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Do Viewers Show What They See? Facial Expression Category Scores and Self-Reports in Sustainability Advertising

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Abstract

This exploratory study examines viewer facial expression category scores during selected windows in two sustainability-related videos with different narrative tones. We combined automated facial expression analysis (AFEA) during viewing with retrospective questionnaires for 99 international participants. The three focal birth year response bands included 91 participants. At each stimulus-coded window, we summarised the viewer AFEA score for the corresponding expression category. Generation Z viewers had the highest descriptive average across the ten selected windows among the three cohorts. Sadness had the highest whole-video average among the non-neutral categories in both videos. Qualitative comparisons of aggregate AFEA scores and questionnaire responses showed different patterns across categories and videos. The non-probability sample, differences between the two stimuli, and absence of a pre-exposure baseline limit interpretation to descriptive patterns in the observed sample. These patterns identify stimulus windows and expression categories for follow-up studies of emotional mirroring.

Keywords: generational cohort analysis; emotional mirroring; neuromarketing; automated facial expression analysis; implicit and explicit responses; sustainability advertising

1. Introduction

Sustainability and environmental awareness influence corporate strategies, consumer behaviour, and media content [1,2]. In the UK alone, 83% of managers surveyed planned to increase or maintain their sustainability investment by 2026 [3]. Consumer surveys indicate that some consumers are willing to pay a premium for sustainable products [4]. However, this evidence does not establish a uniform preference across consumers or equivalent willingness to pay across generational cohorts. Reported willingness also does not necessarily translate into purchasing behaviour.

Emotional responses are relevant to sustainability communication, but engagement, behavioural intentions, and actual behaviour represent distinct outcomes. Janić et al. [5] demonstrated discrepancies between EEG-based indicators and self-reported responses to environmental CSR videos, supporting complementary measures of audience response. More broadly, Sheng et al. [6] found that environmental appeals had a small advantage over personal appeals for pro-environmental intentions but not for actual behaviour. Emotional

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or attitudinal responses should therefore not be treated as sufficient evidence of behavioural change. A message's effectiveness also depends on the audience and context [7,8], and perceived greenwashing can undermine credibility [9].

To deepen the understanding of such responses, neuromarketing techniques such as EEG, AFEA, and other biometric measures can complement self-reports by providing time-linked indicators of attention, arousal, and facial or physiological responses [10–13].

These methods do not directly reveal unconscious emotional states and therefore need to be interpreted carefully. Janić et al. [5] and Ćirović et al. [14] found that environmental CSR messages may not engage audiences as intended; neuro-informed pretesting could have a role in sustainability communication.

In the present study, AFEA and self-reports provide complementary observations of viewer responses to two sustainability videos. The terms positive and negative are used to denote the dominant tone of the narrative (not necessarily what viewers feel) in a stimulus: a positive stimulus focuses on environmental improvement, regenerative practices, and expressions of joy or delight, while a negative stimulus focuses on plastic pollution, environmental harm, and expressions of sadness or fear. These categorisations are the researchers' own, so they were not independently confirmed by a stimulus pretest. In this study, a video refers to moving image communication rather than a still visual or print advertisement. The responses were assessed for each video presented as a whole, not separately, for imagery, language, written text, or sound contribution.

In this study, emotional mirroring is defined as an observable correspondence between an emotion shown in a stimulus and the viewer's time-linked facial expression response [15,16]. Such correspondence might be relevant for interpersonal communication and advertising, but it should not be interpreted as empathy or a shared subjective emotional state. Generations may also respond differently because of age-related and sociocultural influences [17–19].

Lee and Haley [19] examined generational responses to social issue advertising; Zito et al. [20] used a mix of methods to evaluate a UNICEF campaign among older adults; Janić et al. [5] assessed environmental CSR videos using EEG and self-reports. These studies provide complementary bases of knowledge about audience differences, social communication, and response measurement. The current study builds on these by examining viewer facial expression category scores at stimulus-coded windows and retrospective self-reports in sustainability videos across Generation X, Millennials, and Generation Z. Facial expression measures and self-reports measure different aspects of a response at different times; disagreement does not imply that either measure captures a more authentic emotional state. Consumer protection relevance is indirect: multimethod assessment could help determine whether the emotional presentation of sustainability messages corresponds to audiences' reported experiences, but this study does not assess deception, consumer vulnerability, purchasing decisions, or protection outcomes and thus cannot establish a direct consumer protection benefit.

2. Literature Review

2.1. Emotional Advertising and Neuromarketing

Advertising can shape attention, memory, attitudes, and behaviour through cognitive and affective routes [21,22]. More recent evidence indicates that emotion-eliciting image content attracts earlier and stronger initial visual attention, although this advantage decreases after the first fixation [23]. Research on audiovisual advertising also distinguishes the recall of an emotionally salient narrative from the recall of the advertised brand [24]. Emotional salience should therefore not be assumed to improve all components of advertising effectiveness equally. Neuromarketing complements self-reports by recording

physiological or behavioural responses during exposure, but these measures are indicators rather than direct reflections of consumers' internal states [10,11].

Automated Facial Expression Analysis (AFEA) uses computer vision algorithms to detect faces in images or video, extract facial features or movements, and assign scores to predefined expression categories (some systems also estimate facial action units). AFEA is therefore a behavioural measurement method (unlike neural recording like EEG or manual FACS coding), and its time-resolved output can be aligned with scenes, but the interpretation of its scores depends on the system, recording conditions, and validation evidence [25,26]. Facial expressions can tell us about emotional responding, but an automated category score still needs contextualization rather than being treated as a direct measure of subjective feeling. Advertising applications show both this temporal value and why complementary outcomes are needed. Baños-González et al. [24] combined automated coding of facial expressions with emotion and recall measurements in COVID-19 advertisements to differentiate responses to a narrative from brand recall. Mancini et al. [27] combined the automatic coding of facial expressions, eye tracking, and self-reports in an experiment on YouTube in-stream ads. The presence or absence of platform elements (timers, progress bars) changed the measured responses. These studies show both how facial analysis can be used to evaluate advertising and why presentation context and separately measured outcomes matter. Their results do not prove the accuracy of the present software or that facial expression scores measure advertising effectiveness alone.

For the present study, AFEA and post-exposure questionnaires are treated as complementary rather than interchangeable measures. AFEA captures time-linked facial expression patterns, whereas questionnaires capture consciously reported and retrospective experience. Their combination can reveal convergence or divergence between immediate facial responses and self-reports without assuming that either measure is inherently more authentic [20,28].

2.2. Facial Expression Analysis and Emotional Mirroring

Facial expression research often uses Basic Emotion Theory and FACS [29,30]. FACS provides an anatomically based system for describing observable facial movements through action units; to infer an emotion from these movements, there is an additional interpretative step. Facial expressions are also context-bound and culture-specific, and show individual differences [31,32]. Recent work on methodology points out limitations due to demographic bias, recording conditions, and assumptions embedded in automated systems (e.g., Cross et al. [25]). Li et al. [26] showed that classification performance varies between Western and Eastern facial datasets for two widely used systems. These results do not establish CoolTool's performance here because it would be necessary to validate this software and sample.

Emotional mirroring refers to a partial correspondence between an observed emotional expression and the observer's response [15,33]. It is conceptually distinct from empathy and emotional contagion because similar facial movements do not necessarily demonstrate the same subjective feeling or a shared emotional state [34]. The present study uses expression categories coded in selected stimulus windows to identify which viewer AFEA scores to summarise. This yields a time-linked description of the corresponding viewer expression category. Evaluating emotional mirroring would require evidence that the expression response increases relative to a suitable reference condition. Motor mimicry denotes matching another person's movements, whereas emotional contagion denotes convergence in emotional states [16,34]. Matching AFEA categories at selected timeframes is a coarser measure than movement-level matching and does not, by itself, establish either mechanism.

2.3. Sustainability Advertising, Generational Differences, and Research Gap

Sustainability communication research looks at how message characteristics relate to different response outcomes [5]. Janić et al. [5] compared neuro-physiological indicators with self-reports for environmental CSR videos, and Sheng et al. [6] distinguished between environmental appeals and personal appeals on intentions and behaviour. These results show that sustainability communication should be evaluated based on clearly specified outcomes rather than emotional engagement being equated with behavioural effectiveness. Therefore, in the present study, we look at correspondence between stimulus expressions, viewers' facial expression patterns, and retrospective reports.

Generational cohorts may respond differently to social issue advertising [19]. Cohort labels should be interpreted cautiously because age, culture, education, media habits, and digital experience may also influence responses.

The present study brings together time-linked facial expression analysis, retrospective self-reports, and exploratory cohort comparisons for two sustainability videos. The study links specific stimulus windows to the corresponding viewer expression scores and compares aggregate AFEA patterns with retrospective self-reports.

This research thus addresses the following questions:

- RQ 1. What viewer AFEA scores are observed for the expression categories coded in the selected stimulus windows?
- RQ 2. How do the selected-window AFEA scores compare descriptively between the two videos?
- RQ 3. How do the observed response patterns vary across Generation X, Millennials, and Generation Z?
- RQ 4. How do aggregate AFEA score patterns compare with retrospective self-reports?

3. Materials and Methods

3.1. Research Design

This study used a quantitative multimethod design combining AFEA and self-report questionnaires [35,36] to compare time-linked facial expression patterns with retrospective assessments. The dataset and protocol are documented in Clemens [37]. Generative AI (ChatGPT, GPT-6 Astra, OpenAI, San Francisco, CA, USA) was used solely to generate illustrations for the graphical abstract. The authors wrote the prompts and reviewed and edited the resulting illustrations.

3.2. Participants and Sampling

Participants were recruited purposively and through convenience sampling (with participant referrals [38]). They had to be aged 18 or older and have sufficient English proficiency to understand the stimuli and questionnaire. The CoolTool export had 99 different completed responses collected from 27 July to 13 September 2024. Checking against recorded birth year response codes gave 91 participants in the three focal response groups. The eight other participants were full sample eligible. Two selected 1922–1955, and six 1956–1965. The following non-overlapping birth year definitions are used for the cohort labels. The sample sizes refer to the corresponding recorded response groups:

1. Generation X (1966–1980), $n = 22$;
2. Millennials (1981–1995), $n = 22$;
3. Generation Z (1995–2009 definition), $n = 47$ in the youngest questionnaire response group.

Each participant selected one birth year band. The questionnaire provided the adjacent options 1981–1995 and 1995–2009 [37]. The Gen Z response group is defined as

the 47 participants who selected 1995–2009; because the export contains only the bands selected, the cohort assignment of any born in 1995 follows their recorded choice. Generational boundaries vary across sources [39], so the cohort comparisons were interpreted as exploratory [17].

The first author recruited participants through her personal network, including friends and family contacts. She shared the study with people she knew to be adults and asked the recipients to forward it only to adults who understood English. The Formal Information Sheet stated the age and English-language eligibility criteria. Participants confirmed on the consent form that they had read and understood the sheet and agreed to take part. There was no separate age-verification question or screening step. Adult status was therefore based on the stated eligibility criteria and the consent procedure rather than on independent verification.

Ethics and Facial Data Protection

The study was approved by the university ethics reviewers at CITY College, University of York Europe Campus (approval code 45; 8 July 2024). Informed consent was obtained from all participants. Before participation, participants received information about the study, were informed that participation was voluntary and that they could withdraw without giving a reason, and provided consent before recording began.

3.3. Procedure

Participants accessed the study remotely via an online link. CoolTool recorded facial expression scores through the participant's device camera during video playback and collected questionnaire responses after viewing. All participants watched Nestlé's Generation Regeneration (Video 1) first and completed the self-report questions for that video before viewing PLASTIK (Video 2). The presentation order was fixed, with no counterbalancing.

Generational grouping was used for analysis, not as a requirement for participation. For the window analysis, five stimulus timeframes per video were selected by inspecting the displayed facial expressions and manual FACS coding.

Viewer AFEA scores were analysed at the corresponding timeframes. These timeframes were chosen from the expressions of the stimulus but not necessarily peaks in participants' responses.

The two measures were treated as complementary rather than interchangeable. AFEA provided time-linked facial expression scores during stimulus exposure, whereas the questionnaire captured retrospective self-reports. Their integration enabled comparisons between response modalities but did not, by itself, establish that either measure was more valid or more authentic [40].

The questionnaire asked how much each video elicited feelings of disgust, fear, scepticism, sadness, neutrality, surprise, or delight, and how much it evoked positive or negative emotions. Intensity was measured on a seven-point scale. It also asked about familiarity with each video (prior knowledge), the importance of sustainability, and the birth year category. These were retrospective assessments of each video, not ratings of individual FACS-coded timeframes.

3.4. Stimuli

Moving-image stimuli were used to examine facial expression responses over time and to align those responses with selected expressions displayed in the stimulus. This design does not test whether video is more emotionally effective than static advertising. The stimuli were Nestlé's corporate film Generation Regeneration [41] and the environmental awareness film PLASTIK by MeshMinds and Studio Birthplace [42]. They are different

sustainability communications rather than positive and negative versions of an otherwise identical message. The stimulus source, topic, narrative structure, duration, and communicative purpose differ alongside emotional tone. Responses may therefore reflect these combined characteristics, including prior brand attitudes or perceived source credibility, which may also vary across age cohorts. Between-video comparisons are exploratory and cannot isolate an effect of emotional valence.

The predominant narrative tone and content of each stimulus are summarised in Table 1. A predominantly negative narrative may contain individual positive expressions, as illustrated by the Delight timeframe coded in PLASTIK. The classification of overall tone was not validated through pretesting. Unfamiliarity with a particular video does not establish unfamiliarity with its producer or neutrality toward the brand.

Table 1. Characteristics of the video stimuli.

Criterion	Video 1: Generation Regeneration—Nestlé	Video 2: PLASTIK—MeshMinds and Studio Birthplace
Displayed emotions	Predominantly joy/delight	Includes surprise, sadness, fear and a selected delight expression
Scenery	Idealised regenerative farming, sustainable role models	Polluted food, waste, beach covered in plastic
Dramatic framework	Positive effects of sustainability and environmentally conscious people as a success story	Story about the negative effects of plastic pollution
Emotional approaches	Positive presentation, optimistic attitude towards the future, regenerative agriculture as the environmentally responsible choice.	Depicts adverse consequences of plastic pollution; viewers' subjective feelings are assessed separately.

The source videos used in the study were Nestlé's Generation Regeneration, Nestlé's *Sustainability Promise* (2021) [41], and MeshMinds' (PLASTIK)—A short film to end plastic pollution in South-East Asia (2022) [42]. The exported timelines cover 88 one-second bins for Video 1 and 159 for Video 2. The last recorded timestamps were approximately 87.8 and 158.3 s, respectively. These values describe the recorded exposure coverage.

The stimulus timeline identified the expression category and time window used to select each set of viewer AFEA scores. The resulting estimates describe the corresponding facial expression category during that window. Evaluating emotional mirroring would require a reference level for comparison.

3.5. Timeline and FACS Coding

For the analysis of viewer AFEA scores, five timeframes were selected per video (N1–N5 and P1–P5) in which actors displayed recognisable facial expressions. The videos were inspected second-by-second, and the selected frames were arranged chronologically in a stimulus timeline (see Figure 1 for an example).

The coded windows were N1, 00:01–00:02; N2, 00:02–00:03; N3, 00:06–00:08; N4, 00:11–00:16; and N5, 00:16–00:18 for Video 1. For Video 2, they were P1, 00:01–00:02; P2, 00:21–00:23; P3, 00:43–00:46; P4, 01:10–01:12; and P5, 01:18–01:21 [37].

The first author (A.D.C.) coded all ten stimulus windows from static screenshots, created the emotion timeline using the FACS manual [30], and identified the actors' action units and assigned expression categories for comparison with the corresponding CoolTool viewer scores. The second author (N.D.) checked the initial FACS coding. No inter-coder reliability statistic was computed. We verified all ten window times and expression labels against Appendix B of the original study [37] (pp. 83–85). The archived P3 entry pairs AU4 with

"inner brow raiser", the FACS name for AU1; the first author confirmed that the intended action was AU4 (brow lowerer), and P3 is reported under its archived Sadness label.

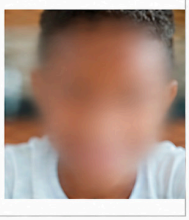
ID	Timecode (Start)	Timecode (Ende)	Action Unit(s)	FACS Name	Muscular Basis	Emotion	Screenshot of frame
N1	00:01	00:02	AU6 + AU12 + AU25	Cheek Raiser + Lip Corner Puller + Lips Part	Orbicularis Oculi, Pars Orbitalis + Zygomatic Major + Depressor Labil, or Relaxation of Mentalis or Orbicularis Oris	Happy (delight)	

Figure 1. Example of timeline emotion coding. Source: screenshots from the video stimuli [41].

The happiness-related stimulus expression was labelled "Delight" to align the terminology with the CoolTool output category.

3.6. Data Analysis

CoolTool's facial-coding module (web-based platform, accessed July–September 2024; CoolTool Inc., San Francisco, CA, USA) automatically classifies facial patterns captured by the device camera during exposure and displays category scores along the stimulus timeline [43]. The legacy CoolTool NeuroLab guide describes percentages displayed as software estimates of the probability assigned to each expression category at a given time [44]. The 2024 export gives time-stamped values and separate one-second series on a 0–100 scale for seven facial expression categories plus Neutral. Exported values were used as descriptive category scores. The questionnaire responses were analysed separately as retrospective self-reports, and the two response measures for the whole sample were descriptively compared. For the selected-window estimates, we averaged each participant's one-second CoolTool scores for the corresponding category within each selected window. Each window consisted of one-second bins from its start time up to its end time (end time excluded). A participant contributed to a window estimate if every second in that window had a score from 0 to 100. We retained zero scores and treated −1 entries as missing. Each eligible record contributed equally to the group mean. The All column includes all records eligible for any of the five recorded birth year bands; the other columns include all records eligible within the named cohorts. The valid participant count is shown with each estimate. Participant-level window means are provided in Table S1 of the Supplementary Materials.

For each video and expression category, the 33rd and 66th percentiles of the one-second timeline means (all usable participant scores at each second) were calculated [45,46]. The All column used the full-sample timeline means, and the three cohort columns used one shared percentile reference distribution pooled from their cohort-specific timeline means. Percentiles were calculated by linear interpolation. Window means below the 33rd percentile were labelled low, means at or between cut-off lines medium, and means above the 66th percentile high (relative positions in specified reference distributions). Figures 2–4 use original CoolTool dashboard timelines. The dashed line "Threshold" appears near 4% on these plots. The window means, participant counts, and percentile categories were calculated independently of this line.

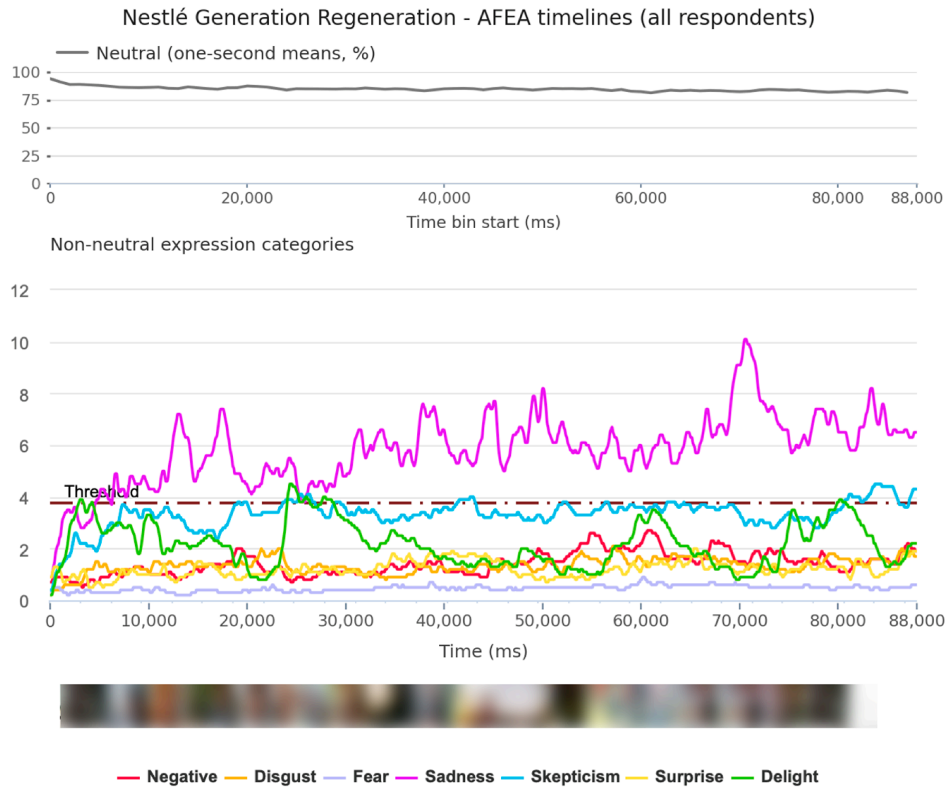


Figure 2. Video 1 emotion timeline for all respondents. The dashed "Threshold" line is a display element of the original CoolTool dashboard; its derivation is not documented, and it was not used in any reported calculation or classification.



Figure 3. Video 2 emotion timeline for all respondents. The "Threshold" line is explained in the caption of Figure 2.

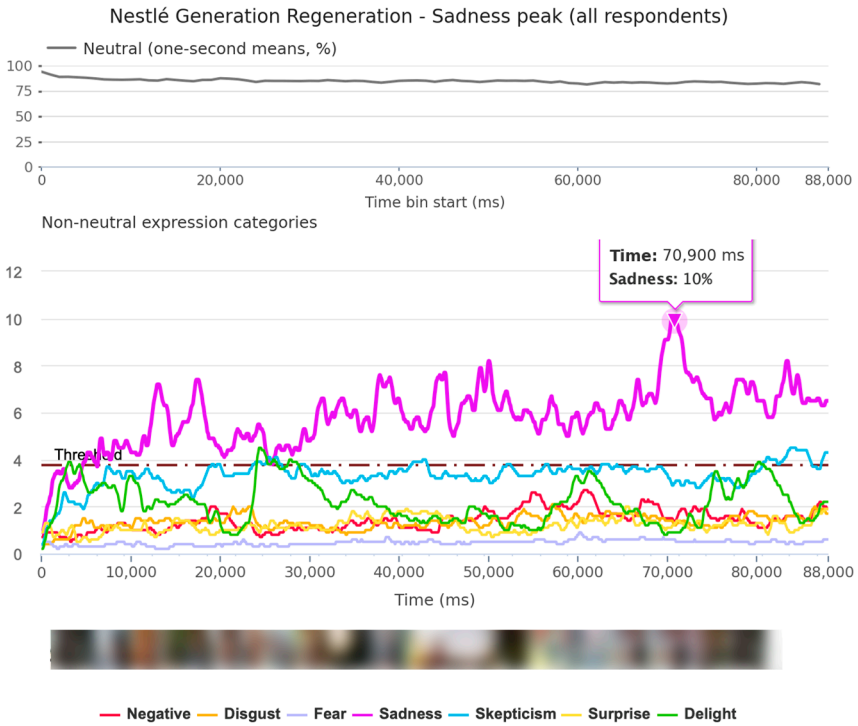


Figure 4. Peak sadness in Video 1. The "Threshold" line is explained in the caption of Figure 2.

4. Results

Results are presented for each video before descriptive comparisons are made across videos and generations. The selected-window tables report the non-neutral AFEA category corresponding to the stimulus coding for each window. "Video 1" refers to Nestlé's Generation Regeneration commercial, and "Video 2" refers to PLASTIK by MeshMinds and Studio Birthplace. All the between-video and between-generation comparisons are descriptive; no claim of statistical significance is made.

4.1. Percentile-Based Classification of Video 1 Windows

Table 2 reports the relative AFEA score categories for the selected Delight windows in Video 1 using the full-sample and pooled cohort reference distributions described in Section 3.6.

Table 2. Relative AFEA score categories in Video 1.

ID	Analysed Emotion Using FACS	Analysis Groups			
		All	**Gen X**	**Millennials**	**Gen Z**
N1	Delight	Medium	Low	Low	High
N2	Delight	High	Low	Low	High
N3	Delight	High	High	Medium	High
N4	Delight	Medium	Medium	Low	High
N5	Delight	Medium	Medium	Medium	High

Within the overall distribution for Video 1, the Delight scores at N2 and N3 were classified as high, while N1, N4, and N5 were classified as medium.

All five Gen Z window means were classified as high, whereas no Millennial timeframe was classified as high.

4.2. AFEA Category Scores in Video 1

Table 3 reports the participant-weighted Delight category scores in Video 1. Each cell shows the mean percentage followed by the valid participant count in parentheses.

Table 3. AFEA category scores in selected Video 1 windows.

ID	Emotion Analysed Using FACS	Analysis Groups			
		All	**Gen X**	**Millennials**	**Gen Z**
N1	Delight	2.16% (99)	0.75% (22)	0.23% (22)	3.83% (47)
N2	Delight	3.96% (98)	0.82% (22)	1.18% (22)	7.12% (46)
N3	Delight	3.30% (96)	3.41% (21)	1.79% (21)	4.23% (46)
N4	Delight	2.30% (95)	2.43% (21)	1.29% (21)	2.77% (45)
N5	Delight	2.36% (97)	2.15% (22)	1.86% (21)	2.73% (46)

Figure 2 shows the time course of the average AFEA expression-category scores across Video 1. The curves describe changes in automated classifications rather than direct measurements of subjective feelings.

4.2.1. Overall Scores in Video 1

Among the selected Video 1 timeframes, the overall Delight score was the highest at N2 (3.96%) and lowest at N1 (2.16%). Although the selected stimulus expressions were coded as Delight, Sadness had the highest whole-video average among the non-neutral categories, with a timeline peak of approximately 10%. Fear had the lowest whole-video score among the non-neutral categories.

4.2.2. Scores by Generation in Video 1

At N2, the Delight score was 0.82% for Gen X, 1.18% for Millennials, and 7.12% for Gen Z. Gen Z had the highest Delight score at each selected timeframe. The Millennial scores remained below 2% at all five timeframes. These differences are descriptive.

4.3. Percentile-Based Classification of Video 2 Windows

Table 4 reports the relative AFEA score categories for Video 2 at timeframes P1–P5, using the percentile classification described in Section 3.6.

Table 4. Relative AFEA score categories in Video 2.

ID	Emotion Analysed Using FACS	Analysis Groups			
		All	**Gen X**	**Millennials**	**Gen Z**
P1	Surprise	Low	Low	Medium	High
P2	Surprise	Low	Medium	Low	High
P3	Sadness	Medium	Low	Medium	High
P4	Delight	High	High	Low	High
P5	Fear	High	High	Medium	High

4.3.1. Overall Classification in Video 2

For the overall sample, the corresponding AFEA categories were classified as low for Surprise at P1 and P2, medium for Sadness at P3, and high for Delight at P4 and Fear at

P5. These labels indicate relative positions within the analysed distribution, not statistically established levels of emotional mirroring.

4.3.2. Classification by Generation in Video 2

Using the shared cohort reference distribution, the Gen X scores for Delight at P4 and Fear at P5 were classified as high. The Millennial scores were classified as medium at P1, P3, and P5, with no timeframe classified as high. The Gen Z scores were classified as high at all five timeframes. Table 5 gives the corresponding continuous scores for comparison.

Table 5. AFEA category scores in selected Video 2 windows.

ID	Emotion Analysed Using FACS	Analysis Groups			
		All	Gen X	Millennials	Gen Z
P1	Surprise	0.78% (98)	0.07% (22)	0.39% (22)	1.39% (47)
P2	Surprise	0.85% (98)	0.36% (22)	0.25% (22)	1.49% (46)
P3	Sadness	11.47% (99)	10.32% (22)	11.47% (22)	13.80% (47)
P4	Delight	1.02% (99)	1.24% (22)	0.04% (22)	1.02% (47)
P5	Fear	0.88% (99)	0.90% (22)	0.73% (22)	0.97% (47)

4.4. AFEA Category Scores in Video 2

Table 5 reports participant-weighted AFEA scores for the expression category coded at each selected window in Video 2. Each cell shows the mean percentage followed by the valid participant count in parentheses.

4.4.1. Overall Scores in Video 2

Sadness had the highest whole-video average among the non-neutral categories in Video 2, with a timeline peak above 15%. At the selected Sadness window P3, the mean was 11.47% across 99 valid participant records. The Fear, Delight, and Surprise scores at their selected timeframes were lower.

4.4.2. Scores by Generation in Video 2

At P3, Gen Z had the highest Sadness score (13.80%). Gen Z also had the highest Surprise scores at P1 and P2. At P4, Gen X had the highest Delight score among the three cohorts, while the Millennial score was 0.04%. These are descriptive comparisons of software-classified facial expression scores.

4.5. Comparison of Selected AFEA Scores

The unweighted mean of the five window scores was 2.81% for Video 1 and 3.00% for Video 2. The latter summary is strongly influenced by the Sadness score at P3 (11.47%). The remaining four Video 2 window scores averaged 0.88%. Video 1 contributes five Delight scores. Video 2 contributes scores for Surprise, Sadness, Delight, and Fear. Each mean summarises the specific categories and windows included. Table 6 summarises these averages by video.

Table 6. Unweighted mean of the five selected-window scores for each video.

Video 1	2.81%
Video 2	3.00%
Each of the five window means for a video contributes equally. Means were calculated before rounding.	

4.5.1. Generational Averages

Across the ten selected-window scores, the unweighted mean was 3.94% for Gen Z, 2.24% for Gen X, and 1.92% for Millennials. These are descriptive summaries of different expression categories across the two stimuli. Table 7 summarises these averages by cohort.

Table 7. Unweighted mean of the ten selected-window scores for each cohort.

Mean of Selected AFEA Category Scores by Cohort	
Gen X	2.24%
Millennials	1.92%
Gen Z	3.94%
Each of the ten window means for a cohort contributes equally. Means were calculated before rounding.	

4.5.2. Similarities in Sadness

Sadness had the highest whole-video average among the non-neutral categories in both videos. Gen Z had the highest reported whole-video Sadness score among the three cohorts for each video. Table 8 provides the CoolTool whole-video Sadness summaries (E AVG) for each cohort. The final row gives the unweighted mean of the three cohort summaries for each video. These means were 5.06% for Video 1 and 11.77% for Video 2. The CoolTool E AVG values for all participants were 5.80% for Video 1 and 11.21% for Video 2. In the full-sample timelines (Figures 2 and 3), the other non-neutral categories remained at or below approximately 5% throughout both videos, whereas Sadness exceeded this level for most of each video.

Table 8. CoolTool whole-video Sadness scores by cohort and for the full sample.

Average Sadness Score	Video 1	Video 2
Gen X	3.47%	10.85%
Millennials	3.71%	11.34%
Gen Z	8%	13.12%
All participants (CoolTool E AVG)	5.80%	11.21%
Unweighted mean of the three cohort summaries	5.06%	11.77%

4.6. Implicit vs. Explicit Responses

In the overall sample, 95 of 99 participants (96%) reported that they had seen neither video before. AFEA classifications and retrospective questionnaire responses showed both convergence and divergence, depending on the emotion and video.

Sadness had the highest average among the non-neutral AFEA categories for Video 1, and 58% of participants reported feeling no sadness after viewing it.

Figure 4 shows the time course of the Sadness category in Video 1. The reported peak occurred at 70.9 s, with a score of approximately 10%. Self-reports showed a different pattern.

The CoolTool summary in Figure 5 displays 58% at “Not at all”, 13% at “Very little”, 8% at “Little”, 15% at “Neutral/Somewhat”, 4% at “Much”, and 2% at “Very much”. The seventh category had no responses.

Although AFEA produced comparatively high sadness scores, the explicit self-reports indicated little or no consciously reported sadness for most participants.

The results documented for the study also show that correspondence varied by emotion and video [37]. For Video 2, 54 of 99 respondents (54.5%) selected one of the three highest fear ratings, and the AFEA Fear timeline was generally below 1%. Sadness was prominent in the AFEA timeline, and 77 of 99 respondents (77.8%) selected one of the three highest

sadness ratings. The AFEA Delight scores were relatively low, and 55% reported no delight. These examples indicate qualitative convergence as well as divergence. AFEA scores and percentages selecting questionnaire categories are different quantities, and these aggregate comparisons do not establish participant-level agreement or a numerical discrepancy on a common scale.

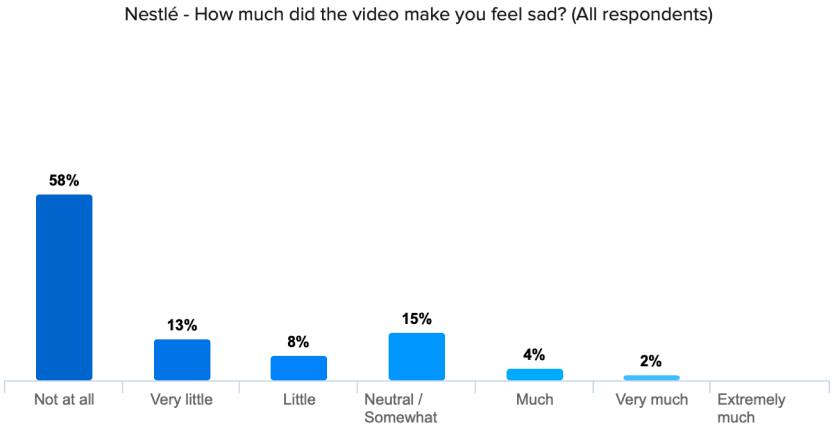


Figure 5. Explicit sadness responses for Video 1 (all respondents).

5. Discussion

The analyses addressed four objectives.

1. Describe viewer AFEA scores in stimulus-coded windows;
2. Compare selected-window scores across the two videos;
3. Describe score patterns across the three focal cohorts;
4. Compare aggregate AFEA patterns with retrospective self-reports.

The study examined viewer facial expression category scores in selected windows of two sustainability videos and described patterns across Gen X, Millennials, and Gen Z. AFEA and self-reports provided complementary indicators of participants' responses.

5.1. Viewer Expression Scores in Stimulus-Coded Windows

Research Question 1 was addressed by identifying displayed expressions through FACS and comparing them with time-linked AFEA categories. This procedure summarised the viewer AFEA score for the corresponding facial expression category during each selected window.

The window-specific scores can be considered in light of Hess and Fischer's contextual account of emotional mimicry [34]: responses follow from the meaning of an expression and social relationship with its source (rather than automatically following a facial movement). In sustainability advertising, this means that viewers may respond to a character, an environmental problem, or the whole message; the design here cannot distinguish between these possibilities nor determine whether congruence exceeds baseline facial expressivity. Attention and recall are outcomes in advertising research [23,24], but neither was measured here, so the present expression scores do not provide evidence of improved attention or recall.

The low, medium, and high categories describe where selected-window means fell relative to the full-sample or pooled cohort timeline reference distributions.

5.2. Descriptive Comparison of the Two Videos

The mean of the selected-window scores was 3.00% for PLASTIK and 2.81% for Nestlé. P3 Sadness contributed most to the PLASTIK mean. Without P3, the remaining four

PLASTIK windows averaged 0.88%, below the Nestlé mean, and Gen Z had a higher mean for Nestlé than for PLASTIK (4.14% versus 3.73%). The direction of the between-video difference therefore depends on a single window and on the group considered. Differences in expression category, source, topic, narrative structure, duration, and visual content limit comparisons between the two summaries.

The percentile categories describe individual windows relative to their reference distributions. The means condense the selected-window scores for these two specific videos.

The higher sadness scores for Video 2 can be seen alongside Fernández-Aguilar et al.'s meta-analysis of film-based emotion induction [47], Baumeister et al.'s broader account of negativity effects [48], and other possible interpretive frameworks, but they do not imply that an AFEA sadness score reflects felt sadness or that negative sustainability messages are more effective. Another explanation is that the pollution narrative and scenes produced different facial responses. Mancini et al. [27] also show that responses to video advertising differ with presentation context (even when the advertising content is preserved). The source credibility, narrative content, and presentation conditions need separate testing before we attribute this present difference to emotional tone.

5.3. Descriptive Patterns Across Cohorts

Generation Z had the highest descriptive mean across the ten selected-window scores, followed by Generation X and Millennials. Prior research has shown that age cohorts can respond differently to social issue advertising [19].

Lee and Haley [19] looked at responses to social issue advertising by value orientation and age so that there was an avenue for thinking about audience differences other than cohort labels. The ranking of facial expression scores here provides a different result and should not be interpreted as evidence that Generation Z are more persuaded or Millennials are less concerned about sustainability; media habits, sustainability involvement, age expressivity, and sample composition are all explanations (none of which was isolated here) and evidence that automated classification performance varies across demographic datasets [26], meaning that comparability is something to check rather than assume. These considerations provide competing explanations for the pattern we observe; they do not state that any particular explanation applies to these participants.

5.4. Comparison of AFEA Scores and Self-Reports

The fourth research question examined the relationship between AFEA-based facial expression scores and explicit self-reports. The two response modalities showed emotion-dependent convergence and divergence. Differences between measures have also been reported in research comparing implicit or behavioural indicators with explicit measures [49–52].

This discrepancy can be compared with Janić et al. [5], who compared EEG indicators with self-reports for environmental CSR videos: their results also motivate us to look at several response dimensions, but EEG and facial expression analyses measure different signals and are not interchangeable (the AFEA was recorded during exposure, whereas self-reports were retrospectively summarised). Immediate expressions, remembered feelings, and evaluations of messages might therefore differ without any being wrong. On the other hand, the recording and classification problems mentioned by Cross et al. [25] could also explain disagreement. The aggregate comparison cannot distinguish between these explanations or participant-level correspondence.

For Video 1, Sadness had the highest average among the non-neutral AFEA categories, and 58% of participants reported feeling no sadness. Memory, scale interpretation, mixed

emotions, social desirability, and the limitations of automated classification are all plausible explanations which require direct testing.

Overall, the fact that AFEA-based and self-reported responses differ indicates that multimethod assessment is warranted. The value is comparing complementary indicators, not treating one method as a measure of participants' true emotions.

6. Theoretical and Practical Implications

6.1. Theoretical Implications

The theoretical contribution of the study is separating three elements that otherwise become conflated when discussing emotional advertising (the expression shown in a message; the viewer's concurrent facial expression pattern; the viewer's retrospective account of feelings). Correspondence between them makes emotional mirroring a testable question rather than an assumed consequence of exposure. In line with contextual accounts of mimicry [34], the descriptive variation across scenes suggests questions as to whether congruence of expression occurs when a sustainability narrative is presented. To establish emotion-specific mirroring, comparisons with baseline or matched time windows and non-target categories of expression would be needed; the present findings neither confirm nor refute the general theory of emotional mirroring.

A second implication is that an emotional response vs. communication effectiveness needs to be distinguished. Sustainability appeals research distinguishes intentions from behaviour [6], just as advertising research distinguishes narrative recall from brand recall [24]. Future studies could measure viewer expression scores, message credibility, and personal relevance separately and test how each relates to persuasion or sustainable behaviour.

6.2. Practical Implications

The practical implications are tentative because the study is exploratory and does not establish statistically significant cohort or framing effects but does indicate that sustainability campaigns may benefit from pretesting emotional responses rather than assuming that the same message will be received similarly by all audiences.

Campaign developers could use time-linked AFEA results to select scenes for closer inspection and ask viewers what those scenes meant to them and whether the environmental claims were clear and credible (e.g., a sadness-classified peak might trigger follow-up questions about concern, confusion, or discomfort rather than assuming scene persuasion); self-reports and (where possible) independently measured recall or behaviour outcomes would help determine whether a facial response serves the campaign purpose. The present study does not show that this pretesting approach improves the performance of campaigns.

When comparing alternative campaign versions, practitioners should keep the source, topic, length, and presentation conditions as constant as possible and pretest the emotional tone intended. The difference between the two videos here does not support choosing negative framing over positive framing. These are provisional applications that require transparent consent and proportionate handling of facial data—concerns raised in neuromarketing research [53].

7. Limitations and Future Research

As with any academic research, this study has limitations [54]. As Ioannidis [55] argues, limitations should be explicitly addressed in order to situate the findings and inform future research.

First of all, the study was performed in English, so all the participants had to understand and speak English. Because not all the participants were native speakers, this may have influenced their emotional responses: emotional intensity tends to be lower when stimuli are

presented in a second language (foreign language effect) [56]; processing second-language stimuli requires more cognitive effort, which reduces engagement with emotions [57].

Furthermore, bilinguals tend to report stronger and more nuanced emotional experiences in their native language [58]. No native-versus-non-native speaker comparison was performed, so language differences cannot be ruled out as an explanation for cohort patterns.

Purposive, convenience, and referral recruitment limits generalizability through selection bias [38]. No stimulus pretest was performed; manually coding selected facial expressions does not independently validate the video's overall emotional tone. Cohort assignment was further limited by the questionnaire bands: the 1981–1995 and 1995–2009 options overlapped at 1995, and exact birth years were not recorded, so participants born in 1995 could have selected either band.

A further limitation concerns stimulus comparability. Video 1 was a corporate brand film, whereas Video 2 was an activist-style film about plastic pollution. The videos differed not only in emotional framing but also in source, topic, narrative, duration, visual intensity, and communicative purpose. These differences preclude attributing the observed response patterns specifically to positive versus negative framing. The fixed viewing order and the intervening questionnaire could also have influenced responses to PLASTIK.

No pre-exposure facial expression baseline was available. The reported scores refer to expression categories during exposure and may represent stimulus responses, habitual expressivity, or both. Three windows (N1, N2, and P1) were within the first three seconds of playback when remote recording or face tracking may have started, so the scores could be biassed by that event. The exported data leave those seconds unverified in quality. A good baseline, matched windows, and comparison expression categories would allow future studies to test for emotion-specific increases in the corresponding viewer response.

Future research should compare stimuli matched on source, topic, duration, and narrative structure, and independently pretest emotional tone. Prior work on emotional disclosure and advertising suggests that gender warrants examination [59,60].

Lastly, neuromarketing and emotional-mirroring research in sustainability advertising is still developing. Future interdisciplinary studies should examine non-self-reported response patterns alongside explicit assessments, while using validated measures, transparent algorithmic reporting, and triangulated designs to capture the complexity of responses to advertising content.

8. Conclusions

This study combined stimulus-coded windows, concurrent viewer AFEA category scores, and retrospective questionnaires to describe responses to two sustainability videos.

Among the three recorded cohorts, Gen Z had the highest descriptive average across the ten selected-window scores. The P3 Sadness window contributed most to the *PLASTIK* average. The correspondence between aggregate AFEA and questionnaire patterns varied by expression category. These observations are specific to the two videos, the selected windows, and the observed sample. They identify windows and categories for future studies using comparable stimuli, baseline measurements, and validated facial expression measures.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/world7120207/s1, Table S1: Anonymised participant-level CoolTool scores for the ten analysed time windows (N1–N5 and P1–P5), with the recorded birth-year band of each participant.

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