

Young Adults' Responses to Environmental Risk in Social Advertising: Hormonal Correlates, Consumer Behaviour and Environmental Attitudes

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Abstract

Aim: This study aimed to examine whether exposure to an environmentally themed advertisement eliciting strong negative emotions triggers short-term changes in salivary steroid hormones (cortisol, testosterone, DHEA) and whether these hormonal responses are associated with pro-environmental attitudes and ethically minded consumer behaviour.

Methodology: The research was conducted in two stages. First, a pretest ($N = 139$) was used to identify the environmental video advertisement perceived as the most emotionally negative. Second, a single-group quasi-experiment ($N = 22$) was conducted in which saliva samples were collected five minutes before and five minutes after the exposure. Hormonal concentrations were assessed using ELISA, while environmental attitudes and consumer behaviour were measured with the New Environmental Paradigm (NEP) scale and the Ethically Minded Consumer Behaviour (EMCB) scale.

Results: The advertisement produced significant hormonal changes among men, including a decrease in cortisol and the cortisol/DHEA ratio, and an increase in the testosterone/cortisol ratio. No significant hormonal changes were observed among women. Post-pre hormonal differences were significantly related to selected NEP dimensions and ECB components, including recycling and willingness to pay more for ethical products.

Implications and recommendations: The findings suggest that physiological markers may help evaluate emotional risk processing in environmental communication and support gender-sensitive campaign design. Future research should test larger samples and examine whether hormonal responses predict long-term behavioural change. Given the exploratory nature of the study, the small sample size, and the single-group design, the results should be interpreted as preliminary and should be confirmed.

Originality/value: The article offers a novel psychophysiological perspective on environmental advertising by integrating hormonal biomarkers with environmental attitudes and ethical consumer behavior.

Keywords: environmental behaviour, social advertising, negative emotions, stress biomarkers

1. Introduction

Climate change and environmental pollution are one of the biggest challenges facing the world today. They have a negative impact on numerous areas of life, such as health, social mobility, agriculture, and contribute to natural disasters (Celik, 2020). Therefore, corporations, governments, non-profit institutions and citizens must embrace shared environmental responsibility, even if it entails incurring additional costs (Wei et al., 2018). Previous research in the field of integrated social marketing showed that the combination of information and emotions in media campaigns is essential in the process of changing social attitudes towards environmental protection. Public awareness campaigns intentionally evoke emotions to motivate attitude change in the target audience and increase their cognizance (Hamelin et al., 2017) or stimulate and maintain their interest over a long period of time (Sollberger et al., 2017). Environmental advertisements often present issues related to natural environment degradation, climate change and loss of biodiversity, which evoke negative emotions. Fear, sadness or anger may cause stress and influence changes in steroid hormone levels, such as testosterone, cortisol and DHEA (Dutheil et al., 2021; Joseph et al., 2021). The aim of analysing the endocrine response to this kind of advertising was to obtain insight into the mechanisms underlying engagement in environmental issues and behavioural change.

Although the literature offers abundant research on the role of emotions in advertising (Odou & Schill, 2020), few studies have analysed an association between negative emotions evoked by video advertisements and changes in steroid hormone levels; these hormones shape social behaviour.

Research has shown that administration of testosterone leads to increased vigilance and motivation to act (Bos et al., 2012), whilst stress-induced increase in cortisol and DHEA levels enhances the ability to make better decisions in the real world (Shields et al., 2016). Nevertheless, the role of contextual factors remains largely unknown. The study was designed as an exploratory pilot study to examine whether exposure to an emotionally charged video advertisement (ad/advert) portraying the negative consequences of environmental degradation for the natural environment and humans, affects testosterone, cortisol, and DHEA levels in the context of pro-ecological and ethically minded consumer behaviour.

The directions in research to date have shown that the potential of direct behavioural effects of emotions evoked by advertising has not been fully explored (Poels & Dewitte, 2019). The results of the present study may be used in designing advertising stimuli in such a way as to optimise advertising messages. The physiological responses of recipients may constitute a more objective measure of a message's impact, as emotionally charged content can elicit hormonal activity that modulates levels of engagement and encourage the propensity for attitudinal or behavioural change.

2. Literature Review

2.1. Social Marketing in Green Communication

Communication is a fundamental element of social marketing, although it does not always fit into the traditional marketing mix concept. However, those who communicate social messages should remember that the effectiveness of their efforts will increase when they apply the principles of Integrated Social Marketing Communication in practice, a complex, multifaceted construct that goes beyond the process of communication and social education. This observation stems from the fact that many social campaigns have focused solely on providing information to address knowledge deficits, rather than effectively driving changes in social behaviour (Hodson, 2019; Rodriguez-Sanchez, 2023). While this approach is somewhat understandable, as the state does not sell products but can foster social change with regard to understanding key societal issues, it still appears insufficient for achieving specific practical goals.

Research has shown that an approach focused solely on information dissemination yields limited effects, merely increasing knowledge and social awareness of a given issue. It rarely effectively shapes specific social behaviour (Kamenidou et al., 2025). Furthermore, mass media messages are often created without deep reflection or marketing support, which seem essential for increasing the likelihood of real social behaviour change (Alden et al., 2011). Effective social advertising not only informs but also inspires action (Kotler, 2022).

In practice, social marketing rarely functions with the support from other scientific disciplines, e.g. psychology or sociology. However, this coexistence allows for a more comprehensive understanding of the persuasive nature of advertising messages and their determinants, such as fear-based and controversial appeals (Taufique, 2022). Therefore, the development of social marketing theory and practice requires multidisciplinary cooperation, both in research and in campaign design.

A notable example of social marketing is the state's involvement in promoting values important to society. Social advertising can shape social attitudes, while the state may initiate and support green campaigns through public institutions, NGOs, the private sector, legal regulations, and public media access (Adebayo, 2025; Rathee & Milfeld, 2024; Rogowska et al., 2024). At the same time, state engagement with citizens is based on complex psychosocial mechanisms, and for this reason social marketing draws on communication theories relevant to environmental protection, such as the Theory of Persuasive Communication, the Elaboration Likelihood Model, and the Fear and Hope Appeals Theory (Bakir et al., 2019; Ettinger et al., 2021; Rundle-Thiele et al., 2019).

2.2. Emotions, Stress and Hormone Levels

The interaction between emotions, stress and physiological response has been described in the Lazarus theory, which presents the following order of events: stimulus, cognitive appraisal, followed by emotions and physiological changes (Lazarus, 1982). Lazarus and Folkman (1984), in their Cognitive Appraisal Model of Stress, drew attention to the transactional nature of stress, stressing that it is not solely a property of a situation nor a trait of an individual, but rather the result of a dynamic interaction between a person and their environment. A key element of this process is cognitive appraisal, which includes primary appraisal, during which an individual determines whether a given event constitutes a threat, a challenge, or a loss, and secondary appraisal, which refers to the analysis of available resources and the ability to cope with the demands of the situation. Depending on the results of these assessments, the individual adopts specific coping strategies, which may be aimed at problem-solving or at regulating the emotions associated with stress. The authors suggested that coping effectiveness depends on a continuous, dynamic relationship between environmental demands and an individual's resources, and that the process itself is variable and subject to modification as circumstances change and the situation is reassessed. In advertising campaigns, the role of a stimulus is played by advertising messages, often deliberately chosen by the advertiser to influence the audience in an intended way (Achar et al., 2016). In public awareness campaigns, one such stimulus is the induction of negative emotions. Depending on their context and purpose, advertisements can attract attention, affect information encoding, and build engagement that may elicit action (Achar et al., 2016; Berger et al., 2023; Durkin et al., 2018).

Rational advertisement appeals in pro-environmental social advertising are not as effective as the emotional ones. Furthermore, women respond more strongly to this type of negative emotional appeals in advertisements than men (Noble et al., 2014). Research has shown that negative emotions affect our memory, helping us retrieve facts more accurately than when experiencing positive emotions (cf. Levine & Pizarro, 2006). This has been confirmed by studies using neuroimaging methods, demonstrating that compared to other types of advertisements, fear appeal communications induced greater activation in several areas of the brain and enhanced recall (e.g. Mostafa, 2020). Not all negative emotions have the same effect: Berger et al. (2023) showed that content which triggers anxiety and anger holds attention for longer than that evoking sadness. In turn, exposure to advertisements evoking fear and those eliciting multiple negative emotions increases the likelihood of taking action, whereas messages evoking sadness discourage action (Durkin et al., 2018). Chalkiadaki and Vaida (2023) emphasised that threats and fear are only effective when the viewers feel that they can take action to prevent the threat or mitigate negative emotions by increasing engagement.

A systematic review and meta-analysis found a significant positive relationship between momentary negative emotions and cortisol levels (Joseph et al., 2021). Cortisol administration may reduce negative emotions, whereas increased testosterone is associated with the subjective experience of anger and the motivation to regain control and dominance (Langer et al., 2022; Peterson & Harmon-Jones, 2012). DHEA has also been shown to increase in response to acute mental stress and may protect against the adverse effects of negative emotions by improving mood (do Vale & Escera, 2018; Dutheil et al., 2021).

Research has suggested that strong emotions may activate the endocrine system and its variation depends, among others, on gender. Negative emotions elicited by a video ad may stimulate the endocrine system in response to the environmental threats presented. This study helped to determine whether environmental protection content has an actual impact on the body's physiological response.

- H1: Environmental advertising evoking strong negative emotions induces changes in steroid hormone levels in the subjects.
- H2: Hormonal responses to environmental advertising evoking negative emotions will differ depending on gender.

Given the growing number of studies indicating that various systems of the human body act together rather than independently, the interaction between testosterone, cortisol and DHEA levels may point to specific aspects of physical response, such as energy mobilisation, adaptation processes, hormonal regulation and hormonal balance. Thus the analysis of the mutual associations between testosterone, cortisol and DHEA levels provides a better understanding of complex hormonal changes in response to environmental advertising content evoking negative emotions.

H3: The ratios of testosterone/cortisol, cortisol /DHEA and testosterone/DHEA are more accurate biomarkers of the hormonal response to negative emotions evoked by an environmental video ad than the absolute levels of these hormones analysed separately.

2.3. Pro-Ecological and Ethically Minded Attitudes in Relation to Hormone Levels

Pro-ecological consumer behaviour is determined by numerous factors, including environmental (Liu et al., 2020) and ethically minded attitudes (van den Broek et al., 2017). Previous studies pointed to a relationship between negative emotions and hormonal responses, however no direct evidence has been identified as to the role of consumer and ethical attitudes in the body's hormonal response to an environmental video ad evoking negative emotions. Indirectly, one group of studies pointed to an association of pro-ecological and ethically minded attitudes with consumer intentions and behaviour (Harth et al., 2013), whereas another group indicated a possible impact of negative emotions on hormone levels (Chalkiadaki & Vaida, 2023). Both these groups suggested that an environmental video ad evoking negative emotions constituted a greater emotional stimulus in individuals with a high level of pro-ecological and ethically minded attitudes, translating into changes in the levels of the hormones analysed.

H4: There is a relationship between pro-ecological attitudes and the levels of testosterone, cortisol and DHEA in response to an environmental video ad evoking negative emotions.

H5: There is a relationship between ethically minded consumer behaviour and the levels of testosterone, cortisol and DHEA in response to an environmental video ad evoking negative emotions.

The subject of environmental pollution is extremely emotional, especially for environmentally conscious people with a high level of empathy and understanding of the role it plays in their lives. Any excessive environmental interference, even when conscious, shatters the emotional balance – triggering anger and bewilderment. This is how advertising messages related to the protection of environmental resources are usually designed (Jansson et al., 2010), as their goal is to evoke emotions and profound reflection (Orzan et al., 2013).

3. Methodology

3.1. Subjects

The study comprised two groups of participants. A total of 144 participants were involved in selecting the video advertisement which was the independent variable in the experimental part of the study. Five participants were excluded as they did not provide responses or failed to complete the video ad selection questionnaire correctly. The sample ultimately included 139 participants: 81 men with a mean age of 20.83 years (SD = 1.56) and 58 women with a mean age of 21.21 years (SD = 1.47). A total of 22 participants (10 men with a mean age of 22.3 years (SD = 1.42) and 12 women with a mean age of 22.5 years (SD = 1.17)) took part in the experimental part of the study. No participant took part in both phases. Inclusion criteria were age ≥ 18 and no acute illness or endocrine disorders. Exclusion criteria included current steroid medication and visible blood in saliva. The participants were not compensated or received course credit. The study adhered to the Declaration of Helsinki. All the participants gave their consent to participate and were informed that they could withdraw at any time.

The study was approved by the Bioethics Committee of the Poznan University of Medical Sciences (Resolution No. 794/22).

3.2. Procedures and Measures

3.2.1. Experimental Procedure

The participants were recruited on campus and were not paid. The stimulus was selected in a two-stage pretest. First, four public environmental service announcements on YouTube were identified based on emotive and controversial content:

„Wody to nie śmietnik” [Water is not a dump]: <https://www.youtube.com/watch?v=2H-uSqCSjnU>;

„Nie truj sąsiada” [Don't poison your neighbour]: advertising available from the corresponding author <https://www.youtube.com/watch?v=0PdLOCuMgs0>;

„Nie śmieć” [Don't litter]: unavailable on YouTube, advertisement available from the corresponding author;

„Stop suszy” [Stop to drought]: <https://www.youtube.com/watch?v=8D5f12dfbZQ>

Second, four independent sessions were run with separate groups ($N = 34, 35, 37, 38$) that differed in ad order in which the advertisements were presented. Before viewing the participants ranked the four environmental problems by importance, and after viewing they ranked the ads by the intensity of negative emotions evoked. Those that received the highest overall rating based on the pretest criteria were selected as the stimulus for the main study.

3.2.2. Laboratory Session

The participants were recruited on campus and were not paid for participation. The main study used a single-group pretest–posttest quasi-experimental design conducted under controlled laboratory conditions.

The experimental sessions were conducted between 08:00 and 09:30. To minimise diurnal variation and capture short-latency endocrine responses, saliva was collected five minutes before and five minutes after public service announcement exposure. After the second saliva sample had been collected, participants completed the NEP and EMCB questionnaires. This timing was chosen to avoid priming participants with environmental or ethical consumption-related content before exposure to the advertisement and to prevent interference with the timing of saliva collection. This fixed -5/+5 min window targeted appraisal-proximal changes in relational indices (T/C, C/DHEA, exploratory T/DHEA) that can shift over brief intervals while reducing the influence of unrelated activities. Physiological diurnal fluctuations motivate the fixed morning window (Marceau et al., 2014). Moreover, hormones can enter saliva by a variety of mechanisms, but for the neutral steroids the most common route is rapid diffusion through the acinar cells and as such their concentration is independent of the rate of saliva flow (Vining et al., 1983).

During the recruitment process the participants were instructed to abstain from caffeine, alcohol, drugs, heavy meals, and intense physical activity for 24 hours prior to testing. They were also asked to declare, before the experiment, if they had experienced any major life stressors (e.g. a car accident, death of a close relative) or, for example, suffered gum damage (the presence of blood in saliva provided grounds for exclusion). No participants were excluded on the basis of these criteria.

3.3. Evaluation of Pro-Ecological and Ethically Minded Consumer Behaviour

New Environmental Paradigm (NEP). The 15-item NEP (Dunlap et al., 2000) assessed environmental attitudes across five dimensions: limits to growth (RLG), rejection of exemptionalism (PE), fragility of

nature's balance (FNB), anti-anthropocentrism (AN), and the possibility of an eco-crisis (PEC). The responses used the 1-5 Likert scale.

The Ethically Minded Consumer Behaviour (EMCB) scale (Sudbury-Riley & Kohlbacher, 2016). It captures five constructs: willingness to pay more for ethical products (PAYMORE), environmental boycotting (ECOBOYCOTT), social boycotting (CSRBOYCOTT), deliberate purchase of environmentally friendly products (ECOBUY), and support for recycling (RECYCLE). The items were rated on the 5-point scale from 1 "never true" to 5 "always true", with higher scores indicating stronger ethically minded behaviour.

Internal consistency was estimated for the total scores of both scales. Cronbach's alpha was acceptable for the NEP total scale ($\alpha = 0.710$) and high for the EMCB total scale ($\alpha = 0.858$). However, given the very small sample size, these reliability estimates should be interpreted with caution.

3.4. Biochemical Analysis

In each condition, namely before and after exposure to the advertisement, each participant in the experiment was asked to deposit 1 ml of saliva into each of two polypropylene vials. DHEA, testosterone and cortisol levels were determined by immunoenzymatic assay using the following Demeditec Diagnostics GmbH kits: DHEA free in saliva ELISA (DES6666); Cortisol free in saliva ELISA (DES6611) and Testosterone free in saliva ELISA (DES6622). For testosterone, the detection limit was 6.1 pg/ml and the mean intra and inter-assay coefficients of variation were below 7% and 8%, respectively. For DHEA, the mean inter and intra-assay coefficients of variation were below 10% and the sensitivity was 6.4 pg/ml. For cortisol, the mean intra and inter-assay coefficients of variation were below 6% and 7%, respectively, and the sensitivity was 0.019 ng/ml.

3.5. Statistical Analysis

First, the authors quantified the most important environmental problems and the video ads shown to the participants in terms of the level of negative emotions they evoked, using the Thurstone method. The results were shown on a unidimensional interval scale. Normality was assessed with the Shapiro-Wilk test for pre values, post values, and change scores Δ (post – pre) for cortisol, testosterone, DHEA, and ratio indices within each gender. When Δ approximated normality, the paired-samples t-tests were used to evaluate within-person change and reported mean Δ with 95% confidence intervals, $t(df)$, p , and effect size as Hedges' g for small-sample correction. When Δ violated normality, Wilcoxon signed-rank tests were conducted. For analyses based on log-transformed values, 95% confidence intervals were given on the log scale. Between-group comparisons of endocrine responses were conducted on percent change $((\text{post} - \text{pre})/\text{pre} \times 100\%)$ to facilitate interpretability and comparability across analytes. Gender differences in percentual change were tested with Welch's t-tests (unequal variances), with 95% confidence intervals for the mean difference and Hedges' g as the effect size. Spearman's rank correlation was used to examine associations between changes in hormone levels in response to the stimulus and environmental attitudes (NEP) and consumer behaviour (EMCB). The study analysed NEP and EMCB as moderators of Δ (post–pre) hormone and ratio responses rather than outcomes. Statistical significance was set at p -values $> .05$.

Given the exploratory and pilot character of the study, the statistical analyses were aimed at identifying preliminary patterns of hormonal responses to the environmental video advertisement and their associations with pro-environmental attitudes and ethically minded consumer behaviour. No a priori power analysis was conducted. A retrospective sensitivity power analysis showed that, with $N = 22$, $\alpha = .05$, and target power = .80, the minimum detectable within-subject effect was approximately Cohen's $d_z = 0.63$. This indicates that the study had adequate sensitivity primarily for moderate-to-large effects.

4. Results

4.1. Level of Negative Emotions Evoked by Video Advertisements

Figure 1 shows the importance ranking of the environmental problems presented in the video ads. The variation in the importance attached to different environmental problems was greater among women than among men. Women rated water scarcity and water pollution as the most important environmental problems and attached significantly less importance to the problems of air pollution (smog) and littering. Men rated water pollution as the most important environmental problem and assessed water scarcity and air pollution (smog) as slightly less important.

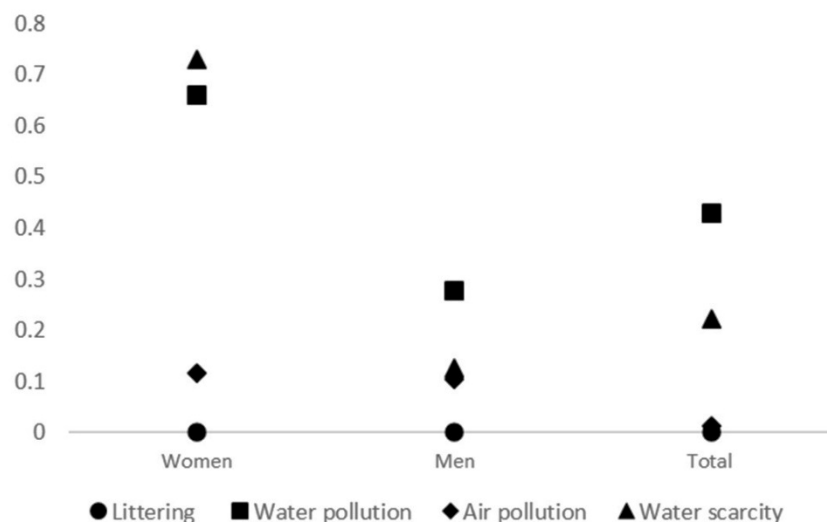


Fig. 1. Unidimensional interval scale of importance ranks regarding environmental problems

Source: own elaboration.

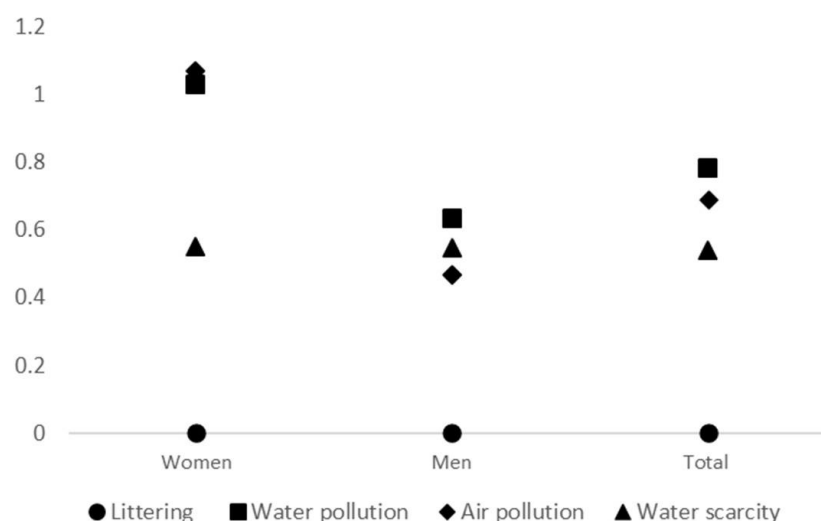


Fig. 2. Unidimensional interval comparative scale of the level of negative emotions evoked by video ads

Source: own elaboration.

The video adverts concerning smog and water pollution evoked the most negative emotions among female participants, while those concerning littering elicited the least negative emotions in both men and women. The video ad dealing with water pollution evoked the most negative emotions among

male participants, however the differences in the level of negative emotions evoked in male participants between this ad and the adverts concerning water scarcity and smog were small (Figure 2). The results indicated that there were no significant differences in the level of negative emotions evoked in male participants between three of the four videos. Based on the data presented in the form of unidimensional comparative scales (Figures 1 and 2), the authors selected the video ad concerning water pollution to examine the hormonal response to its content.

4.2. Hormonal Response to the Social Advertisement

An overview of descriptive statistics for all levels of variables prior to and following exposure to the video adverts and percentage changes is shown in Table 1. The study found a significant decrease in cortisol levels ($t(9) = 2.80, p = .021$, Hedges' $g = 0.81$), a significant increase in the testosterone/cortisol ratio ($t(9) = 2.95; p = 0.016$, Hedges' $g = 0.85$) and a significant decrease in the cortisol/DHEA ratio ($t(9) = 2.68; p = 0.025$, Hedges' $g = 0.78$) in the male participants following exposure to the video advert. No significant changes were found in the levels of other analysed hormones and other analysed ratios in the male participants. No significant changes in the levels of analysed hormones and the analysed ratios in response to the video were found in the female participants.

Table 1. Descriptive hormone and ratio data (mean $\pm$ SD) before and after exposure to the video ad, with change scores Δ (post-pre) (mean $\pm$ SD)

Analyses	Men			Women		
	Before mean (SD)	After mean (SD)	Δ mean (SD)	Before mean (SD)	After mean (SD)	Δ mean (SD)
Testosterone	270.19 (86.39)	280.69 (82.4)	10.50 (39.39)	89.40 (38.61)	87.66 (36.09)	-1.74 (17.40)
Cortisol	13.48 (4.87)	12.28 (4.15)	-1.20 (1.35)	9.38 (4.22)	8.58 (3.28)	-0.81 (1.90)
DHEA	760.50 (353.25)	831.26 (234.26)	70.76 (258.18)	618.94 (352.17)	584.98 (359.05)	-33.96 (137.22)
Testosterone/Cortisol	21.7 (8.19)	25.09 (10.64)	(3.39) (3.63)	10.5 (5.04)	11.07 (4.23)	0.57 (2.16)
Testosterone/DHEA	0.39 (0.13)	0.35 (0.11)	-0.04 (0.08)	0.16 (0.04)	0.17 (0.09)	0.05* (0.25)
Cortisol/DHEA	0.021 (0.009)	0.016 (0.006)	0.00 (0.01)	0.019 (0.011)	0.02 (0.018)	-0.02* (0.24)

Units: testosterone pg/ml; cortisol ng/ml; DHEA pg/ml. Ratios: T/C, T/DHEA, C/DHEA. Δ = post – pre. Cells marked with an asterisk (*) report log- Δ mean and log- Δ SD.

Source: own elaboration.

4.3. Between-Gender Differences in Scale-Free Hormonal Change Following Exposure

Using percent change as the primary descriptor, men and women showed broadly similar responses, with all p -values $> .05$. Cortisol decreased modestly (men about 8%, women about 5%), and testosterone rose slightly (about 6% vs about 4%). The largest directional difference appeared for DHEA (men about 21% vs women about 0%), mirrored by C/DHEA (about -18% vs +1%; directional trend only, $p = .10$) and T/DHEA (about -7% vs +9%). The overall effects were small to moderate ($|g| \leq 0.69$) and did not indicate significant gender-related differences (Table 2).

Table 2. Gender differences in percentage changes of salivary hormones and hormonal ratios after exposure to the advertisement

Analyses	Men mean $\pm$ SD	Women mean $\pm$ SD	Men – Women (difference)	Welch t (df)	<i>p</i>	95% CI of difference	Hedges' <i>g</i>
Cortisol	-8.08 $\pm$ 7.86	-5.45 $\pm$ 21.29	-2.63	-0.40 (14.42)	0.70	[-16.81, 11.55]	-0.15
Testosterone	5.98 $\pm$ 17.10	3.60 $\pm$ 31.03	2.38	0.23 (17.62)	0.82	[-19.64, 24.39]	0.09
DHEA	20.63 $\pm$ 41.33	0.21 $\pm$ 37.33	20.43	1.21 (18.43)	0.24	[-15.11, 55.96]	0.50
T/C ratio	15.22 $\pm$ 14.85	9.45 $\pm$ 19.72	5.77	0.78 (19.84)	0.44	[-9.63, 21.17]	0.31
C/DHEA ratio	-17.70 $\pm$ 23.13	0.88 $\pm$ 27.95	-18.58	-1.71 (20.00)	0.10	[-41.30, 4.13]	-0.69
T/DHEA ratio	-6.58 $\pm$ 22.73	8.84 $\pm$ 30.02	-15.43	-1.37 (19.86)	0.19	[-38.92, 8.07]	-0.55

Notes: Data are shown as mean $\pm$ SD. Changes were calculated as percent change ((post – pre)/pre $\times$ 100%). Gender differences were evaluated using Welch's t-test with unequal variances. 95% confidence intervals (CI) for mean differences are shown. Effect sizes are expressed as Hedges' *g*. Significance threshold was set at $p < 0.05$ (two-tailed).

Source: own elaboration.

4.4. Relationship between Environmental Attitudes and Consumer Behaviour and Hormonal Data

The difference between cortisol levels before and after exposure to the video ad in the male participants was strongly correlated with the rejection of exemptionism ($r = 0.72$; $t = 2.92$; $p = 0.019$). Among the female participants there was a positive relationship between the fragility of nature's balance ($r = 0.58$; $t = 2.24$; $p = 0.049$) and the rejection of exemptionism ($r = 0.62$; $t = 2.47$; $p = 0.033$) dimensions and the difference between testosterone levels before and after exposure to the video. Other dimensions measured by the NEP scale were not correlated with changes in testosterone, cortisol and DHEA levels in response to the advert.

Among the male participants there were correlations between consumer behaviour and changes in testosterone, DHEA and cortisol levels in response to the video ad. The differences in testosterone levels were significantly negatively correlated with RECYCLE ($r = -0.79$; $t = -3.63$; $p = 0.007$), whereas the level of willingness to pay more for an ethical product (PAYMORE) increased significantly with increasing the difference in the levels of DHEA ($r = 0.64$; $t = 2.33$; $p = 0.048$) and cortisol ($r = 0.76$; $t = 3.34$; $p = 0.010$).

5. Discussion and Conclusions

As an exploratory pilot investigation, the study provided preliminary indications of gender-specific patterns in both attitudes toward environmental problems and emotional responses to risk-oriented environmental advertising. The first part of the study concerned stimulus selection and was based on a pretest of environmental video advertisements, where the women rated water scarcity and water pollution as the most important environmental problems, whereas only water pollution was rated the most important environmental problem by the male participants. This suggests that these environmental issues are widely regarded as particularly important and may provide a strong impetus for taking action to protect the environment. The study also showed that the variation in the importance attached to different environmental problems was greater for women than for men. The differences may be due to the fact that women care more about the interests of others and are more environmentally aware, and thus more likely than men to engage in pro-environmental behaviour (Briscoe et al., 2019; Nadeem et al., 2020).

In the stimulus-selection pretest, the analysis of negative emotions evoked by different environmental advertising messages showed that the women responded most emotionally to advertising concerning air and water pollution, whereas the men responded most emotionally to advertising concerning air and water pollution and water scarcity. It was also found that the variation in the level of negative emotions evoked by different video ads was greater among the women, which may indicate their greater empathy and stronger affective engagement in messages depicting suffering, environmental degradation, and potential consequences for future generations. These findings showed that the stimuli used in advertising to influence the level of negative emotions in the audience should be adapted to the gender of the target population. Women may therefore be more sensitive to the safety and health aspects of environmental protection, such as air quality and access to clean water at their household level (Kennedy & Kmec, 2018; Pinkhasov et al., 2010).

In the laboratory phase of the study, the authors examined the hormonal responses to the selected environmental video advertisement and their associations with NEP and EMCB scores. The statistical analysis of the effects of environmental advertising evoking negative emotions on hormone levels in the participants revealed significant differences only for men. In the male participants, cortisol levels and the cortisol/DHEA ratio decreased significantly and the testosterone/cortisol ratio increased significantly in response to exposure to the video ad (H1-H3). No significant changes in the hormone levels and the ratios analysed in response to the advert were found in the female participants. These findings may point to a discrepancy between negative emotions reported by the participants during the stimulus-selection phase and their body's physiological (hormonal) response. These differences are significant from the perspective of marketing practice, demonstrating that reliance solely on descriptions provided by the audience is insufficient. It is also important to consider latent physiological processes that may influence pro-social attitudes and behaviour. The decrease in cortisol levels and the cortisol/DHEA ratio found in the male participants may suggest that they effectively dealt with the stress induced by exposure to the video. The increase in the testosterone/cortisol ratio in the male participants may also be a response to the sense of potential threat evoked by the content of the advert. Thus, an increase in the testosterone/cortisol ratio may reflect the body's response to stress and point to the activation of the body's defence mechanisms (Casto & Edwards, 2016). The discrepancy between the level of negative emotions reported by the female participants and their hormonal response may be due to the fact that they did not perceive the content of the adverts as a direct threat in their private sphere (Xia & Li, 2023). Overall, the findings suggest that exposure to advertising evoking negative emotions may induce specific hormonal responses in men, but not necessarily in women. These differences may be associated with different aspects of the response to negative emotions and stress. In the social marketing context, this implies the need not only to test messages at the cognitive and emotional levels but also to analyse their physiological effects. The integration of neurobiological and marketing research offers new opportunities to personalise campaigns and enhance their effectiveness in promoting pro-ecological behaviour. However, given the limitations resulting from the small sample size, these findings should be interpreted with caution. Further studies are needed to understand the mechanisms underlying the gender-related differences in hormonal responses to this type of external stimuli.

In both the male and female participants a strong correlation was found between the change in cortisol levels in response to advertising evoking negative emotions and rejection of the belief that the human race is the absolute master of nature and that humans own the environment and are not part of it. Moreover, the analysis showed a positive correlation between changes in cortisol levels and the belief that nature's balance is fragile and can easily be upset (H4). Given the limitations of the study, these findings should be interpreted with caution, suggesting that the participants could have experienced increased activation of the nervous system, manifested as an increase in cortisol levels, in response to exposure to advertising that challenges their attitudes.

There was also a significant negative correlation in the male participants between the change in testosterone levels in response to environmental advertising evoking negative emotions and RECYCLE

behaviour and a significant positive correlation between a willingness to pay more for an ethical product (PAYMORE) and differences in DHEA and cortisol levels (H5). Thus, the findings preliminarily suggest that there may be an association between the change in testosterone levels induced by environmental advertising evoking negative emotions and the tendency to engage in pro-environmental behaviour, such as recycling.

These findings may contribute to the fear-appeal theory by providing preliminary evidence that brief exposure to an environmental public service announcement produced rapid, measurable shifts in stress biomarkers aligned with ecological beliefs and ethically minded consumer habits. The authors also observed a potential mismatch between physiology and self-report: the men showed stronger hormonal responses despite reporting lower negative affect. This pattern supports multi-component models of emotion and underlines the value of pairing psychophysiological measures with message-effect metrics. Associations between changes in cortisol or testosterone and NEP dimensions, as well as links between hormonal deltas and EMCB components, suggest that ecological worldviews and consumer ethics shape early stress responses to threat cues.

From a practical perspective, these preliminary findings suggest that the effectiveness of fear-based environmental messages may be enhanced by combining them with clear efficacy cues and feasible calls to action. The results also indicate that messages may need to be tailored to different processing pathways, frames emphasising challenge, agency with concrete calls to action may fit men, whereas narratives that connect environmental degradation to family health and local water quality may resonate more with women. End cards and calls to action should align with ethical behaviour such as recycling or willingness to pay more, while positioning environmental threats explicitly as health risks and offering feasible, credible steps to act. The article points to the potential value of individual profiling that integrates environmental attitudes with early physiological responsiveness is more promising than relying on demographics alone. However, given the exploratory nature of the study, the small sample size and the single-group design, these practical implications should be treated as tentative and require confirmation in larger studies with a control group. Future research should also examine, among other issues, whether rapid physiological pretesting during formative campaign development can improve message design.

6. Limitations of the Study

One of the main limitations of this study was the relatively small sample size in the experimental part, hence the obtained results should be interpreted with caution, especially in the context of generalising them to the young adult population. At the same time it should be emphasised that the study was exploratory in nature and represented an attempt at the preliminary identification of the analysed relationships. In experimental studies utilising quasi-medical procedures, including laboratory biomarker measurements and multi-stage research protocols, relatively small sample sizes are often encountered due to high costs, organizational complexity, and the time-consuming nature of implementation. This does not change the fact, however, that the presented results require replication on larger and more diverse samples, which will allow for the verification of their stability and increase the possibility of formulating more general conclusions.

References

- Achar, C., So, J., Agrawal, N., & Duhachek, A. (2016). What We Feel and Why We Buy: The Influence of Emotions on Consumer Decision-Making. *Current Opinion in Psychology*, 10, 166-170. <https://doi.org/10.1016/j.copsyc.2016.01.009>
- Adebayo, W. G. (2025). Resilience in the Face of Ecological Challenges: Strategies for Integrating Environmental Considerations into Social Policy Planning in Africa. *Sustainable Development*, 33(1), 203-220. <https://doi.org/10.1002/sd.3113>

- Alden, D. L., Basil, M. D., & Deshpande, L. (2011). Communications in Social Marketing. In G. Hastings, K. Angus, & C. Bryant (Eds.), *The Sage Handbook of Social Marketing* (pp. 167-177). SAGE Publications.
- Bakir, V., Herring, E., Miller, D., & Robinson, P. (2019). Organized Persuasive Communication: A New Conceptual Framework for Research on Public Relations, Propaganda and Promotional Culture. *Critical Sociology*, 45(3), 311-328. <https://doi.org/10.1177/0896920518764586>
- Berger, J., Moe, W. W., & Schweidel, D. A. (2023). What Holds Attention? Linguistic Drivers of Engagement. *Journal of Marketing*, 87(5), 793-809. <https://doi.org/10.1177/00222429231152880>
- Bos, P. A., Panksepp, J., Bluthé, R.-M., & van Honk, J. (2012). Acute Effects of Steroid Hormones and Neuropeptides on Human Social-Emotional Behavior: A Review of Single Administration Studies. *Frontiers in Neuroendocrinology*, 33(1), 17-35. <https://doi.org/10.1016/j.yfrne.2011.01.002>
- Briscoe, M. D., Givens, J. E., Hazboun, S. O., & Krannich, R. S. (2019). At Home, in Public, and in between: Gender Differences in Public, Private and Transportation Pro-Environmental Behaviors in the US Intermountain West. *Environmental Sociology*, 5(4), 374-392. <https://doi.org/10.1080/23251042.2019.1628333>
- Casto, K. V., & Edwards, D. A. (2016). Testosterone, Cortisol, and Human Competition. *Hormones and Behavior*, 82, 21-37. <https://doi.org/10.1016/j.yhbeh.2016.04.004>
- Celik, S. (2020). The Effects of Climate Change on Human Behaviors. In S. Fahad, M. Hasanuzzaman, M. Alam, H. Ullah, M. Saeed, I. Ali Khan, & M. Adnan (Eds.), *Environment, Climate, Plant and Vegetation Growth* (pp. 577-589). Springer. https://doi.org/10.1007/978-3-030-49732-3_22
- Chalkiadaki, E. S., & Vaida, S. (2023). The Role of Negative Emotions in Climate Change Awareness Advertising. *Educational Journal*, 26(1). <https://doi.org/10.24193/ed21.2023.26.13>
- do Vale, S., & Escera, C. (2018). Dehydroepiandrosterone and Dehydroepiandrosterone-Sulfate and Emotional Processing. In G. Litwack (Ed.), *Vitamins and Hormones* (vol. 108, pp. 413-441). Academic Press. <https://doi.org/10.1016/bs.vh.2018.01.022>
- Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). New Trends in Measuring Environmental Attitudes: Measuring Endorsement of the New Ecological Paradigm: A Revised NEP Scale. *Journal of Social Issues*, 56(3), 425-442. <https://doi.org/10.1111/0022-4537.00176>
- Durkin, S., Bayly, M., Brennan, E., Biener, L., & Wakefield, M. (2018). Fear, Sadness and Hope: Which Emotions Maximize Impact of Anti-Tobacco Mass Media Advertisements among Lower and Higher SES Groups? *Journal of Health Communication*, 23(5), 445-461. <https://doi.org/10.1080/10810730.2018.1463320>
- Dutheil, F., de Saint Vincent, S., Pereira, B., Schmidt, J., Moustafa, F., Charkhabi, M., Bouillon-Minois, J.-B., & Clinchamps, M. (2021). DHEA as a Biomarker of Stress: A Systematic Review and Meta-Analysis. *Frontiers in Psychiatry*, 12. <https://www.frontiersin.org/articles/10.3389/fpsy.2021.688367>
- Ettinger, J., Walton, P., Painter, J., & DiBlasi, T. (2021). Climate of Hope or Doom and Gloom? Testing the Climate Change Hope vs. Fear Communications Debate through Online Videos. *Climatic Change*, 164(1), 19. <https://doi.org/10.1007/s10584-021-02975-8>
- Hamelin, N., Moujahid, O. E., & Thaichon, P. (2017). Emotion and Advertising Effectiveness: A Novel Facial Expression Analysis Approach. *Journal of Retailing and Consumer Services*, 36, 103-111. <https://doi.org/10.1016/j.jretconser.2017.01.001>
- Harth, N. S., Leach, C. W., & Kessler, T. (2013). Guilt, Anger, and Pride about In-Group Environmental Behaviour: Different Emotions Predict Distinct Intentions. *Journal of Environmental Psychology*, 34, 18-26. <https://doi.org/10.1016/j.jenvp.2012.12.005>
- Hodson, J. (2019). An Ecological Model of Climate Marketing: A Conceptual Framework for Understanding Climate Science Related Attitude and Behavior Change. *Cogent Social Sciences*, 5(1). <https://doi.org/10.1080/23311886.2019.1625101>
- Jansson, J., Marell, A., & Nordlund, A. (2010). Green Consumer Behavior: Determinants of Curtailment and Eco-Innovation Adoption. *Journal of Consumer Marketing*, 27(4), 358-370. <https://doi.org/10.1108/07363761011052396>
- Joseph, N. T., Jiang, Y., & Zilioli, S. (2021). Momentary Emotions and Salivary Cortisol: A Systematic Review and Meta-Analysis of Ecological Momentary Assessment Studies. *Neuroscience & Biobehavioral Reviews*, 125, 365-379. <https://doi.org/10.1016/j.neubiorev.2021.02.042>
- Kamenidou, I., Gkitsas, S., Mamalis, S., Mylona, I., Pavlidis, S., & Stavrianea, A. (2025). A Multigenerational Cohort Approach Towards Environmental Attitudes According to the New Ecological Paradigm (NEP) Scale and Perception of Social Marketing Campaigns' Role. In N. Tsounis, & A. Vlachvei (Eds.), *Advances in Applied Microeconomics*. International Conference on Applied Economics (ICOAE) 2024. Springer. https://doi.org/10.1007/978-3-031-76654-1_13
- Kennedy, E., & Kmec, J. (2018). Reinterpreting the Gender Gap in Household Pro-Environmental Behaviour. *Environmental Sociology*, 4(3), 299-310. <https://doi.org/10.1080/23251042.2018.1436891>
- Kotler, P. (2022). The Battle between Commercial Marketing and Social Marketing. *Social Marketing Quarterly*, 28(4), 325-331. <https://doi.org/10.1177/15245004221136334>

- Langer, K., Jentsch, V. L., & Wolf, O. T. (2022). Cortisol Promotes the Cognitive Regulation of High Intensive Emotions Independent of Timing. *European Journal of Neuroscience*, 55(9-10), 2684-2698. <https://doi.org/10.1111/ejn.15182>
- Lazarus, R. S. (1982). Thoughts on the Relations between Emotion and Cognition. *American Psychologist*, 37(9), 1019-1024. <https://doi.org/10.1037/0003-066X.37.9.1019>
- Lazarus, R., & Folkman, S. (1984). *Stress, Appraisal, and Coping*. Springer.
- Levine, L. J., & Pizarro, D. A. (2006). Emotional Valence, Discrete Emotions, and Memory. In B. Uttl, N. Ohta, & A. L. Siegenthaler (Eds). *Memory and Emotion: Interdisciplinary Perspectives* (pp. 37-58). Blackwell Publishing. <https://doi.org/10.1002/9780470756232.ch3>
- Liu, P., Teng, M., & Han, C. (2020). How Does Environmental Knowledge Translate into Pro-Environmental Behaviors? The Mediating Role of Environmental Attitudes and Behavioral Intentions. *Science of The Total Environment*, 728, 138126. <https://doi.org/10.1016/j.scitotenv.2020.138126>
- Marceau, K., Shirtcliff, E. A., Hastings, P. D., Klimes-Dougan, B., Zahn-Waxler, C., Dorn, L. D., & Susman, E. J. (2014). Within-Adolescent Coupled Changes in Cortisol with DHEA and Testosterone in Response to Three Stressors during Adolescence. *Psychoneuroendocrinology*, 41, 33-45. <https://doi.org/10.1016/j.psyneuen.2013.12.002>
- Mostafa, M. M. (2020). Neural Correlates of Fear Appeal in Advertising: An fMRI Analysis. *Journal of Marketing Communications*, 26(1), 40-64. <https://doi.org/10.1080/13527266.2018.1497680>
- Nadeem, M., Bahadar, S., Gull, A., & Iqbal, U. (2020). Are Women Eco-Friendly? Board Gender Diversity and Environmental Innovation. *Business Strategy and the Environment*, 29(8). <https://doi.org/10.1002/bse.2563>
- Noble, G., Pomeroy, A., & Johnson, L. W. (2014). Gender and Message Appeal: Their Influence in a Pro-Environmental Social Advertising Context. *Journal of Social Marketing*, 4(1), 4-21. <https://doi.org/10.1108/JSOCM-12-2012-0049>
- Odou, P., & Schill, M. (2020). How Anticipated Emotions Shape Behavioral Intentions to Fight Climate Change. *Journal of Business Research*, 121, 243-253. <https://doi.org/10.1016/j.jbusres.2020.08.047>
- Orzan, G., Serban, C., Iconaru, C., & Macovei, O. I. (2013). Modeling the Impact of Online Social Marketing Campaigns on Consumers' Environmentally Friendly Behavior. *Research Journal of Recent Sciences*, 2(3), 14-21.
- Peterson, C. K., & Harmon-Jones, E. (2012). Anger and Testosterone: Evidence that Situationally-Induced Anger Relates to Situationally-Induced Testosterone. *Emotion*, 12(5), 899-902. <https://doi.org/10.1037/a0025300>
- Pinkhasov, R. M., Wong, J., Kashanian, J., Lee, M., Samadi, D. B., Pinkhasov, M. M., & Shabsigh, R. (2010). Are Men Shortchanged on Health? Perspective on Health Care Utilization and Health Risk Behavior in Men and Women in the United States. *International Journal of Clinical Practice*, 64(4), 475-487. <https://doi.org/10.1111/j.1742-1241.2009.02290.x>
- Poels, K., & Dewitte, S. (2019). The Role of Emotions in Advertising: A Call to Action. *Journal of Advertising*, 48(1), 81-90. <https://doi.org/10.1080/00913367.2019.1579688>
- Rathee, S., & Milfeld, T. (2024). Sustainability Advertising: Literature Review and Framework for Future Research. *International Journal of Advertising*, 43(1), 7-35. <https://doi.org/10.1080/02650487.2023.2175300>
- Rodriguez-Sanchez, C. (2023). The Role of Social Marketing in Achieving the Planet's Sustainable Development Goals (SDGs). *International Review on Public and Nonprofit Marketing*, 20, 559-571. <https://doi.org/10.1007/s12208-023-00385-3>
- Rogowska, J., Piątkowska, K., & Głowacz, Z. (2024). Societal Involvement in Household Waste Sorting Behavior in the Context of the Circular Economy: A Case Study of Poland. *Sustainability*, 16(5), 1841. <https://doi.org/10.3390/su16051841>
- Rundle-Thiele, S., David, P., Willmott, T., Pang, B., Eagle, L., & Hay, R. (2019). Social Marketing Theory Development Goals: An Agenda to Drive Change. *Journal of Marketing Management*, 35(1-2), 160-181. <https://doi.org/10.1080/0267257X.2018.1559871>
- Shields, G. S., Lam, J. C. W., Trainor, B. C., & Yonelinas, A. P. (2016). Exposure to Acute Stress Enhances Decision-Making Competence: Evidence for the Role of DHEA. *Psychoneuroendocrinology*, 67, 51-60. <https://doi.org/10.1016/j.psyneuen.2016.01.031>
- Sollberger, S., Bernauer, T., & Ehlert, U. (2017). Predictors of Visual Attention to Climate Change Images: An Eye-Tracking Study. *Journal of Environmental Psychology*, 51, 46-56. <https://doi.org/10.1016/j.jenvp.2017.03.001>
- Sudbury-Riley, L., & Kohlbacher, F. (2016). Ethically Minded Consumer Behavior: Scale Review, Development, and Validation. *Journal of Business Research*, 69(8), 2697-2710. <https://doi.org/10.1016/j.jbusres.2015.11.005>
- Taufique, K. M. R. (2022). Integrating Environmental Values and Emotion in Green Marketing Communications Inducing Sustainable Consumer Behaviour. *Journal of Marketing Communications*, 28(3), 272-290. <https://doi.org/10.1080/13527266.2020.1866645>
- van den Broek, K., Bolderdijk, J. W., & Steg, L. (2017). Individual Differences in Values Determine the Relative Persuasiveness of Biospheric, Economic and Combined Appeals. *Journal of Environmental Psychology*, 53, 145-156. <https://doi.org/10.1016/j.jenvp.2017.07.009>
- Vining, R. F., McGinley, R. A., & Symons, R. G. (1983). Hormones in Saliva: Mode of Entry and Consequent Implications for Clinical Interpretation. *Clinical Chemistry*, 29(10), 1752-1756.

- Wei, S., Ang, T., & Jancenelle, V. E. (2018). Willingness to Pay More for Green Products: The Interplay of Consumer Characteristics and Customer Participation. *Journal of Retailing and Consumer Services*, 45, 230-238. <https://doi.org/10.1016/j.jretconser.2018.08.015>
- Xia, W., & Li, L. M. W. (2023). Societal Gender Role Beliefs Moderate the Pattern of Gender Differences in Public- and Private-Sphere Pro-Environmental Behaviors. *Journal of Environmental Psychology*, 92, 102158. <https://doi.org/10.1016/j.jenvp.2023.102158>

Reakcje młodych dorosłych na zagrożenia środowiskowe w reklamach społecznych: korelaty hormonalne, zachowania konsumenckie i postawy wobec środowiska

Streszczenie

Cel: Celem niniejszego badania była ocena wpływu kontaktu z reklamą o tematyce ekologicznej, wywołującą silne negatywne emocje, na krótkotrwałe zmiany stężenia hormonów steroidowych w ślinie (kortyzolu, testosteronu i DHEA) oraz analiza związku tych reakcji hormonalnych z postawami proekologicznymi i etycznym zachowaniem konsumentów.

Metodyka: Badanie przeprowadzono w dwóch etapach. W pierwszym etapie wykonano test wstępny ($N = 139$) w celu zidentyfikowania reklamy wideo o tematyce środowiskowej postrzeganej jako wywołującej najsilniejsze negatywne emocje. Następnie przeprowadzono quasi-eksperyment z jedną grupą ($N = 22$), w ramach którego pobrano próbki śliny 5 minut przed oraz 5 minut po ekspozycji na reklamę. Stężenia hormonów oceniono za pomocą testu ELISA, natomiast postawy proekologiczne i zachowania konsumenckie zmierzono przy użyciu skali *New Environmental Paradigm* (NEP) oraz skali *Ethically Minded Consumer Behavior* (EMCB).

Wyniki: Reklama wywołała istotne zmiany hormonalne u mężczyzn, w tym spadek poziomu kortyzolu i stosunku kortyzolu do DHEA oraz wzrost stosunku testosteronu do kortyzolu. U kobiet nie zaobserwowano istotnych zmian hormonalnych. Różnice hormonalne przed i po ekspozycji były istotnie powiązane z wybranymi wymiarami NEP i komponentami EMCB, w tym z recyklingiem oraz gotowością do zapłacenia wyższej ceny za produkty etyczne.

Implikacje i rekomendacje: Wyniki badania wskazują, że markery fizjologiczne mogą wspierać ocenę przetwarzania ryzyka emocjonalnego w komunikacji środowiskowej oraz stanowić podstawę do projektowania kampanii uwzględniających różnice płci. W przyszłych badaniach warto uwzględnić większe próby oraz sprawdzić, czy reakcje hormonalne pozwalają przewidywać długoterminowe zmiany zachowań. Biorąc pod uwagę eksploracyjny charakter badania, małą liczebność próby i projekt z jedną grupą, wyniki należy interpretować jako wstępne i wymagające potwierdzenia.

Oryginalność/wartość: Badanie przedstawia nowatorskie podejście psychofizjologiczne do reklamy środowiskowej poprzez połączenie biomarkerów hormonalnych z postawami wobec środowiska oraz etycznymi zachowaniami konsumenckimi.

Słowa kluczowe: zachowania proekologiczne, reklama społeczna, emocje negatywne, biomarkery stresu
