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# Exploring physiologic reactions to persuasive information

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**Abstract**

Persuasion aims at changing peoples' motivations and/or behaviors. This study explores how and when physiology reflects persuasion processes and specifically whether individual differences in motivations and behaviors affect psychophysiologic reactions to persuasive information. Participants ($N = 70$) with medium or high meat consumption patterns watched a persuasive video advocating limited meat consumption, while their electrodermal and cardiovascular physiology was measured. Results indicated that the video increased participants' moral beliefs, perceived behavioral control, and reduction intentions. This study also found an increase in physiologic arousal during the persuasive video and that people with motivations less aligned to the persuasion objective had more physiologic arousal. The findings encourage further psychophysiologic persuasion research, especially as these insights can potentially be used to personalize persuasive messages of behavior change applications.

**KEYWORDS**

affective computing, ECG, personalized persuasive technologies, persuasion, psychophysiology

## 1 | INTRODUCTION

Attempts at persuasion try to change attitudes and behaviors (Perloff, 2008), often by making us feel (Lewinski et al., 2016) or think about something (Petty & Cacioppo, 1986; Wegener & Carlston, 2005). Both emotional (Gross, 2002; Kreibig, 2010; Posner et al., 2005) as well as cognitive processes (Gazzaniga et al., 2009; Grassmann et al., 2016; Overbeek et al., 2014) can activate our physiology. Nevertheless, there is currently no unified understanding of psychophysiology during persuasion processes. Therefore, this study investigates *how* and *when* physiology changes during an attempt at persuasion. Moreover, it focuses on the impact of individual aspects, such as current behavior and motivations, in relation to psychophysiologic responses to persuasive information.

Studying physiologic reactivity in the context of persuasion can be useful, as these insights can further enhance our understanding of the underlying mechanisms of persuasion (Chua et al., 2011; Schneider et al., 2009). Peripheral physiologic measures such as heart rate (HR) or sweating can correlate with and therefore be proxies or predictors of behavior and experience because these measures reflect deeply rooted physiologic reactions of the nervous system (Cacioppo et al., 2007). In addition, the psychophysiologic knowledge gained could be used to leverage peripheral physiology as additional input in the personalization of persuasive interventions (i.e., through

Luisa Asta was doing an internship with the Human-Technology Interaction group at the Eindhoven University of Technology while doing the work.

physiologic computing, Fairclough, 2009). Persuasive interventions have the ability to efficiently support people in changing their behavior (Chua et al., 2011). Personalized persuasive interventions can adapt to a specific user, which will foster persuasion (Markopoulos et al., 2015). For instance, current behaviors and motivations can affect susceptibility to persuasion and are therefore a good basis for personalization. Expectedly, the current behaviors and motivations also influence the emotion (regulation) processes that emerge from a persuasive attempt, which in turn are reflected in physiology. Thus, physiologic measures might be useful for the personalization of persuasive interventions.

## 1.1 | Subject-specific motivations affect psychologic responses to persuasion

We make a distinction between persuasion, an attempt at persuasion, and persuasion-related processes. An attempt at persuasion concerns the effort that tries to persuade someone, for example, a message or video. Persuasion-related processes are psychologic processes evoked by that persuasion attempt. Persuasion is when people change their attitudes, intentions, or behaviors by conforming to an attempt that encourages this change (Falk & Scholz, 2018; Perloff, 2008). An attempt at persuasion can influence emotional or cognitive states. For example, an attempt at persuasion might result in increased cognitive effort when elaborating on a message (Petty & Cacioppo, 1986) or negative emotions when confronted with a discrepancy between your own and the advocated behavior (Cialdini & Goldstein, 2004; Festinger, 1985). The persistence of persuasion is variable. That is if the person is motivated and able to consider the message it leads to a more durable attitude change, while persuasion is less persistent when based on simple inferences and affective associations (see also *Elaboration Likelihood Model*, Petty & Briñol, 2014; Petty & Cacioppo, 1986).

Attempts at persuasion will not be equally effective for everyone due to differences in stable characteristics or traits, such as personality (Cacioppo et al., 1986; Oyibo et al., 2017; Perloff, 2008) or initial beliefs and motivations (Cialdini & Goldstein, 2004). Additionally, persuasive effectiveness can differ due to the momentary state of a person: Mood can influence the perception of a persuasive cue (DeSteno et al., 2004; Rosselli et al., 1995), and situational constraints on time or resources can hamper the elaboration on a persuasive cue (Petty & Cacioppo, 1986). This is why personalized approaches are more likely to achieve persuasion than generic interventions (Chua et al., 2011; Lacroix et al., 2009).

How people inherently feel about the topic at which a persuasive message is directed, affects the relative persuasiveness of the message. People have beliefs and motivations that steer behavior or behavior change (Ajzen, 1991; Michie et al., 2011). To illustrate, the theory of planned behavior describes individual beliefs about the (desirability) of the behavioral outcomes, social norms, and perceived control (Ajzen, 1991). These beliefs result in motivations to perform or not perform a behavior: The overall evaluation of the targeted behavior results in an *attitude toward the behavior*, social pressures result in *injunctive and descriptive norms*, and people's confidence to perform a behavior is defined by *perceived behavioral control* (Ajzen, 2002).

Importantly, the motivations to behave in a certain way are unique to an individual and can influence the process of persuasion. The decision (not) to comply with a persuasive message can depend on the alignment between the advocated information and current motivations: Completely aligned messages are not persuasive, as they cannot change motivations. People are susceptible to persuasive information that is slightly misaligned with their current motivations and behaviors. Misalignment between their own and the advocated motivations and behaviors can cause discomfort or stress, partly because social approval is essential for human survival (Cialdini & Goldstein, 2004). This discomfort can motivate actions in line with compliance (Festinger, 1985; Harmon-Jones & Harmon-Jones, 2007). However, if the conflict is too large, the attempt is likely to backlash or elicit a counter-reaction. In that case, the person might feel threatened in their freedom and becomes motivated to reject what is proposed. This response is known as *psychologic reactance* (Brehm, 1966; Sittenthaler et al., 2015).

## 1.2 | Physiology as an indication of persuasion-related processes

As all mental states have a physiologic substrate (Andreassi, 2007; Cacioppo et al., 2007), also the mental states associated with persuasion-related processes, are expectedly measurable in physiology. Earlier research indeed hinted at a link between persuasion-related processes and peripheral physiology[1]: Electrodermal and

[1]This paper focuses on peripheral physiology, as these parameters are easily accessible in daily life with wearables (van Lier et al., 2020) and incorporable in Persuasive Technology applications. But studies revealed also several neural underpinnings of persuasion-related processes by analyzing concurrent brain activation (Bartra et al., 2013; Falk et al., 2015; Falk & Scholz, 2018; Vezich et al., 2017). The brain areas associated with persuasion-related processes were also associated with peripheral physiologic activity (Bartra et al., 2013; Gianaros et al., 2005; Shoemaker & Goswami, 2015; Thayer, Hansen, Saus-Rose, & Johnsen, 2009).

cardiovascular activity predicted the effectiveness of narrative persuasion (Barraza et al., 2015; Correa et al., 2015). Threatening messages evoked more systolic blood pressure reactivity compar

ed with control messages (Schneider et al., 2009). Also, facial muscle activity (Lewinski et al., 2016) and body posture (Briñol & Petty, 2008) appeared to offer insights into persuasion-related processes. Therefore, it is clear that peripheral physiology is involved in persuasive processes.

However, it is not clear which psychologic process during persuasion brings this physiologic change. To date, research into the psychophysiology of persuasion has mainly focused on the effects caused by persuasive strategies, that is, narrative vignettes (Barraza et al., 2015; Correa et al., 2015), threat or challenge message framing (Schneider et al., 2009), or fear appeals (Wegener & Carlston, 2005). But physiologic activity will rather depend on the processes that the person goes through. Heart rate variability (HRV) was, for example, implicated in related processes such as appraisal (Bartra et al., 2013; Thayer et al., 2012) and mentalizing (Denny et al., 2012; Okruszek et al., 2017). Similarly, electrodermal activity was associated with energy regulation and highly responsive to social interactions (Cacioppo et al., 2007, p. 172). In the present paper, we study the effect of information–motivation misalignment on the persuasion process and its reflection in physiology. Specifically, this research aims to extend the current knowledge by analyzing physiology during persuasive information that is misaligned with people's current motivations. We expect that the emotions and cognitions aroused by information–motivation misalignment result in clear physiologic patterns.

There is reason to believe that the processing of messages slightly misaligned with current motivations reflects in physiologic responses. That is, slightly misaligned messages can evoke emotions, such as discomfort or stress (Cialdini & Goldstein, 2004), or ask for emotion regulation as these messages, for example, try to make you feel guilty or ashamed (Lewinski et al., 2016). These processes are likely to affect HR and HRV in the cardiovascular system, which both play a role in emotion regulation and control (Berntson et al., 1993). Similarly, these negatively valenced emotions can affect skin conductance level (SCL) and responses (SCRs) in the electrodermal system (Kreibig, 2010). SCL and the number of SCRs are known to increase upon exposure to a stressor (Brouwer et al., 2018) or when a person becomes motivated to act in line with compliance (Festinger, 1985; Harmon-Jones & Harmon-Jones, 2007). Physiologic arousal, especially heightened electrodermal activity (Harmon-Jones & Harmon-Jones, 2007), is seen as being part of these motivational processes (Baum et al., 1986). Also, one may be inclined to invent counterarguments to resist the slightly misaligned persuasive messages, which ask for cognitive effort. HR and HRV are found to covary with mental effort (Fairclough & Mulder, 2011; Fairclough et al., 2005; Lacey, 1967). Indeed, research indicates that when resistance to persuasion depends on cognitive elaboration, greater resistance also entails a higher HR (Cacioppo, 1979).

There is also reason to believe that greater misalignment between the advocated message and current motivations reflects even more in physiologic responses. Psychologic reactance (see Section 1.1) is known as a state with motivational, emotional, and cognitive components that can activate a person's physiology (Miron & Brehm, 2006; Rains, 2013; Sittenthaler et al., 2015, 2016; Steindl et al., 2015). Because people often feel angry, hostile, or uncomfortable during reactance (Brehm, 1966; Steindl et al., 2015), this state is expected to provoke a rapid emotional response. A meta-analysis by Kreibig (2010) shows that SCR and SCL as well as HR and HRV change in the presence of anger. For example, HR, SCL, and SCRs appear to increase significantly in the 20 min before an aggressive incident (de Looff et al., 2019). Psychologic reactance is also characterized by negative cognitions (Rains, 2013), which might reflect in physiology. Previous research (Sittenthaler et al., 2015, 2016) indeed related to a delayed HR response during legitimate and vicarious reactance to cognitive processing.

## 1.3 | Study aims and hypotheses

This paper describes an explorative study that intends to determine *how* and *when* people's physiologic activity changes due to persuasion. In particular, it probes the potential effects of current motivations and behavior on psychophysiologic reactions to persuasive information. Thereby, it aims to create insight into the underlying process of persuasion, specifically in case of misalignment of these current motivations with the persuasive information presented. Based on the current knowledge, we expect that greater information–motivation misalignment will result in more physiologic activity. As such, more physiologic activity during persuasion-related processes can be expected in people whose current motivations are less aligned to the advocated goal compared with people whose motivations are more aligned. We also expect that this can be measured in features of the electrodermal and cardiovascular systems, such as HR, HRV, skin conductance, and skin conductance responses.

We test these presumptions by persuading people to limit their meat consumption. Nowadays, meat consumption is determined by cultural-oriented values such as masculinity, nutrition, and hedonism (de Bakker & Dagevos, 2012). Plant-based alternatives have become largely available. Meat consumption is a voluntary behavior that has a high potential for change (Zur & Klöckner, 2014). Many people both care for animals/the environment and enjoy eating meat. This inconsistency is better known as the *meat paradox* (Bastian et al., 2012; Loughnan et al., 2014). Furthermore, research has identified a variety of beliefs that may contribute to the reduction of meat consumption (i.e., moral considerations, health aspects, and environmental impact) and a tool to capture the underlying motivations that lead to consumption behavior (Zur & Klöckner, 2014). This makes meat consumption a useful subject for persuasion research. We will investigate whether the degree of alignment between a person's current motivations and the topic of vegetarianism predicts physiologic responses to an attempt at persuasion on this topic. Therefore, people with medium or high current meat consumption patterns will be exposed to a persuasive video advocating limited meat consumption, while their physiologic activity is being measured.

Considering the above, we formulate the following hypotheses: (1) An attempt at persuasion evokes peripheral physiologic reactivity, that is increased HR, SCL, SCRs, and decreased SDNN and RMSSD. (2) Physiologic reactivity to an attempt at persuasion relates positively to the misalignment between a person's current motivations and the advocated information—a greater information–motivation misalignment is expected to evoke more peripheral physiologic reactivity to the attempt at persuasion.

# 2 | METHOD

## 2.1 | Design

This study has a between-subject design, distinguishing people with medium and high meat consumption. Peripheral cardiovascular and electrodermal physiology was measured while participants watched a persuasive video that deployed various persuasion strategies and urged them to limit meat consumption. Participants' motivations to limit meat consumption were measured 1 week before the study as well as immediately after the video to establish the persuasive impact of the video. Ethical approval was obtained from the institutional review board of the Eindhoven University of Technology.

## 2.2 | A priori power analysis

Earlier research found an effect of attitude strength on susceptibility to persuasion with an effect size of $f$ = 0.22 (Pomerantz et al., 1995). An a priori power analysis for $F$ tests with two groups, two measurements, and a 90% power in G*power indicated that a sample size of at least 58 participants should be enough assuming the predicted effect size of $f = 0.22$ (Faul et al., 2007). The sample size given is multiplied by factor 1.2 to ensure that the effect is not negated by unpredictable shortcomings of the study as subjects may drop out, data loss, measurement failure, etc. Thus, we used a sample size of 70 participants.

## 2.3 | Participants

Recruitment occurred via the University participant database. Seventy people without (a history of) cardiovascular disease and with sufficient English language skills participated in this study. Participants were included if they reported eating meat in any of their meals (breakfast, lunch, and dinner) at least 5 days a week. They were divided into two experimental groups as follows: Group M (medium meat consumption) included people who reported to eat meat five or six times per week ($N = 36$, 13 women, $M_{age} = 29$, $SD_{age} = 16$), whereas Group H (high meat consumption) included daily consumers of meat ($N = 34$, 10 women, $M_{age} = 25$, $SD_{age} = 6$).

## 2.4 | Manipulation

The persuasive video included fragments from the documentary *Cowspiracy: the sustainability secret*, which discusses the adverse consequences of animal product consumption on society and the environment (Anderson & Kuhn, 2014). The persuasive video had a total duration of 9:35 min and employed various persuasive strategies, including rational arguments (O'Keefe, 2013), authority (Cialdini, 2004), clear forceful language (Miller et al., 2007), fear appeals (Rogers, 1983), repetition (Michie et al., 2013), and new information (Armstrong, 2010).

To indicate when a certain persuasive strategy was active, the video was split into 19 epochs of 30 s. Two independent raters scored active persuasion principles per epoch (Table 1). For this, a subset of relevant principles from the persuasion principle index was selected (see Armstrong, 2010, p. 387 for the full persuasion principle map). Appendix A presents how the selected persuasion principles were applied to our video. Table 1 indicates when both raters agreed in categorizing a certain principle in the features shown during that epoch. The video started with the current state of animal agriculture and its effects on the environment, as discussed

**TABLE 1** Active persuasion principles for each 30-s epoch of the persuasive video

| Persuasion principle* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Influence | | | | | | | | | | | | | | | | | | | |
| Reason | | | ■ | ■ | ■ | | | | | | | | ■ | | | | | ■ | ■ |
| Social proof | | | | | | | | | | | | | | | | | | | |
| Authority | ■ | ■ | | | | | ■ | ■ | | ■ | | | | | | | | | |
| Emotion | | | | | | | | | | | | | | | | | | | |
| Guilt | | | | | | | | | | | | | | | | | | | |
| Fear | ■ | ■ | | | | | | | | | | | | | | | | | |
| Provocation | | | | | | | | | | | | | | | | | | | |
| Overcoming resistance | | | | | | | | | | | | | | | | | | | |
| New perspectives | | | | | ■ | | | | | | | | | | | | | | |
| Stories | | | | | | | | | ■ | | | | | | | | | | |
| Acceptance | | | | | | | | | | | | | | | | | | | |
| Problem and solution | | | | | | | | | | | | | | | | | | | |
| Evidence | | | | | | ■ | ■ | ■ | | | | | | | | | | ■ | ■ |
| Data presentation | | | ■ | ■ | | | | | | | | | | | | | | | |
| Refutation | | | | | | | | | | | | | | | | | | | |
| Repetition of claims | | | | | | | | | | | | | | | | | ■ | | |
| Clear call for action | | | | | | | | | | | | | | | | | | | ■ |
| Messages | | | | | | | | | | | | | | | | | | | |
| Rational argument | ■ | ■ | | | | | ■ | ■ | | | | ■ | | | ■ | | ■ | | ■ |
| Forceful text | | | | | | | | | | | | | | | | | | | |
| Metaphors | | | | | | | | | | | | | | | | | | | |
| Informative illustration | | | ■ | ■ | | | | | ■ | | ■ | | ■ | | | | | | ■ |
| Motion media | | | | | | | | | | | | | | | | | | | |
| Spokesperson | | | | | ■ | | | | | | | ■ | ■ | | | | | | |
| Music/sound | | | | | | ■ | | | | | | | | | | | | | |

*Persuasion principles were validated in previous research (Armstrong, 2010; Armstrong et al., 2016; Green et al., 2016). Each main principle consists of several subprinciples (Armstrong, 2010). Black shading indicates the presence of the specific persuasion principle during that epoch according to two independent raters. Epochs last 30 s each.

by experts from different fields, that is general practitioners, dairy farmers, sustainability scientists, and conservation scientists. It presented quotes such as "animal agriculture is the number one contributor to human-caused climate change" and "raising animals for food costs one-third of the planet's freshwater, occupies 45% of the earth's land, is responsible for 91% of the Amazon destruction and is a leading cause of species extinction and ocean dead zones." The information provided was supported with easily understandable stories, metaphors, and visual representations (see Figure 1a). The video emphasized that by adopting a vegan or vegetarian diet, the participant could lessen the burden on the earth's resources (Figure 1b). Only in the end did the video imply that the viewer could be part of the solution to the meat consumption problem, as the video ended with a clear call for action to "make the change."

## 2.5 | Measurements

### 2.5.1 | Self-report measures

Demographic questions concerned age, gender, and education. Current behavior was assessed with one item asking average weekly meat consumption ranging from *never* to *daily*. To determine the participant's motivation to limit meat consumption, a validated questionnaire identified related intentional and habitual processes as well as situational constraints (Zur & Klöckner, 2014). The resulting motivational state variables were perceived behavioral control, injunctive norm, descriptive norm, health beliefs, moral beliefs, attitude, reduction intention, and habits (Table 2). Apart from attitude, descriptive norm, and reduction intention, all items were answered on a 7-point scale ranging from "completely

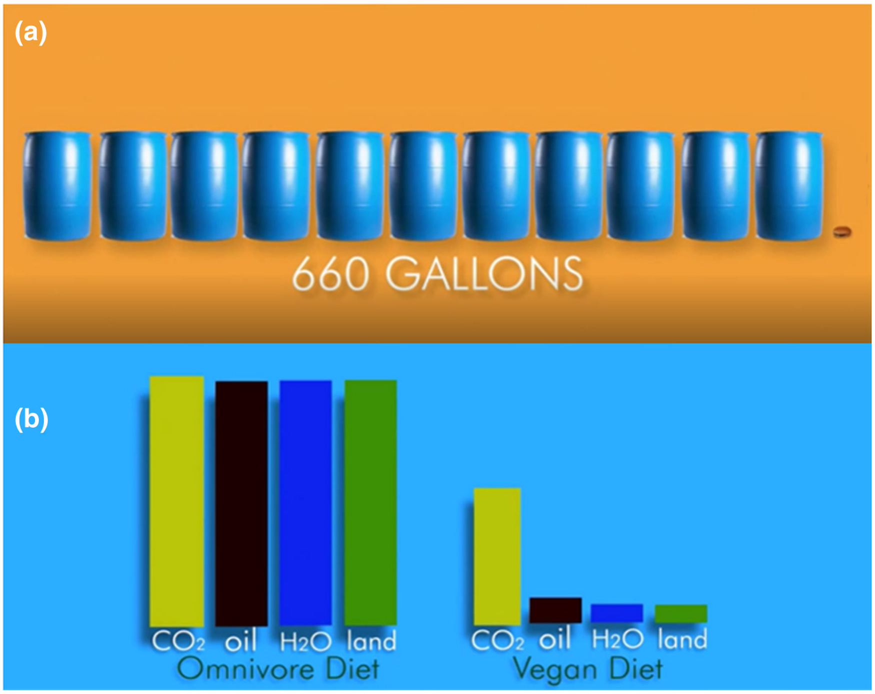


**FIGURE 1** Informative illustrations from Andersen and Kuhn (2014). (a) A visual representation of the amounts of water it takes to make a quarter-pound hamburger versus the actual hamburger. (b) How much materials relatively can be saved by adopting a vegan diet compared with an omnivore diet

**TABLE 2** Descriptive statistics of motivational state 1 week before and immediately after the persuasive video for both intervention groups

| | | | | Median meat consumers | | High meat consumers | | |
|---|---|---|---|---|---|---|---|---|
| **Scale** | **Time** | **No. of items** | **α** | **Mean** | ***SD*** | **Mean** | ***SD*** | |
| Attitude | Before | 1 | – | 5.056 | 1.330 | 4.471 | 1.212 | |
| | After | 1 | – | 4.722 | 1.446 | 4.588 | 1.559 | |
| Moral beliefs | Before | 5 | 0.636 | 4.811 | 1.032 | 4.659 | 0.801 | ◆ |
| | After | 5 | 0.579 | 5.489 | 0.825 | 5.494 | 0.806 | |
| Health beliefs | Before | 2 | 0.700 | 4.528 | 1.336 | 4.191 | 1.451 | |
| | After | 2 | 0.787 | 4.708 | 1.518 | 4.324 | 1.440 | |
| Perceived behavioral control | Before | 4 | 0.568 | 4.792 | 1.039 | 4.507 | 1.074 | ◆ |
| | After | 4 | 0.665 | 5.285 | 0.932 | 4.993 | 1.031 | |
| Reduction intention | Before | 4 | 0.584 | 0.910 | 0.364 | 0.713 | 0.262 | ◆,● |
| | After | 4 | 0.642 | 1.097 | 0.415 | 0.897 | 0.332 | ● |
| Injunctive norm | Before | 4 | 0.472 | 2.604 | 0.983 | 2.397 | 1.015 | |
| Descriptive norm | Before | 5 | 0.650 | 34.194 | 11.222 | 34.294 | 21.274 | |
| Habits | Before | 3 | 0.808 | 4.58 | 1.367 | 5.431 | 1.304 | |

*Note:* Descriptive and injunctive norms, as well as habits, were not measured after the intervention, as they cannot change over the short course of the experiment. ◆, this variable was significantly affected by time (before/after video), ●, this variable was significantly different between groups (M/H).
Abbreviations: *α*, Cronbach's alpha, *SD*, standard deviation.

disagree" to "completely agree." The attitude was measured by asking whether participants thought "introducing vegetarian dishes in my diet would be … pleasant–unpleasant" on a 7-point Likert scale (Zur & Klöckner, 2014). Descriptive norm was quantified as the number of people with a vegetarian or meat-light diet in the social network of the participant. Reduction intention was measured on a 4-point ordinal scale with 1 = "no intention to reduce," 2 = "intention to reduce," 3 = "intention to become vegetarian," and 4 = "intention to become vegan." In addition, a control questionnaire with three questions tested whether the participant had paid attention to the video and one question probed the novelty of the information presented.

### 2.5.2 | Physiologic measures

A Mobi physiology-recording device, sampling at 1029.5 Hz, with three Kendall H124SG electrodes in Lead II placement and two dry electrodes with Velcro straps on the fingertips of the index and middle fingers was used to measure cardiovascular (ECG) and electrodermal (EDA) activity, respectively. Physiology was measured during the complete laboratory experiment.

## 2.6 | Procedure

One week before the laboratory session, the participants completed an online survey checking their applicability and gathering their demographic information, current meat-eating behavior, as well as motivations to limit meat consumption. Then, the participants were divided into two groups based on the current medium or high meat consumption: either 5 or 6 days per week (Group M) or every day of the week (Group H). The experimental procedure was the same for both groups. Participants were instructed to refrain from drinking caffeinated drinks in the 2 h preceding the laboratory session. Upon arrival in the laboratory, the participants received an explanation and signed an informed consent form. After cleansing the skin with an alcohol prep pad, the electrodes were applied to the positions indicated. Then, they were attached to the physiological-recording device and seated in front of a computer screen. On a desktop, custom OpenSesame software with a Legacy-backend (Mathôt et al., 2012) executed the experiment by script. It started with a 5-min neutral sea-life video with classical music (Piferi et al., 2000), during which a baseline recording of physiologic activity in rest was performed. Afterward, the 9:35-min persuasive video was displayed on the computer screen. Finally, the participant completed a survey again assessing motivations to limit meat consumption as well as control questions.

## 2.7 | Signal processing

Answers to the questionnaire measuring motivational state to limit meat consumption were analyzed as instructed (Zur & Klöckner, 2014). We applied a 50 Hz notch filter to all physiologic signals. In the ECG signal, R-peaks were detected to calculate interbeat intervals (IBIs) and manually checked. IBIs outside the 0.4–1.4 s range or three times the standard deviation from the mean were checked and interpolated if the value seemed to be an artifact (Norris et al., 2007). The EDA signal was converted from a resistance to a conductance signal and downsampled to 5 Hz. A 0.5 Hz low-pass Butterworth filter was applied to the log-transformed conductance signal (Boucsein, 2012).

The next step was parameter extraction for each experimental segment (baseline, video, and survey). From IBI data, mean HR was computed, as well as HRV using the standard deviation of the normal-to-normal peaks (SDNN), and root mean square of successive differences (RMSSD) (Berntson et al., 1997; Camm et al., 1996). From the filtered EDA signal, mean SCL and the number of skin conductance responses per minute (SCRs) per experiment segment were calculated. The SCRs were calculated by counting positive to negative zero crossings in the first time-derivative of the filtered EDA signal (Boucsein, 2012). As HRV parameters are time-dependent, a fixed time range was used to calculate mean values for each experiment segment, that is, physiologic baseline, persuasive video, and survey completion. The time range was set to 4.5 min to ensure equal-length physiology traces in each experiment segment.[2] In the baseline segment, we sampled a physiologic trace during the last 4.5 min. Since the persuasive video was 9:35 min, the following two samples were created: one sample over the last 4.5 min of the first half of the video and one sample over the first 4.5 min of the last half of the video. The physiologic parameters between both samples did not differ significantly, thus the average of the physiologic parameters during both samples eventually served as parameter values. Last, parameter extraction during the survey concerned the first 4.5 min of the segment. Next, physiologic activity values with a Mahalanobis score larger than 25 were replaced as missing values (Yuan & Zhong, 2008). The Mahalanobis score is a multivariate distance measure that rescales variables based on their eigenvector to remove covariance and calculates the distance from the matrix mean. Physiologic reactivity was calculated by subtracting the value in a rest state (baseline) from the value during the video, that is, HR reactivity $_{(video)}$ = HR $_{(video)}$ − HR $_{(baseline)}$ and likewise for the survey segment and the other physiologic parameters.

Furthermore, the physiologic trace during the video was sampled in 19 epochs of 30 s, as this is the shortest

[2]Although 5-min epochs are recommended for short-term HRV (Shaffer & Ginsberg, 2017; Wang & Huang, 2012), research indicated that the differences in HRV values between 5- and 3-min epochs are minimal (Wang & Huang, 2012). As the relatively reliable epochs of 4.5 min allow for equal physiologic traces and thus our analyses, we decided on this.

acceptable period for calculating reliable ultra-short-term HRV features (Lewis et al., 2013; Shaffer & Ginsberg, 2017). Again, physiologic parameter values were extracted for each epoch and checked for outliers. For signal processing, R Studio (RStudio Team, 2016) was used with packages *Psych* (Revelle, 2017), *Tidyverse* (Wickham, 2017), *Signal* (Carezia et al., 2015), and *Zoo* (Zeileis & Grothendieck, 2005).

### 2.8 | Statistical analyses

First, we verified whether the video was persuasive for both consumption groups. Multiple within-between ANOVAs with motivations as dependent variables, and time (before/after) as well as a group (medium/high meat consumption) as independent variables tested whether the persuasive video affected motivations and if this differed based on initial consumption patterns. The motivational state variables tested were moral beliefs, health beliefs, perceived behavioral control, attitude, and reduction intentions. Injunctive and descriptive norms, as well as habits, were not tested, as they cannot change over the short course of the experiment.

We also investigated changes in physiology during the persuasive video and if those changes related to specific persuasion principles (Green et al., 2016). We identified the persuasion principles that were active in the epochs that evoked more activity compared with the preceding and the following epoch, that is, higher HR, SCL, or SCRs values and lower SDNN or RMSSD values. As our sample size did not allow for enough power for statistical tests on this purpose, these results were described qualitatively.

To investigate our hypotheses, we modeled physiologic reactivity with multiple linear mixed models. This was done separately for each physiologic reactivity parameter of interest as a dependent variable (HR, RMSSD, SDNN, SCL, and SCRs). This approach enabled us to create subject-specific models, account for missing data, and characterize the unexplained or residual variation in the response on multiple levels (Bates et al., 2015; Venables & Ripley, 2002). Physiologic reactivity was tested in a linear mixed model with experiment segment (video/survey), experimental group (M/H), and the motivational state variables (habits, moral beliefs, health beliefs, perceived behavioral control, attitude, injunctive norm, and reduction intention[3]) as fixed factors, and participant as a random factor. Descriptive norm was not included in this model as it was not assessed with a scale. This model allowed us to investigate how and when physiologic reactivity was evoked in our experimental procedure (Hypothesis 1) by looking at the effects of the experiment segment (video/survey). In addition, it allowed us to investigate whether greater information–motivation misalignment evoked more peripheral physiologic reactivity to the attempt at persuasion (Hypothesis 2) by looking at the effects of the initial motivational states (habits, moral beliefs, health beliefs, perceived behavioral control, attitude, injunctive norm, and reduction intention). To avoid overfitting, we started with a simple model and compared a series of increasingly complex fits using the Akaike Information Criterion (AIC) (Venables & Ripley, 2002): Our simple model included only experiment segment as a fixed factor and participant as a random factor. Then, group (medium/high meat consumption) was added and evaluated. One by one, a variable of initial motivational state was added to the model and evaluated. The added variable was only retained when it significantly explained more variance and added predictive power to the model based on AIC weights (Wagenmakers & Farrell, 2004). As the resulting relative importance of the added motivational state variables (indicated by AIC weights) is order dependent and variables are expectedly highly correlated, the variables were added with a fixed sequence; habits, moral beliefs, perceived behavioral control, reduction intention, injunctive norms, attitude, and health beliefs. For analysis, R Studio (RStudio Team, 2016) was used with packages *Car* (Fox & Weisberg, 2019), *Psych* (Revelle, 2017), *lme4* (Bates et al., 2015), and *lmerTest* (Kuznetsova et al., 2017).

[3]Descriptive norm was not included in this model as it was not assessed with a scale. That is descriptive norm was quantified as the number of people with a vegetarian or meat-light diet in the social network of the participant

## 3 | RESULTS

Incorrect timestamps led to the exclusion of data sets of two participants. Insufficient conductance properties of the skin led to an additional exclusion of electrodermal activity values for 14 participants. This left 54 complete and 14 incomplete data sets for analysis. We only excluded the incomplete data sets from the correlational analysis, as the linear mixed models could handle missing data (Venables & Ripley, 2002).

### 3.1 | Self-report data

The self-report data had no outliers but only perceived behavioral control was normally distributed. Because 68 was considered a reasonable sample size, we continued

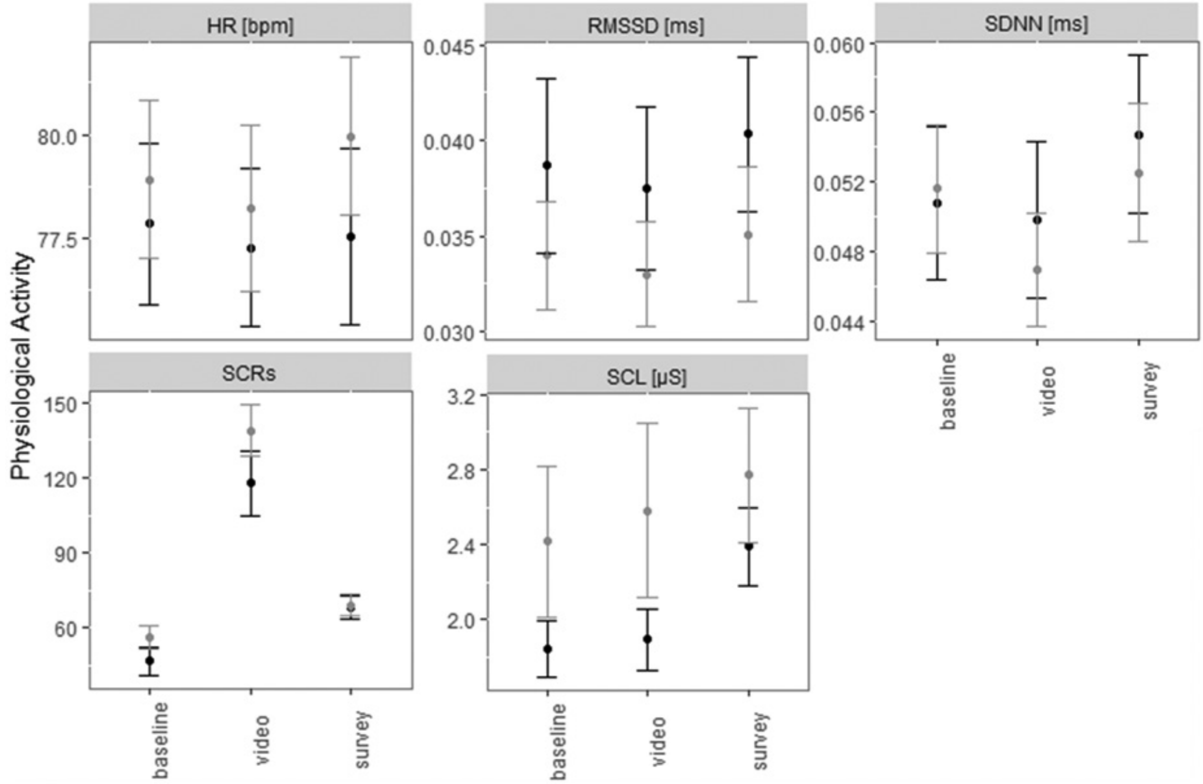


**FIGURE 2** Average physiologic activity per segment for each experimental group with error bars representing standard errors of the mean. Black = group of medium meat consumers, gray = group of high meat consumers

our analysis with parametric tests (Norman, 2010). Levene's test revealed homogeneity of variance for all self-report scales. Cronbach's alpha indicated sufficient internal reliability for all scales except for the initial injunctive norm scale. Table 2 depicts descriptive statistics for both groups.

Six within-between ANOVA's with Benjamini and Hochberg's correction for multiple testing were conducted to compare the video's effect on the motivational state variables, that is, moral beliefs, health beliefs, perceived behavioral control, reduction intentions, and attitude, of medium and high meat consumers. There was a significant effect of time (before/after video) on moral beliefs ($F(1, 136) = 26.014$, $p < .001$), perceived behavioral control ($F(1, 136) = 8.063$, $p = .021$), and reduction intention ($F(1, 136) = 9.899$, $p = .008$), as well as a significant effect of consumption patterns (M/H) on reduction intention ($F(1, 136) = 11.280$, $p = .004$), but no interaction effects between consumption patterns and time. Post hoc comparisons using the Tukey HSD test revealed that scores before the video were lower than after for moral beliefs, perceived behavioral control, and reduction intention (all *ps* < .009). It also revealed a lower reduction intention of high meat consumers compared with medium meat consumers both before and after the video (see both *ps* < .05 in Table 2).

## 3.2 | Physiologic data

Only HR and SDNN reactivity values were normally distributed. The nonnormal distribution of the other variables was no problem for our analyses as normal distribution was not a requirement in linear mixed models (Venables & Ripley, 2002) and a sample of 68 participants was considered an acceptable sample size for applying standard statistics (Norman, 2010). Figure 2 depicts the average physiologic activity in each experiment segment for both experimental groups.

Per 30-s epoch, we calculated average physiologic activity for each parameter (Figure 3). Epochs with an increase in physiologic activity compared with the epoch before (10%–50% of the physiologic activity range, marked light gray) were considered interesting, especially when the increase in activity was substantial (>50% of the range, marked dark gray). As higher HR, SCL, or SCRs values and lower SDNN or RMSSD values are generally considered to indicate arousal, visual inspection of the average physiologic activity values in Figure 3 indicated a clear arousal increase for most of the physiologic activity parameters. The most notable fluctuation in physiology occurred at the end of the video in epoch 19 when the viewer was presented with the call for action to make the change, especially for HR, SCL, and SCR (the high SDNN value

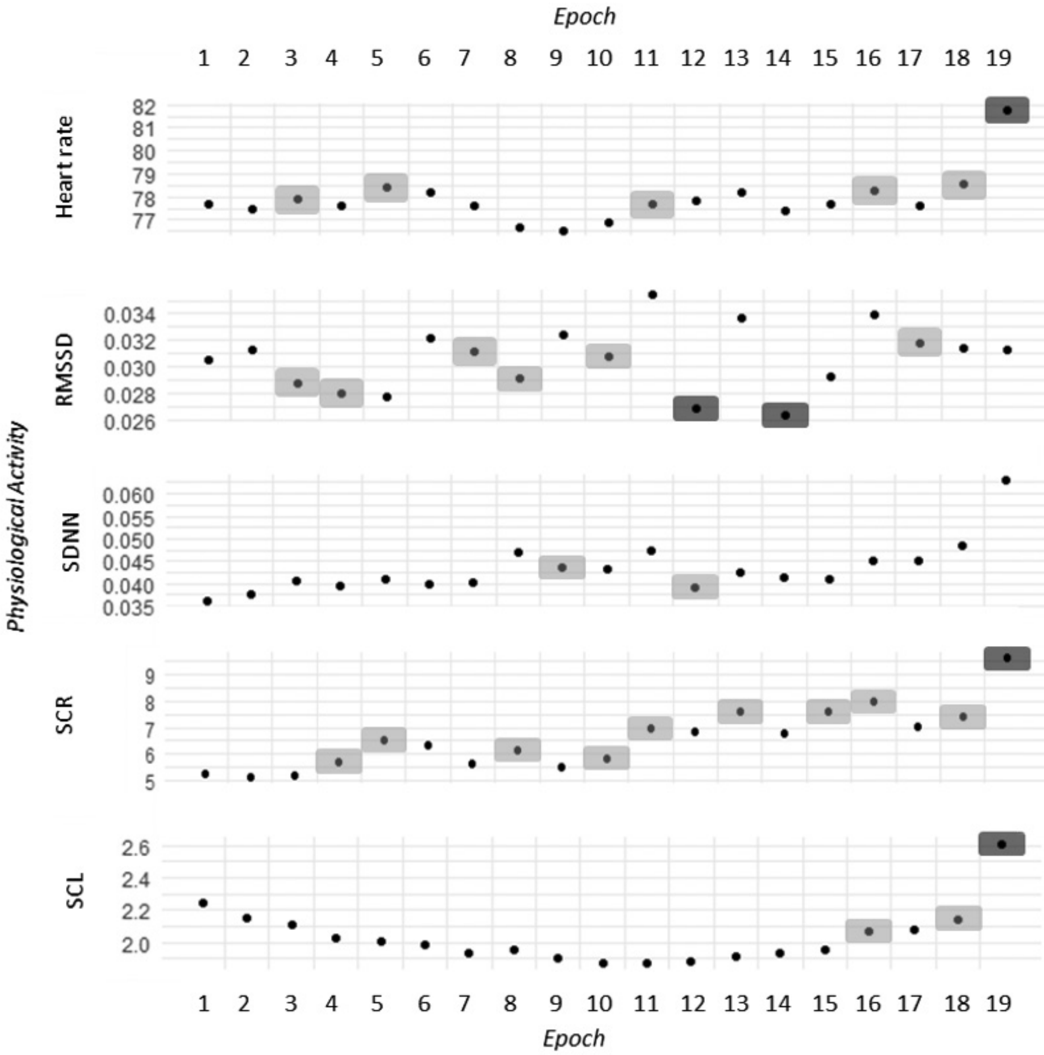


**FIGURE 3** Average physiologic activity for each 30-s epoch with light gray markers indicating a small increase in activity (10%–50% of the range) and dark gray markers indicating a notable increase in activity (>50% of the range)

is due to the rapid change in HR). During epochs 16, 18, and 19, three of the five physiologic parameters indicated an increase in arousal. Two of the five physiologic parameters showed increased reactivity during epochs 3, 4, 5, 8, 10, 11, 12, 13, 15, 16, 18, and 19. We calculated for each persuasion principle (Table 1) whether its usage generally, that is, more than 50% of the time, coincided with these increases in arousal. This was six times out of the 6 epochs that used reason, 1 out of 1 for new perspectives, 3 out of 5 for evidence, 2 out of 2 for data presentation, 1 out of 1 for a clear call for action, 4 out of 6 for rational arguments, 5 out of 6 informative illustrations, and 3 out of 3 for the use of a spokesperson.

## 3.3 | Relational mixed model analyses

The results of our linear mixed model analyses are presented in Table 3. To test our first hypothesis that physiology was impacted by persuasive messaging, we looked at the physiologic reactivity during video and survey. The results showed that for some parameters, physiologic reactivity during the video was significantly different from zero, as indicated by lower RMSSD and SDNN values and more SCRs (see row "Persuasive video" in Table 3). These results indicated more activity during the video than in the preceding baseline measurement. In addition, we found that during the survey HR, RMSSD, SDNN, and SCL were higher than during the video, while there were fewer SCRs (see row "Survey" in Table 3). Table 3 also implicitly shows that Group (M/H) did not explain variance in physiologic reactivity, as it was included in the model as a predictor but did not emerge as significant for any physiologic parameter. People's high or medium meat consumption pattern did not affect their physiologic reactivity.

Next, we investigated whether greater information–motivation misalignment evokes more peripheral

**TABLE 3** Summary of the best mixed linear model fits for reactivity of heart rate (HR), root mean square of successive differences (RMSSD), standard deviation from normal-to-normal intervals (SDNN), skin conductance level (SCL), and the number of skin conductance responses (SCRs) in relation to initial motivations

| | HR | | RMSSD • 100 | | SDNN • 100 | | SCL | | SCRs | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Predictors** | **Est.** | ***p*** | **Est.** | ***p*** | **Est.** | ***p*** | **Est.** | ***p*** | **Est.** | ***P*** |
| Persuasive video (Intercept) | −2.90 | .088 | −0.58 | **.009** | −0.30 | **.030** | −0.02 | .840 | 60.11 | **<.001** |
| Survey | 1.24 | **.003** | 0.24 | **.020** | 0.52 | **<.001** | 0.09 | **<.001** | −62.31 | **<.001** |
| Initial moral beliefs | 0.92 | **.009** | | | | | | | | |
| Initial reduction intention | −2.44 | **.010** | 0.55 | **.024** | | | | | | |
| Initial attitude | | | | | | | −0.03 | .063 | | |
| Initial injunctive norm | | | | | | | 0.06 | **.005** | 7.15 | .094 |
| Random effects | | | | | | | | | | |
| Subject variance | 5.55 | | 0.35 | | 0.65 | | 0.01 | | 1341.26 | |
| ICC | 0.38 | | 0.42 | | 0.50 | | 0.69 | | 0.06 | |
| *N* | 68 pnr | | 68 pnr | | 68 pnr | | 54 pnr | | 54 pnr | |
| Obs. | 134 | | 134 | | 134 | | 104 | | 104 | |
| $R^2$ /Cond. $R^2$ | 0.141/0.466 | | 0.076/0.464 | | 0.050/0.522 | | 0.228/0.761 | | 0.418/0.451 | |
| AIC | 675.395 | | 308.859 | | 403.251 | | −134.537 | | 1,060.121 | |

*Note:* Group (M/H), initial habits, initial health beliefs, and initial perceived behavioral control did not contribute to explaining variance in any of the models and therefore are not included in this table.

Abbreviations: AIC, Akaike information criterion; Cond. $R^2$, conditional $r^2$ statistics; Est., estimated difference in units of the physiologic parameters; ICC, intraclass correlation coefficient; Obs., observations; *p*, *p* value (presented in bold if significant); $R^2$, marginal $r^2$ statistics.

physiologic reactivity to the attempt at persuasion. To this end, we looked at the effect of the initial motivational states as predictors in our linear mixed models. We found that initial motivational state variables explained variance in most physiologic reactivity parameters, except for SDNN reactivity. That is, variance in HR reactivity to the persuasive video and survey was best explained by considering the person's moral beliefs and reduction intentions (see column "HR" in Table 3). Results showed that HR increased 0.92 bpm per unit of initial moral beliefs and decreased with 2.44 bpm per unit of initial reduction intention. Higher initial reduction intention is also related to higher RMSSD values (see column "RMSSD" in Table 3). Variance in RMSSD reactivity to the video and survey was best explained by also considering reduction intentions. The subject-specific null model including experiment segment as a fixed factor explained SDNN reactivity best (see column "SDNN" in Table 3). Variance in SCL reactivity to the video and survey was best explained by also considering initial attitude and injunctive norm (see column "SCL" in Table 3). SCL was 0.06 μS higher for people with a unit higher initial injunctive norm. The inclusion of initial attitude and initial injunctive norm in, respectively, the SCL and SCRs model lowered overall AIC, although these factors seemed to not significantly explain variance.

## 4 | DISCUSSION

Persuasion-related processes might be measurable in physiology. This explorative study investigated whether peripheral physiologic responses to an attempt at persuasion increase our understanding of the underlying psychologic process. We specifically researched to what extent individual differences in initial behaviors and motivations affect physiologic reactivity to persuasion attempts. Psychophysiologic responses from people with medium and high meat consumptions habits were collected while they viewed a persuasive video advocating vegetarianism. Physiologic responses of the cardiovascular and electrodermal systems were related to the changes in motivations to limit meat consumption, in specific attitude, reduction intention, perceived behavioral control, health beliefs, and moral beliefs. We expected physiologic reactivity to the attempt at persuasion, and our results did partially support this. We also expected that greater information–motivation misalignment would result in more physiologic reactivity, and our results supported this hypothesis. Our findings are discussed in detail in the following sections.

## 4.1 | A persuasive video motivates behavior change for all

Before testing our hypotheses, we checked whether the manipulation had the anticipated effect—did the video persuade our participants? The results confirm that the video indeed increased participants' motivations to limit their meat consumption. After viewing the video, participants found eating meat to be more immoral, thought they had more control over their consumption behavior, and had higher intentions to reduce their meat consumption. Generally, the video did not affect participants' attitude toward introducing vegetarian dishes in one's diet nor did it affect their health beliefs. For attitude, this finding is surprising and may originate in the fact that in the validated questionnaire, the attitude was measured with a single scale (Zur & Klöckner, 2014), whereas previous research recommends a set of scales with instrumental and experiential components (Ajzen, 2002). Furthermore, the focus of the video on the environmental consequences of animal product consumption explains why we did not find a change in health beliefs.

The persuasive effects of the video on motivations were the same for participants with medium or high meat consumption habits. Although the intentions to reduce meat consumption turned out to be higher among the medium consumers (both before and after the video), we did not find the expected interaction effect between consumption group and time. From this, we conclude that the video was no more persuasive for people whose initial behaviors were more in line with the message in the persuasive video. However, it could also be that the high meat consumption group was more reluctant to (report a) change in motivation. In that sense, an increase from 1 to 2 in the high meat consumption group might be more meaningful than from a 4 to 5 in the medium consumption group. Another explanation for not finding the anticipated result is that, besides reduction intentions, the two groups did not differ in motivational aspects at baseline. Thus, the difference between the groups may have been not large enough to result in a different increase in intentions to reduce meat consumption.

## 4.2 | Physiologic responses to a persuasion attempt

The video did not clearly arouse the participants (Hypothesis 1). Participants had lower average SDNN and RMSSD as well as more SCRs in exposure to the persuasive information compared with a rest state. But there was no apparent short-term change in HR or SCL, while these are the parameters that are most often measured as arousal indicators (Cacioppo et al., 2007). Therefore, although physiologic reactivity was present, this experiment did not yield a clear demonstration of overall arousal due to the persuasive information. Part of the results also seemed to indicate that on average, participants were more aroused while completing the survey compared with watching the persuasive video, as suggested by higher average HR and SCL values. In contrast, however, SDNN, RMSSD, and SCRs results hint at less arousal during the survey. The contradiction between these findings is currently not understood. One explanation for the increased HR and SCL activity involves a difference in self-related processing between watching a movie and self-reporting one's experience. Watching a movie is a passive activity that does not ask for reflection on the information regarding one's self-image. In contrast, it is possible that during the survey, the participants more actively integrated the persuasive information into their situation, which may have resulted in higher salience of the potential conflict between the information provided in the video and their habits and behaviors. Self-related processing and conflict detection might have caused arousal in HR and SCL, which is consistent with previous neuroscientific research (Cascio et al., 2015; Pegors et al., 2017; Vezich et al., 2017).

We also looked at whether ultra-short-term changes in physiology are related to specific persuasion principles (Green et al., 2016) using physiology measures for 19 epochs of 30 s. The most pronounced arousal increases coincided with the presentation of the use of reason, informative illustrations or a spokesperson, the presentation of new perspectives, evidence, or rational arguments, and especially a clear call for action. This seems to provide some first evidence that the exposure to some—but not all—persuasion principles might indeed influence physiology. This finding should be further investigated with a counterbalanced design, as during most epochs more than one persuasion principle was active (Table 1). Therefore, it was not possible to single out the effect of a single persuasion principle. We also found a considerable rise in arousal toward the end of the video. One possibility for this increase might be that only at this clear call for action, the viewers feel addressed and part of the problem, which resulted in increased arousal. Possibly, this increase in HR, SCRs, and SCL arousal were associated with self-related processing (Vezich et al., 2017). As we found a similar response during the survey, we encourage further research on the relationship between physiology and self-value integration during persuasion. Given that the video continued for another 5 s after the last epoch, we do not think that the increase in physiologic activity was related to physical movement. Nevertheless, we cannot entirely exclude the possibility that toward the end of the video, cues that the video was "wrapping up" were present, and viewers may have become more restless and/or prepared for the next step in the experiment.

### 4.3 | Individual differences in psychophysiologic responses to a persuasion attempt

For our second hypothesis, possible effects of information–motivation misalignment on physiologic reactivity to persuasive information were investigated. We expected that greater misalignment between current behaviors and motivations with the advocated information would evoke more physiologic reactivity to the persuasion attempt. This reasoning did not become evident in differences in physiologic activity between high and medium meat consumers. However, people with motivations more aligned with the advocated behavior did have less arousal compared with people with less aligned motivations: Except for SDNN, arousal in all physiologic parameters during the persuasive video and completion of the survey was explained by initial motivations (Table 3). Specifically, higher initial attitudes toward becoming vegetarian and intentions to reduce meat consumption related to lower arousal (lower HR and SCL and higher RMSSD reactivity), whereas higher initial moral beliefs and injunctive norms increased physiologic reactivity. In sum, participants experienced more arousal when their initial motivation was less aligned with the advocated behavior or when they try to live up to relatively high moral beliefs and injunctive norms. This seems logic, as people will have a harder time reaching the persuasion objective when their motivations lie further away from it. These results suggest that the initial motivations toward a certain behavior relate to physiologic reactivity in exposure to an attempt at persuasion concerning that behavior.

Thus, it appears that initial motivations are related to physiologic reactivity in exposure to persuasive information. This implies that the (mis-)alignment of the person's initial motivations with the persuasive information caused physiologic arousal when contemplating persuasion-aligned behavior. This seems to indicate that physiologic data can hold subject-specific information relevant for persuasive interventions. Persuasive interventions can potentially use this information to adapt their persuasion attempts to that specific user to foster persuasion. Even if the retrieved information remains high level, the physiological responses to a message might reflect whether this message was too distant to the user's motivations and caused reactant responses. The application can then choose a message closer to the user's motivations next time.

### 4.4 | Limitations and future research

In discussing the limitations of the current study, we will also pose several avenues for future research: First, a limitation of the current study was the lack of difference in motivations between the experimental groups. As our sample was not diverse enough, the current study could only provide evidence for a part of the psychophysiologic relationship during persuasion. That is, our sample includes people who eat a minimum of 5 and a maximum of 7 days a week. The beginning (vegans) and the end (carnivores) of the population distribution were not represented. Future research might benefit from recruiting participants with more extreme differences in behaviors and motivations, for example, vegetarians versus daily meat consumers. A greater difference in initial behaviors and motivations might help powerful persuasive stimuli like the "Cowspiracy" excerpt (Anderson & Kuhn, 2014) to uncover the full physiologic relation with persuasion. An inverted U-shape between physiologic reactivity and motivation misalignment can be expected.

Second, although our manipulation was confirmed to be persuasive, it might not have been persuasive enough. Our participants increased their moral beliefs, perceived behavioral control, and reduction intentions after the video, but on average with less than 1 point on a 7-point Likert scale (Table 2). One reason for the lower persuasive power of the video could be that the participants had already relatively high motivations at baseline (>4 on a 7-point Likert scale), indicating a potential ceiling effect. A video that is even more persuasive might result in a more salient change in physiologic activity during the video.

Third, persuasion might consist of several subprocesses that ask for or trigger different psychophysiologic resources. The existence of many validated persuasion strategies (Cialdini, 2007; Green et al., 2016; Rhoads, 2007) illustrates the many potential ways to achieve persuasion. Different ways of persuasion are associated with different underlying psychologic processes, sequentially affecting various associated physiologic processes as well. Our observation that physiology reacts during self-related processing—both at the end of the video and in the survey—might be the first indicator. Nevertheless, the current study was not designed to analyze psychophysiologic responses to each phase of the persuasion process (Cascio et al., 2015) including the exposure to the persuasion attempt followed initially by an emotional response and then by a cognitive valuation of the persuasive information, as well as the integration of the persuasive information into one's self-image, and the performance of persuasion-aligned behavior. Different phases in the persuasion process may involve different psychophysiologic resources, as suggested in Table 3, by the differences in physiologic reactivity during the video (exposure/valuation) and survey (self-image integration). Recent neuroscience research endorses this idea and describes different neural correlates for message-induced persuasion, perceived persuasiveness, and behavior change (Cacioppo et al., 2017). Future research would benefit from making a clear distinction between the different phases of the persuasion process to increase understanding of the psychophysiologic responses.

## 5 | CONCLUSION

Taken together, this study's findings indicate that studying psychophysiologic responses to an attempt at persuasion can indeed increase our understanding of the processes at play. Some physiologic parameters react to a persuasive video or while reflecting on that video. Moreover, variance in physiologic reactivity to persuasive information was better understood using initial motivations: People with motivations more aligned with the persuasive message had less physiologic arousal than people with misaligned motivations. All in all, these findings encourage further psychophysiologic persuasion research.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

## AUTHOR CONTRIBUTIONS

**Hanne A. A. Spelt:** Conceptualization; Data curation; Formal analysis; Methodology; Project administration; Software; Visualization; Writing – original draft; Writing – review & editing. **Luisa Asta:** Conceptualization; Data curation; Investigation; Methodology; Software. **Els T. Kersten-van Dijk:** Conceptualization; Methodology; Supervision. **Jaap Ham:** Resources; Supervision; Writing – review & editing. **Wijnand A. Ijsselsteijn:** Resources; Supervision; Writing – review & editing. **Joyce H. D. M. Westerink:** Conceptualization; Funding acquisition; Methodology; Resources; Supervision; Writing – original draft; Writing – review & editing.

## DATA AVAILABILITY STATEMENT

Data are not available since the information given to the participants before their consent for data collection did not indicate future use of the data.

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## APPENDIX A

**To rate the persuasiveness of the video, relevant principles from the persuasion principle index (Armstrong, 2010; Green et al., 2016) were selected and rephrased (Table A1).**

TABLE A1 Subset of used persuasion principles and explanation for the raters of the video

| Persuasion principle | | Explanation |
|---|---|---|
| Influence | Reason | Does the epoch provide (strong) reasons to support the claim? Reasons should be logic and relevant |
| | Social proof | Does the epoch show that the behavior is widely performed? |
| | Authority | Does the epoch use support from an authority figure to enhance believability? |
| Emotion | Guilt | Does the epoch evoke self-awareness or encourage the viewer to anticipate their guilt if they ignore reasonable advice? |
| | Fear | Does the epoch convey a threat related to likely or severe consequences that can be eliminated? |
| | Provocation | Does the epoch include shocking information and a selling point that helps resolve the incurred shocked feeling? |
| Overcoming resistance | Stories | Does the epoch include a story to put things into context? |
| | Perspectives | Does the epoch provide new perspectives? |
| Acceptance | Problem solution | Does the epoch describe a problem AND show how the limited meat consumption can solve it? |
| | Evidence | Does the epoch provide quantitative evidence? |
| | Data presentation | Does the epoch present substantial amounts of data in simple tables or graphs? |
| | Refutation | Does the epoch respond to negative claims about limiting meat consumption? |
| | Repetition of claims | Does this epoch repeat important claims? |
| | Clear call for action | Does the epoch involve a clear and specific call for action? |
| Message | Rational argument | Does the epoch only involve strong arguments? |
| | Forceful text | Does the epoch use specific words in active voice? |
| | Metaphors | Does the epoch involve a metaphor to show the benefit? |
| | Informative illustration | Does the epoch show illustrations that support the basic message? |
| Motion media | Spokesperson | Does the epoch use a credible spokesperson that is similar to the customer on relevant traits? |
| | Music/sound | Does the epoch use sound or music that is relevant to the story? |