological response has been associated with increased attention to aversive stimuli that do not represent an imminent danger requiring action by the subject (Lang et al., 1997). The psychophysiological reaction was later related to the main behavioral outcome to the extent that the presence of an orienting response was associated with an increased probability of getting the tetanus vaccine.

These results could be explained using a more comprehensive view of the psychophysiological reactions elicited by fear-arousing stimuli. According to this interpretation, the physiological response to the high-threat message came closer to a pattern related to increased attention than to a fight-or-flight response of fear (Bradley & Lang, 2007; Cook & Turpin, 1997). Thus, the information devoted to elicit a scared response, actually would act generating attention to the message and its content, rather than the emotional reaction of fear. This increased attention would foster further processing, which would increase the likelihood of compliance with message recommendations. The relevance of attention in the processing of narrative fear appeals has previously been highlighted (Ooms et al., 2017). As a matter of fact, Witte already pointed out that threatening communications are only effective when they capture the attention of the subjects, arguing "the greater the threat, the greater the fear aroused, the more attention-getting the message" (Witte, 1992a, pg. 339). However such sort of automatic and parallel link between attention and fear is what can be questioned, and it can be argued that the emotion of fear would not be always necessary for threat to be perceived on a sufficient level, and motivation to further process the message would depend on a cognitive risk assessment rather than on the activation of an emotional response.

### The Present Study

The present study was designed to validate these results in a different sample and using different behaviors. While the mentioned report was centred in getting a vaccine, we choose attendance to mammography screening (MS). Both behaviors represent a single action and are easily accomplished and measured. However, while getting a vaccine is a preventive behavior which has no or rare emotional consequences, MS is a detection-oriented behavior bearing, by itself, a high potential of evoking anxiety in the audience due to the uncertainty of the results. This fact could have a relevant effect both, in the subjective and psychophysiological reactions to the messages, as well as in the subsequent health behavior.

Another variation was included in the experimental design. Following the hypothesis that the threatening content of the stimulus actually could arouse an attentional response instead of an emotional one, we introduced a new message, labelled *surprise*. According to Ooms et al. (2017) attention is a crucial concept in the processing of narrative fear appeals and was positively associated with four emotions: fear, sadness, surprise, and compassion.

This new stimulus intended to provoke attention without appealing to the classical threatening resources. Surprise is the result of experiencing novelty (Dillard & Nabi, 2006), and it is associated, along with fear, to increased attentional responses (Ooms et al., 2017). Our aim in this case was to evaluate whether a message with different characteristics but eliciting a similar psychophysiological response could have the same effects as the classical fear appeal on the behavior of the audience.

In summary, based on the empirical evidence, we hypothesized that:

1. When subjects are confronted with a usual fear appeal in health messages or health education and health promotion programs (i.e., not extremely intense) their psychophysiological reaction would be most likely of an orienting nature (OR), including cardiac deceleration and skin conductance increase. This reaction, suggesting increasing attention, resource allocation and sensory intake.
   Thus, in our study we posit that a message designed to capture attention of the audience by focusing either on threatening information (*threat message)* or information novelty/salience (*surprise message*) will provoke a similar psychophysiological response of an orienting nature.
2. The presence of this kind of response (OR) will be associated with an increased probability of adopting the behavior recommended in the message, regardless of the eliciting stimulus. Conversely, when the message elicits in the subject a pattern of defensive response (DR), characterized by HR and SC increases, fear control responses will be elicited, and message rejection measures will increase.

## Method

### Pilot test

We conducted a pilot test of the procedures, messages and instruments using 15 female undergraduated Psychology students. The average age of participants in the pilot test was 21.20 (*SD* = 1.014). In addition to performing initial manipulation checks, we sought feedback on the wording of items and the manipulations during the pilot test. The procedures were considered among the audience as correct and objective and no substantial changes to the procedures were required for the main data collection.

### Participants

Ninety eight asymptomatic women aged 49-50 years agreed to participate. The sample was obtained through the database of a public Breast Cancer Prevention Program. Age was selected specifically because women enter into the public mammogram schedule when they become 50. Hence, these women were going to be appointed to a free public mammogram during the next year. Contact began by a personal letter mailed to the subjects' home address inviting them to participate in the study. Approximately 10 days after sending the letters, the women were contacted by telephone, explained the procedures of the study and asked to participate. Women who reported having had a mammogram within the past 24 months, and women with a prior breast neoplasm or any relevant illness were excluded from the study. The study was approved by the university ethics committee.

### Stimulus Materials

Three health promotion messages on breast cancer, which encouraged regular mammography screening, were prepared. One was regarded as *threat* while the others were labelled *surprise* and *standard*.

Films were presented on a 21-inch colour TV positioned 1.5m in front of the subject. Each was 260 s long and was divided in three phases: introduction (I = 20 s), manipulation (M = 180 s) and recommendation (R = 60 s); only the central part of the stimuli (manipulation) was different.

The *threat* film emphasized the severity and susceptibility of breast cancer and the possible negative consequences if early detection practices are not carried out regularly. Thus, threatening images were used (e.g., a woman taking a wig off; mammography images where a tumour was signalled; a simulation of a cancer expanding for the whole body; or the image of a cemetery) along with a locution emphasizing, for example, that breast cancer is "one of the leading killers of women". Although this message was regarded as *threat*, the information offered was always real and at no moment was the presentation overstated to artificially increase the perceived threat. Special care was also taken to avoid unnecessary disgust in the subjects. These precautions were taken in order to preserve ecological validity and not to design an exaggerated message that would be unviable for use in institutional campaigns.

The *surprise* film was a standard low threat message but including unexpected sequences that interrupted the course of the stimuli. At certain moments, the screen turned suddenly and unexpectedly into black and a text emphasizing the key ideas of the message was displayed. This produced an abrupt change, interrupting the message flow, and increasing the salience of specific ideas.

The *standard* film avoided, where possible, negative information (text or images) about breast cancer. However, at no moment was necessary information hidden. The film emphasized the advantages of early detection using sentences as: "mammography is a good means of early detection and gives us an opportunity to diagnose breast cancer in its very earliest stages". This *standard* film served as a control stimulus.

### Apparatus and Physiological Recordings

Electrodermal Activity (EDA) was recorded by a constant voltage of 0.5 V by the bipolar placement of 7- mm diameter Ag/AgCl standard surface electrodes, attached by adhesive collars to the thenar and hypothenar eminences of the non-dominant hand. Electrodes were filled with 0.068-M NaCl Unibase electrode paste (Fowles et al., 1981), which was used as the contact medium. The raw signal was acquired with Cibertec (Madrid, Spain) Biosig-CP1 module and calibrated to detect activity in the 0-100 μSiemens (μS). This module provided a double output in order to obtain Skin Conductance Level and Skin Conductance Responses in two separate channels (with AC coupling).

Changes in finger pulse volume (FPV) were registered through an ADInstruments (Castle Hill, Australia) PowerLab-MLT1010 piezo-electric pulse transducer kept in place by attaching the Velcro® strap firmly around the distal phalanx of the index finger of the non-dominant hand. The transducer was connected directly to the input of an ADInstruments PowerLab/8Sp recording system. HR was extrapolated on line from the direct FPV sign by the software Chart v.4.1.2. for Windows of ADInstruments, providing a pondered mean of beat to beat HR.

The PowerLab/8SP data acquisition system, with a range of voltage of ± 10 V, controlled by an internal microprocessor 68340 of 32 bits at 16 MHz and a maximum sample rate of 20 KHz on eight channels, was used in the acquisition, amplification and filtering of the EDA and FPV signs. This system converted analogue signals to digital signals by means of a 16-bit A/D converter. The recording unit was connected to a PC through a USB port (500 KB/s, maximum data transfer rate). Control of the system of acquisition, as well as that of the parameters registration and the storing of the data was carried out by Chart v.4.1.2. of ADInstruments for Windows. All the psychophysiological signals were sampled continuously at 1000 Hz throughout the experimental session.

### Self-Report Measures

Self-report measures and instruments were based on those used previously in a study on psychophysiological reactions to fear appeals (Ordoñana et al., 2009). They were composed of questions (between 3-6) for every self-report measure ranked by a 9- point Likert scale. The reliability of the scales was analyzed with the Cronbach's reliability coefficient (α).

*Subjective fear* was measured by having subjects rate the following mood adjectives (*not at all* to *very much*): scared, tense, anxious, uncomfortable, nervous and fearful. These items have been used in other threat appeal studies (Witte, 1992b). A total score is obtained by simply adding the six component subscales, (α = .96).

*Perceived threat* (α = .80) comprised of two underlying dimensions: perceived susceptibility to the threat, which refers to individual's beliefs about their risk of experiencing the threat, and perceived severity of the threat, which refers to beliefs about the magnitude or significance of the harm expected from the threat (Witte & Allen, 2000). *Perceived susceptibility* was assessed with three questions like "How likely is it for you to get breast cancer?" - *not at all likely* to *extremely likely* - (α = .78). *Perceived severity* was measured with four questions (e.g., "How serious do you believe that breast cancer is?") - *not at all serious* to *extremely serious* - (α = .67).

*Perceived efficacy* (α = .72) was also composed of two dimensions: perceived response efficacy, which refers to the effectiveness of the recommended response in averting the threat, and self-efficacy, which refers to the audience's ability to carry out a recommended response (Witte & Allen, 2000). *Perceived response efficacy* was assessed with five questions (e.g., "How effective do you believe mammography screening is in detecting breast cancer?") - *not effective* to *extremely effective* - (α =.79). *Self-efficacy* was determined by three questions such as: "Do you believe that it would be easy for you to have a mammography?" - *absolutely not easy* to *extremely easy* - (α =.59).

*Fear control reactions.* Using the same methodology, scores were obtained for three factors. *Defensive avoidance:* defined as a tendency to ignore or deny the negative consequences shown in a message (Hale & Dillard, 1995; Witte, 1992a, 1994). Participants were asked to respond to the following question in three ways, "When I saw the message, my first instinct was to": (a) "want to/not want to think about breast cancer"; (b) "want to/not want to do something to prevent breast cancer"; and (c) "want to/not want to protect myself from breast cancer" (α =.69). *Message minimization*: measured by assessing the degree to which subjects derogated or minimized the information received through the adjectives: interesting, objective, appropriate and accurate referred to the message (α = .86). *Perceived manipulation:* the degree to which subjects perceived that the message was trying to manipulate them. Subjects were asked whether they felt "manipulated", "exploited", or whether the message "deliberately tried to manipulate my feelings" (α = .90).

*Perceived surprise* was measured by assessing the degree to which the information presented in the film was valued by the women as: new, surprising and striking (α = .85).

In order to analyze if the messages had produced a response in the women of the study, their real behavior was analyzed through the database of the Breast Cancer Prevention Program, where assistance to the scheduled appointment is recorded. Additionally, three months later, women who did not attend to the program's appointment were interviewed by telephone in order to collect information about whether they have got the MS in a different facility or did not want to take a mammogram and the reasons for rejection.

### Personality Traits

Because subjective and physiological responses to affective stimuli may be influenced by personality traits (Gross, Sutton, & Ketelaar, 1998), participants completed the Spanish versions of the Spielberger´s State and Trait-Anxiety Inventory (STAI; Spielberger, Gorusch, & Luschene, 1970) and the Eysenck Personality Questionnaire (EPQ-A; Eysenck & Eysenck, 1975).

### Procedure

Participants were randomly allocated to one of three conditions (threat, surprise, and standard film). They attended a 1h long laboratory session and were tested individually. After their arrival, a 20-minute period of accommodation gave participants the opportunity to become familiar with the laboratory environment. During this period, the trait-anxiety inventory (STAI-T) was given prior to the experimental session. After washing their hands, they were seated in a comfortable armchair in front of a television screen. The procedure was then explained and the physiological sensors were attached. In the last 3 minutes of the accommodation period subjects were directed to rest quietly. The formal testing session started with a 5-min rest period in order to obtain physiological basal levels. Then, one of the films (threat, surprise, or standard) was presented. Physiological responses were recorded continuously during rest, film presentation and a 1-min post film period. Total recording time consisted of 14 min-20 sec. Finally, the subjects completed the self-report measures, the state anxiety inventory (STAI-S) and the different scales of EPQ-A.

### Data reduction

Any artefact-free change in skin conductance equal to or higher than 0.05 μS was considered a response. Frequency of Non-specific skin conductance responses (NSR) was recorded in number of responses per minute. FPV was expressed in volts and HR in beats per minute, with the latter being extrapolated from FPV data by Chart software. HR was calculated from the interbeat interval (IBI; i.e., the difference in time of the peak voltage between one finger pulse and the peak voltage of the next). The data were converted from beat-to-beat values of IBI to HR in beats per minute.

The time course of each response was analyzed (Table 1), for the above-described physiological measures and for each stimulus, by dividing the 260-s stimulus period into variable 60, 40, 35, 20 and 15-s epochs in order to preserve the emotional content and the continuity of the sequences. The mean of the 300-s of the rest period was used as baseline score. This resulted in 11 average measures for each subject, 1 measure corresponding to the rest period, 9 average measures for the film periods (1 for introduction [I]; 6 for manipulation [M1 to M6] and 2 for recommendation [R1 and R2]); and 1 average measure for the post film period. For analysis, difference scores were calculated by subtracting the baseline scores from the average of the film epochs (Gomez et al., 2005; Palomba et al., 2000).

**Table 1**
*Recording periods and number of averaged measures of psychophysiological responses.*

| TOTAL RECORDING TIME (14 min-20 sec) | | | | | |
|---|---|---|---|---|---|
| Acommodation Period (3 min) | Rest Period (5 min) | Stimulus Period (4 min-20 sec) | | | Post Film Period (2 min) |
| | | Introduction (I) | Manipulation (M) | Recommendation (R) | |
| Measures | 1 | 1 | 6 | 2 | 1 |

### Analysis

For every cognitive variable and personality trait one-way analysis of variance (ANOVA) was applied, with message type (high threat, low threat or surprise) as between-subjects factor. Partial eta squared is provided for effect size. The homoscedasticity assumption was assessed with the Levene test. When this assumption was not met, the Welch correction of the *F* test was applied.

For physiological variables, a mixed ANOVA was applied to analyze the rest period, where the between-subjects factor was the message type and the repeated measures factor was the time of measurement for each psychophysiological index.

Mixed ANOVAs were also applied for every psychophysiological outcome, where the between-subjects factor was the message type and the repeated measures factor the difference score calculated for each moment. The homoscedasticity and sphericity assumptions were assessed with the Levene and the Mauchly tests, respectively. When some of these assumptions were not met, Greenhouse-Geisser adjustments for degrees of freedom were carried out. Paired *t*-tests were applied to analyze the variation between rest and introduction periods. In this case, direct scores for both epochs were used. Since the three messages varied only in the "manipulation" period (from M1 to M5), we designed planned comparisons by the Sidak procedure between messages for each of those time periods.

All statistical analyses were performed with SPSS 22.0 for Windows, and the alpha level for all comparisons was set at $p < .05$.

## Results

### Preliminary Analyses

One-way ANOVAs revealed no significant differences between groups in the STAI-T and in the different scales of the EPQ-A inventory. Mean scores and standard deviations were similar for all conditions (Table 2). No group differences in baseline physiological measures were found for heart rate, $F(2, 97) = 1.13$, $p = .32$; or for frequency of NSR, $F(2, 97) = 1.75$, $p = .17$.

**Table 2**
*Mean (SD) and comparisons (ANOVAs) of personality traits by experimental group.*

| | Threat ($n = 33$) | Standard ($n = 32$) | Surprise ($n = 33$) | df1 | df2 | $F$ | $p$ |
|---|---|---|---|---|---|---|---|
| STAI – Trait | 21.15 (11.3) | 21.53 (11.2) | 23.12 (10.5) | 2 | 97 | 0.13 | .71 |
| EPQ | | | | | | | |
| Neuroticism | 11.33 (6.6) | 11.34 (6.9) | 12.59 (5.9) | 2 | 97 | 0.40 | .67 |
| Extroversion | 11.61 (4.1) | 9.94 (4.2) | 9.70 (4.2) | 2 | 97 | 2.05 | .13 |
| Psychoticism | 1.30 (1.6) | 1.22 (1.0) | 1.59 (1.5) | 2 | 97 | 0.56 | .57 |

The absence of statistically significant differences in these analyses before the experimental session allowed us to conclude that the assignment of subject to the experimental groups had been carried out successfully.

### Stimuli Effects on Psychophysiological Responses

Regarding the electrodermal activity, frequency of NSR displayed a reliable and statistically significant increase from rest to introduction period in all films, threat, $T(32) = -3.74$, $p = .001$; surprise, $T(32) = -5.36$, $p < .001$; and standard, $T(31) = - 6.631$, $p < .001$; followed by a progressive decrease (Figure 1). After that, responses tended to return to baseline levels although always remaining above them. A significant effect for Time, $F(155.16, 629.95) = 14.37$, $p < 0.001$; $\eta p^2 = .13$; was obtained. No differences were apparent between groups, and analyses failed to reveal any significant effect for Film, $F(2,95) = 0.49$, $p = .61$; $\eta p^2 = .010$, and Film x Time interaction, $F(13.26, 629.95) = 1.14$, $p = .31$; $\eta p^2 = .024$.

HR also showed an initial increase between baseline and the introductory period and diminished afterwards for all messages. The mixed ANOVA revealed a significant effect for Time, $F(3.62, 343.87) = 13.34$, $p < .001$; $\eta p^2 = .12$; but non significant differences on HR response for Film, $F(1, 95) =.56$; $p = .57$; $\eta p^2 = .01$; or for Film x Time interaction, $F(7.24, 343.87) = 13.49$, $p = .36$; $\eta p^2 = .02$. However, in spite of the absence of global significant differences, HR responses showed a distinctive pattern between groups (Figure 2), concurrent with the moments at which stimuli were different (M1 to M5).

**Figure 1**

*Mean of NSR frequency changes over time for the experimental groups.*

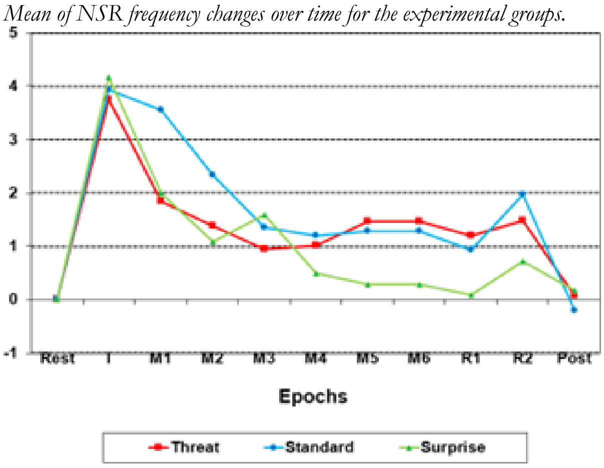
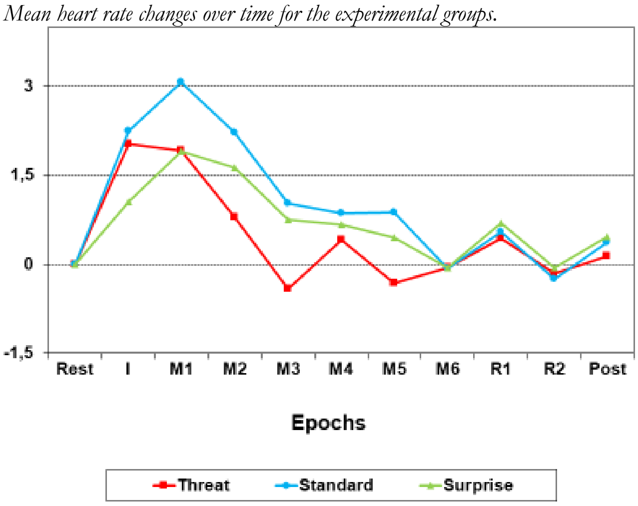



**Figure 2.**

*Mean heart rate changes over time for the experimental groups.*




In the surprise and standard messages, the HR increase continued until the first epoch of the manipulation period (M1), and later decreased progressively to return to baseline levels. However, in the threat message, after the initial increase, HR decreased pronouncedly from the first epoch of the manipulation (M1) and fell below baseline levels at epochs M3 and M5, coincident with the most threatening passages of the stimulus. During M3 women were viewing images showing a cemetery and a simulation of the growth of a tumour in a human figure. During M5, participants were shown a mammogram and a simulation of the extension of breast cancer. This decrease reached significance, compared with the scores at introduction ($p$ < .001) and M1 ($p$ <.05) as shown by the a posteriori Sidak comparisons. Furthermore, the planned comparisons by the Sidak procedure between the messages for the M1-M5 time periods, showed differences between messages in the registered response during some of those periods. In particular, these differences were statistically significant for threat vs. the surprise/standard messages at epoch M3 ($p$ = .05) and marginally significant for M5 ($p$ = .06).

To summarize, results for HR show that, when information was the same in the three messages (Epochs: I, M6, R1 and R2), profiles were very similar for all groups, but differences were apparent during the manipulation period (M1 to M5), when information was different and statistically significant when the most threatening information was presented (M3) and marginally (M5).

### Stimuli Effects on Self-Report Measures

ANOVAs for self-report measures revealed highly signifi-cant Film effects for subjective fear, $F(2, 97) = 14.58$, $p<$ .001; ηp2 = .23; response efficacy, $F(2, 58.9) = 3.43$, $p$ = .032; η2 = .063; behavioral intentions, $F(2, 97) = 4.59$, $p$ = .012; η2 = .08; defensive avoidance, $F$(2, 60.3, p = 4.63, $p$ = .022; ηp2 = .07; and surprise, $F(2, 97) = 18.35$, $p$ < .001; ηp2 = .27. Also, a marginall effect was found for message minimization, $F(2, 97) = 2.56$, $p$ = .082; ηp2 = .05; (Table 3). The threat film was rated as significantly more objective, clear and precise, and it generated more subjective fear than the surprise and standard scenes. Likewise, women who viewed the threat film were more confident that mammography would detect breast cancer and showed less defensive avoidance than those viewing the other messag-es. The threat and surprise films were those that surprised the women more. However, no significant differences in perceived threat were observed between messages.

### Correlations between Self-Report of fear and Psychophysiological Responses

Pearson correlation coefficients were calculated between self-report and psychophysiological responses. There were no significant correlations between average NSR frequency, HR and any of the self-report variables. On the other hand, subjective scores of fear were significantly, though moderately, correlated with perceived susceptibility, perceived severity, defensive avoidance and perceived surprise (Table 4).

**Table 3**
*Means (SD) and comparisons (ANOVAs) of self-report responses to the messages by experimental group.*

| | Threat ($n$ = 33) | Standard ($n$ = 32) | Surprise ($n$ = 33) | df1 | df2 | $F$ | $p$ |
|---|---|---|---|---|---|---|---|
| Subjective fear | 4.13 (1.60) | 2.27 (1.21) | 2.70 (1.52) | 2 | 97 | 14.59 | **.000** |
| Perceived susceptibility | 5.91 (1.41) | 6.01 (0.98) | 5.85 (1.26) | 2 | 62.2 | 0.17[a] | .850 |
| Perceived Severity | 7.48 (0.98) | 7.66 (0.61) | 7.37 (0.62) | 2 | 61.9 | 1.69[a] | .192 |
| Response Efficacy | 7.22 (0.64) | 6.63 (1.09) | 6.99(1.06) | 2 | 58.9 | 3.64[a] | **.032** |
| Self-Efficacy | 7.27 (0.70) | 7.26 (1.00) | 7.35 (1.15) | 2 | 60.2 | 0.07[a] | .930 |
| Perceived Surprise | 4.63 (1.43) | 2.82 (1.22) | 4.83 (1.64) | 2 | 97 | 18.35 | **.000** |
| Behavioral Intention | 7.46 (1.46) | 6.01 (2.18) | 6.97 (2.16) | 2 | 97 | 4.59 | **.012** |
| Defensive Avoidance | 7.23 (0.79) | 6.49 (1.27) | 6.75 (1.18) | 2 | 60.3 | 4.64[a] | **.013** |
| Message Minimization | 7.83 (0.79) | 7.30 (1.20) | 7.69 (0.91) | 2 | 97 | 2.57 | .082 |
| Perceived Manipulation | 7.09 (1.06) | 7.50 (1.12) | 7.44 (1.19) | 2 | 97 | 1.27 | .286 |

Means (and standard deviations) are presented for messages. df: degrees of freedom. $F$: $F$ test. $p$: probability level. [a] $F$ test with Welch correction was applied because the homoscedasticity assumption was not met.

**Table 4**
*Pearson intercorrelation coefficients between self-report and psychophysiological measures.*

| | Fear | Suscep | Sever | Effic | Minim | Manip | Avoid | Surprise | HR | NSR |
|---|---|---|---|---|---|---|---|---|---|---|
| Subjective fear (Fear) | -- | | | | | | | | | |
| Perceived susceptibility (Suscep) | .34** | -- | | | | | | | | |
| Perceived severity (Sever) | .24* | .52** | -- | | | | | | | |
| Perceived efficacy (Effic) | .15 | .12 | .63 | -- | | | | | | |
| Message minimization (Minim) | .16 | .11 | .14 | .13 | -- | | | | | |
| Perceived manipulation (Manip) | -.70 | .21* | .01 | .12 | .12 | -- | | | | |
| Defensive avoidance (Avoid) | .21* | .22* | .10 | .32** | .63** | .30** | -- | | | |
| Perceived surprise (Surprise) | .33** | .14 | .12 | .14 | .43** | -.10 | .11 | -- | | |
| HR | .02 | .02 | -.06 | -.85 | -.01 | .07 | -.13 | -.34 | -- | |
| NSRs | .01 | .05 | -.03 | -.06 | -.03 | -.01 | .11 | -.06 | .13 | -- |

**$p < .01$; *$p < .05$

### Outcome Variables: Assistance to Mammography Screening

Actual assistance to MS was very high. Eight out of ten (81.4%) women from the global sample went to a health centre for preventive MS. In order to analyze this variable, women were divided into three groups: (a) those who followed the message recommendation and took a mammogram when they received the scheduled appointment from the Breast Cancer Prevention Program (SA); (b) those who did not wait for the appointment and requested an MS appointment by themselves (RA); and (c) those who did not attend to MS in spite of having received the appointment (NA). This allowed us for a double comparison: assistance vs. non assistance (A vs. NA); and, within the assistance group, adherents to the recommended scheduled appointment vs. anticipated requested mammogram (SA vs. RA).

T-tests for independent samples were used to compare between the means of subjective variables in different outcome groups. Results showed some differences between assistance (A) and non assistance (NA) groups. Women who took the mammogram showed significantly higher perceived susceptibility, $t(20.2) = 2.14$, $p = .04$; higher perceived threat, $t(20.2) = 2.07$, $p = .05$; higher behavioral intentions, $t(20.7) = 2.25$, $p = .03$; and, marginally, less defensive avoidance, $t\ (20.2) = -2.04$, $p = .054$. Among those who took a mammogram, women who were compliant with message instructions (SA) scored lower in trait anxiety, $t(77) = -3.70$, $p < .01$; and neuroticism, $t(77) = -2.15$, $p = .034$; than those who did not wait and requested a mammogram by themselves (RA) .

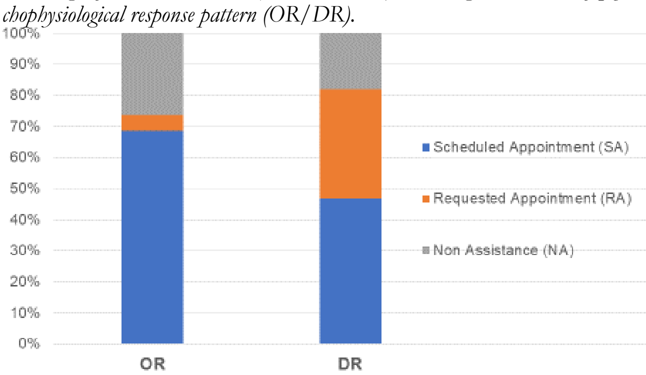
Later on, in order to go more deeply into the possible relationship between psychophysiological reactions to the stimuli and the probability of following the recommendations contained in the message, a categorization on the basis of the main direction of psychophysiological responses was carried out (Ordoñana et al., 2009). Subjects were divided into three groups on the basis of their main psychophysiological reactions, following the defense cascade model (Bradley & Lang, 2007):

1. Subjects who reacted with an average decrease in HR combined with an increase in frequency of NSR were categorized as showing a Stage I pattern (OR; $n$ = 14; 17.7%).
2. Those who showed an average increase in HR and frequency of NSR while viewing the stimulus were categorized as showing a Stage II pattern of response (DR; $n$ = 49; 62.0%).
3. Finally, subjects who did not show any of these profiles were included in a third category named indefinite response (IR; $n$ = 16; 20.3%).

This a posteriori categorization expands the analyses to include not only the magnitude of the autonomic reaction but also its orientation.

Results showed that outcome behavior seemed to be influenced by the kind of psychophysiological response pattern developed by the subjects. Hence women who presented a Stage I pattern of response (OR) were more likely to follow message instructions and to attend the MS appointment delivered by the public prevention program, $\chi^2(1) = 4.723$, $p = .03$. However, the probability of making an appointment for themselves rather than waiting for the scheduled appointment was higher for women who presented a Stage II pattern of response (DR), $\chi^2(1) = 7.498$, $p = .006$ (Figure 3).

**Figure 3**
*Percentage of outcome behavior (SA/RA/NA) according to the kind of psychophysiological response pattern (OR/DR).*




## Discussion and Conclusions

The primary aim of this study was to analyze the role of psychophysiological and subjective responses on the intentional and behavioral effects of health promotion messages, including fear or attentional appeals.

Support for the postulated hypotheses shows mixed results. Regarding psychophysiological response to the messages, all the stimuli provoked alterations in the autonomic response. Hence, frequency of NSR profiles showed a significant increase as compared to the levels registered during the rest period. This result is in consonance with studies which concluded that the different measures of electrodermal activity show an increase in front of arousing stimuli (Bradley et al., 2001; Gomez et al., 2005; Lang et al., 1993; Verschuere et al., 2004). However, we were not able to find significant differences between the three stimuli in this kind of response.

Cardiac response also behaved with an initial increase in HR, as compared to basal levels. The magnitude of this variation was similar to that obtained by other studies (Baldaro et al., 2001; Gomez et al., 2005; Harrison et al., 2000; Palomba et al., 2000; Vögele, Coles, Wardle, & Steptoe, 2003). After the increase, and immediately after the beginning of the manipulation period, where differences between messages were introduced, HR started to diminish progressively. The magnitude of this decrease was associated with the more threatening passages of the stimulus. Thus, it started earlier during the "threat" film, and reached its minimum at two moments (M3 and M5) where the contents of the message were more impressive. Similar decreases in cardiac activity are typically found during exposure to negative images (Bradley et al., 2001; Gomez et al., 2005; Lang et al., 1993; Palomba et al., 2000; Verschuere et al., 2004).

All in all, our experimental manipulations were not able to generate clearly different psychophysiological responses between the three messages. That is, despite some indication of a differential effect for the threat stimuli, we cannot claim success producing different levels of arousal associated to the characteristics of the message. It is well known that messages designed to modify audience's perceptions may not always be effective in doing so (Maloney, Lapinski, & Witte, 2011). There are at least two possible explanations that could account for this lack of significance. Firstly, stimuli may not have been sufficiently diverse to generate such differences. It must be taken into account that breast cancer is in itself a real threat to women. Although the surprise and standard messages tried to minimize threatening information, complete elimination was not possible without distorting the message and undermining the ecological validity of the information. In fact, although subjective fear was greater for the threat stimulus, perceived threat was not significantly different between messages. An alternative explanation concerns the magnitude of the responses. Although they fall into the same range as that obtained in comparable studies (Baldaro et al., 2001; Gomez et al., 2005; Harrison et al., 2000; Palomba et al., 2000; Vögele et al., 2003), it may not have been high enough to show significant differences. We must remember that our stimuli, while depicting relevant aspects of breast cancer, were not designed to generate an anxious state. Indeed, care was taken to design messages that, while dealing with threatening information, were sensitive enough to be used as a promotional communications that could be directed to the general population. Consequently, increasing the magnitude of the threat to obtain higher differences on autonomic response would not be a coherent option, nor would it be considered ethical for this case. Stimuli dealing with a less sensitive issue, allowing for more intense threatening information and greater message differences without compromising its nature and objectives (like car accidents or drug use), could be capable of generating distinct responses more easily.

Nevertheless, what is more important is that psychophysiological responses to the messages did appear to be relevant at modulating the subsequent behavioral response. Independently of the kind of message that were exposed to, subjects showed different psychophysiological response patterns that could be associated with posterior behavior. It is likely that individual characteristics or differences in stress load interact with message conditions in order to produce differential responses (Brownley, Hurwitz, & Schneiderman, 2000). Thus, it is the response, not the message itself what could be more directly associated to message behavioural effects. In concordance with previous results, an autonomic pattern of response consisting of a heart rate decrease accompanied by an increase in skin conductance was related to a greater likelihood of following the instructions contained in the message (Ordoñana et al., 2009). Alternatively, we found that those women who did not follow the instructions in the message, and anticipated to request a mammogram by themselves, before scheduled, were more likely to show a defensive response pattern (i.e., concomitant increases in HR and SC).

A decrease in HR in the face of aversive stimulation has been associated with the facilitation of stimulus perception (Lang et al., 1997; Palomba et al., 2000). It has been interpreted in terms of perceptive-attentional requirements of emotional stimuli, and is related to the orienting response. Thus, a sustained HR decrease has been considered as an index of continuous attention towards aversive stimuli (Cook & Turpin, 1997; Gomez et al., 2005; Palomba et al., 2000). However, while HR deceleration is associated to an orienting response, acceleration relates to defensive responses (Verschuere et al., 2004).

The defence cascade model (Lang et al., 1997) proposed that the difference between OR and DR is not dichotomous but directly related to stimulus aversiveness. This aversiveness depends on the quality of the stimulus, but also on contextual situation, personal experience and individual characteristics. When the aversive level of the stimulus is low, attention is directed towards novelty or significant information rather than to known or neutral stimuli. In this case, sustained cardiac deceleration is indicative of continued attention to an aversive stimulus and occurs when the defensive system is moderately activated but action is not imminent (Öhman, Hamm, & Hugdahl, 2000). This would be reflected in a classical OR (SC increase and HR decrease). However, when the aversive level of the stimulus is higher, orienting arousal turns to defensive activation to prepare an organism for basic flight-or-fight reactions, with a pronounced response involving HR acceleration.

That is, as expected, it seems that a pattern of psychophysiological response indicative of stimulus perception and attention is associated with adherence to message recommendations. This could imply a relationship between the degree of attention to and processing of the information contained in the stimulus and the later behavior (Ordoñana et al., 2009). Thus, it would seem that the information devoted to elicit a scared response, actually could generate attention to the message in some subjects.

However, other subjects showed a defensive autonomic pattern, which is the kind of response associated to an emotional reaction to aversive stimuli, like fear. These subjects also were compliant on taking a preventive mammogram, but their behavior was not exactly the same. They were more likely to anticipate and request the MS before they could be scheduled. This could be explained as an answer to a higher degree of anxiety that should be resolved as soon as possible. The fact that these women had also higher scores on trait-anxiety and neuroticism points to a similar conclusion.

These results can be integrated into the theoretical structure of the EPPM opening some new perspectives and highlighting at least three specific points. Firstly, as suggested before, a strong emotional response would not be always necessary for threat to be perceived on a sufficient level. Threatening information does not always produce fear, and not in every subject. Whether it elicits an attentional or an emotional response would depend on the message, the contextual clues, and the personal experience and characteristics of the subject. Attention is more likely to be directed to stimuli with a motivational significance for the individual (Lang et al., 1997). Hence in the context of a classical health prevention message, focusing on severity and susceptibility may trigger attention, and motivate the further processing of the message, but there would be no need to actually elicit fear. A cognitive appraisal evaluating a possible, but non-imminent, risk may suffice as a motivational factor to continue processing the message. Secondly, our data supports the EPPM proposition regarding the behavioral outcomes. According to this model, when people experience fear they are motivated to reduce that fear by engaging in either danger or fear control processes, as determined by the efficacy appraisal. Women in our sample that showed a defensive pattern of response were more likely to show an intermediate response: they took the mammogram, but they did not follow the instructions in the message to get it. Apparently, they were too anxious to wait for a scheduled appointment and needed to resolve as soon as possible. In this case, the behavior displayed was correct (in terms of getting the mammogram), but they did not follow correctly the instructions of the message. It could be said that they engaged in fear control processes but displaying an adaptive behavior. This fact could be related to suboptimal responses of the public (theoretically adequate but excessive and inefficient) in front of health threats that can generate also dysfunctional situations. Overreactions to health threats provoking problems in health care services (e.g., excessive demands), social environments (e.g., isolation requests) or even markets (e.g., generalization of refusal to unaffected food products due to a food alert), are common and relatively frequent examples of this. Thirdly, our results do not support the notion that measuring subjective fear can be an adequate substitute for psychophysiological responses. We have not been able to find significant correlations between psychophysiological and subjective fear responses, and the same result was obtained in a previous report (Ordoñana et al., 2009). Classical theory in the psychophysiology of emotions assumes that the three systems that define emotion (subjective reports, physiological responses, and overt behavior) do not necessary show high correlations (Lacey & Lacey, 1970) and, actually, the reports of affective experience and physiology are assumed to show discordance (Bradley & Lang, 2007). Hence, the analysis of psychophysiological responses can offer, by itself, relevant and unique information to interpret the effects of this kind of stimuli.

There are several limitations of the present study that warrant discussion and point to future directions for research. Firstly, the objective itself of the study and, as noted before, the nature of the topic of breast cancer, did not allow us to introduce extreme differences between messages. This lack of dissimilarity could have contributed to the absence of clearly significant differences in the psychophysiological responses to the stimuli. Secondly, low relilability of some of the self-report sub-scales (i.e., perceived severity, self-efficacy and defensive avoidance) may have affected part of the results of the analysis involving self-reports.

Finally, although sample size was similar to that used by other studies (Christie & Friedman, 2004; Gomez et al., 2005; Harrison et al., 2000; Palomba et al., 2000), and in spite of its ecological validity, sample amplification might have led to more meaningful results.

In summary, this study presents a psychophysiological approach to the analysis of behavioral effects of messages used in health promotion campaigns. We report specific relationships between autonomic responses and outcome variables that may help to understand how people react to messages conveying relevant information. Our conclusions may be integrated within current theoretical models, such as EPPM, supporting it and opening some new perspectives. Future research is required to extend these findings, and to explore the relationship between psychophysiological and subjective response patterns to real stimuli, as well as the effect of these factors on behavioral variables.

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