A picture is worth a thousand words:

A study about the impact of presentation format on memory retention and perception of an environmental issue

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Abstract

"A picture is worth a thousand words", but does it truly lead to a better understanding in terms of plastic pollution? Plastic pollution campaigns often default to powerful imagery, however, little evidence specifies whether the visual or textual presentation format of an advertisement is more effective in communicating environmental issues, specifically plastic pollution. This study aims to explore to which visual imagery, compared with text-only billboard testimonials, enhances recall of advertisements on plastic pollution. Employing a mixed-methods approach, this study combines a qualitative preliminary study and a quantitative online experiment. The qualitative data were collected through 5 lay participants, narrating a Greenpeace campaign picture into a word testimonial that preserved salient visuals and served as the text stimulus. The quantitative data was gathered through an online experiment where participants were randomly assigned to either the text or the image stimuli condition. In sum, 58 participants imagined a five-minute bus-shelter wait before viewing one stimulus and completing pre/post measures of environmental concern, attitude towards the advertisement, and recall. The analyses revealed no significant group differences in environmental concern, attitude towards the advertisement, and recall. Accordingly, there was even a decline in environmental concern in both groups. This study has limitations due to its small sample size as well as the quantitative online design, which limits the generalizability of the findings. Future research should therefore study a broader, field-based sample to further explore visual and textual efficacy in environmental campaigning.

Keywords: Environmental Campaigning; Visual Format; Textual Format; Environmental Concern; Plastic Pollution; Recall

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1. Introduction

Humans have always been visual creators, from ancient cave paintings used for storytelling, to the use of symbols to share knowledge, and the creation of pictures to express beliefs. Studies show that 65% of people are visual learners, and research suggests that we retain up to 80% of what we see (Paul Martin Lester, 2006; Harris Eisenberg, 2014). Decades of cognitive research confirm that pictures consistently outperform words in memory tests, a finding known as the picture-superiority effect (Baadte and Meinhardt-Injac, 2019). This phenomenon is well documented in cognitive psychology. One of the leading theories explaining why images are more memorable than words comes from psychologist Allan Paivio. Paivio's dual-coding theory argues that pictures receive two memory codes, visual and verbal, whereas words receive only one (Paivio, 1991). Recent work also shows that visual stimuli generate more robust memory traces within the first 200 ms of exposure (Ye et al., 2024). In communication research, however, the key metric is not merely recognition but whether audiences can recall a message unaided when it matters. Rossiter and Percy (1987) label this free recall as the "gateway" to changes in attitude or behaviour. Therefore, crafting messages that embed themselves deeply enough to be retrieved unprompted is central to any effort that aims to convert awareness into meaningful action.

Visual dominance has only intensified in the digital era: Instagram users share more than 95 million photos and videos every day, collectively, the world spends over 14 billion hours on social platforms daily (Dumas et al., 2017). Yet, this torrent of online imagery coincides with shrinking attention spans and surface-level processing; eye-tracking studies show that screen-based readers switch focuses every 47 seconds on average (Mark, 2023). Therefore, when overload becomes the norm, clear and memorable visuals matter more than ever.

Given the power of visuals to captivate and inform, it is no surprise that visual media play a critical role in addressing urgent global issues. One of the most pressing challenges today is plastic pollution. Ritchie et al. (2023) stated that over the past twenty years, plastic production has doubled. What started in the early 20th century with the first commercial use of Bakelite steadily developed into a major problem: the excessive plastic consumption. Striking photojournalism, such as sea turtles entangled in six-pack rings, often triggers stronger emotional reactions and policy support than text-only reports (Ma & Hmielowski, 2022). Nevertheless, large surveys reveal a persistent "awareness-action" gap: although plastic waste ranks as the public's top ocean concern, fewer than one in three respondents can spontaneously recall concrete facts or recommended behaviours (Baechler et al., 2023). Therefore, closing this gap requires messages that remain accessible in memory long after initial exposure.

Offline channels, however, remain critical when sustained processing time is required. Out-of-home (OOH) ads like roadside billboards deliver the highest unaided ad-recall scores among all major media, outperforming online, TV, and print by as much as 20 percentage points (Katkar & Vidyapeeth, 2024). Hence, underlining the importance of offline communication in terms of environmental campaigning.

Consequently, this study focuses on the following research question: "To what extent does visual imagery, compared with text-only billboard testimonials, enhance recall of advertisement on plastic pollution?"

2. Theoretical Framework

2.1 Environmental Campaigns

Global environmental issues, like plastic pollution, have reached a crisis point, heightening the need for effective public communication campaigns. According to Rotar (2024) environmental campaigns apply communication approaches, principles, and strategies to the environmental field in order to communicate about the environment, environmental problems, and our relationship to nature. Rossiter and Percy (2017) defined persuasive communication as a purposive attempt to influence what people know, feel, or do. Building on this definition, Moser (2010) describes environmental campaigns as a systematic, multi-channel effort aiming to raise awareness and motivate collective action on ecological issues. Recent research by Ballew et al. (2025) finds that using well-crafted climate change messages may strengthen public support for climate action. Therefore, communication campaigns are a critical tool: they can raise awareness, shape opinion, and mobilize behaviour across diverse societies. In short, as the stakes for the planet rise, so does the strategic importance of persuasive campaigns that make subtract threats tangible.

Today, environmental communicators operate in a highly competitive "attention economy", whereas audiences are bombarded with thousands of messages daily. On average, a person may be exposed to 6,000-10,000 advertisements each day, most of which are filtered out or forgotten within seconds (Kirk, 2022). Hence, non-profit organizations have to use creative strategies to capture public attention.

Online communication, which includes social media ads, in-feed banners, or pop-ups, offers targeting and interactivity but confronts an even harsher attention economy. Large cross-market studies find that approximately 85% of digital advertisements receive less than 2.5 seconds of active attention (Nelson-Field, 2024). Social platforms encourage constant multitasking, through notifications and endless feeds, users may have limited cognitive

resources, impairing deep processing (Koessmeier & Büttner, 2021). Furthermore, neuro-linguistic evidence similarly points to a shift toward fragmented reading patterns, whereby information is consumed in short bursts rather than sustained sequences (Fallon & Pylkkänen, 2024).. These empirical differences align with the Limited-Capacity Model of Motivated Mediated Message Processing, which posits that cognitive resources allocated to encoding, storage, and retrieval are finite and subject to competition (Lang, 2000). In stimulus-rich online feeds, multiple concurrent cues tax available capacity, producing superficial processing. By contrast, a single static billboard, though viewed briefly, occupies the central visual field, without competing pop-ups or parallel content.

Billboard testimonials remain a strategic touchpoint because they provide involuntary, repeated exposure in public spaces. Although drivers and pedestrians devote only a few seconds of visual attention to the standard poster, empirical research reports high unaided recall rates, levels that equal or surpass many digital formats (Altrjman et al., 2022). Therefore, single static billboard testimonials, though viewed briefly, occupy the central visual field, without competing pop-ups or parallel content.

2.2 Effects of Environmental Campaigns

Research in advertising indicates that successful environmental campaigns rely on strong audience awareness, which is measured by recall, positive attitudes toward the advertisement, and environmental concern (Balaskas et al., 2023;Percy & Rossiter, 1991). These outcomes serve as a core foundation for evaluating a campaign's impact. Recall refers to unaided memory for campaign content, whereas recognition captures memory when cues are provided (Keller, 1993). Building on this definition, Percy and Rossiter (1991) show that spontaneous recall is the decisive metric whenever the environmental choice is made outside the exposure point. Further, they show with their framework that recall-dominant situations

demand deeper processing campaigns that optimise for recall, therefore tend to generate stronger downstream behaviour in high-involvement contexts. Later empirical replications continue to treat unaided recall as the “gold standard” indicator of campaign penetration and later impact on people's behaviour (Kahn, 2013). Hence, recall represents a pivotal construct within the context of this study.

Environmental concern and attitude towards the advertisement have a close relationship. On the one hand, attitude towards the advertisement is defined as the viewer’s overall, affect-laden evaluation of a specific advertisement, independent of prior brand beliefs (MacKenzie & Lutz, 1989). A favourable advertisement often spills over to issue evaluation and behavioural intention. On the other hand, environmental concern denotes the degree to which individuals worry about environmental problems and feel motivated to alleviate them (Wesley Schultz, 2001). Well-designed environmental messages have been shown to elevate environmental concern by making global threats personally relevant (Ballew et al., 2025). Positive attitudes toward the advertisement can increase environmental concern (Balaskas et al., 2023).

2.3 Visual and Textual Presentation Format

After examining the key dependent variables, namely recall, environmental concern, and attitude towards the advertisement, attention now turns to the independent variable of interest: the message format. Message format refers to the dominant presentation mode. A visual billboard conveys its claim imagery, which is sometimes supported by a short tag line. text billboards convey the same claim through extended words (Xue & Muralidharan, 2015). Visual messages often trigger affective responses and capture attention more rapidly than their textual counterparts. For example, visual framing in environmental campaigns has been shown to enhance message salience and emotional engagement (Kidd et al., 2019) Eye-

tracking research further supports this advantage: participants spend significantly more time focusing on graphic warnings compared to text-only messages (Boshoff & Toerien, 2017). In emotionally charged contexts such as environmental degradation or public health, images can elicit stronger intuitive reactions, facilitating faster processing and longer retention (Wilson et al., 2021).

Effective campaign design requires an understanding of how message format impacts audience information processing. According to the Elaboration Likelihood Model (ELM), persuasion follows two routes: the central route, which requires both high motivation and sufficient opportunity, and the peripheral route, which o(Petty & Cacioppo, 1986).tion (Petty & Cacioppo, 1986). C(Petty & Cacioppo, 1986).tion (Petty & Cacioppo, 1986). Central-route conditions preferably occur at bus shelters, train platforms, or in slow-moving traffic, where dwell time can exceed ten seconds (Koessmeier & Büttner, 2021). On the other side, when motivation or opportunity is low, viewers rely on peripheral cues such as vivid imagery or source credibility. Hence, clarifying this theoretical foundation highlights why our study must test both visual and text-based executions.

Images engage viewers quickly, triggering attention and emotion before conscious reading begins. The Dual-Coding Theory posits that pictures are encoded in both imagistic and verbal systems, increasing recallability (Paivio, 1991). As an example, concrete threat images, which show a turtle entangled in plastic, trigger faster orienting responses and are recalled more accurately than abstract text (Severtson & Henriques, 2009). Likewise, research on pictorial cigarette warnings corroborates this advantage. Research by Noar et al. (2016), shows that image warnings produce higher recall than text-only warnings. Fear-appeal studies further demonstrate that moderate levels of negative emotion can improve ad recall while minimizing defensive avoidance (Klein et al., 2017). The mobilizing potential of images is also supported by work from Salazar et al. (2022), who conducted a field experiment

comparing positive versus negative visual frames in a marine conservation context. Results indicated that viewers exposed to negatively framed images were significantly more likely to engage with the campaign and take supportive actions than those shown more idealistic visuals. Such emotional intensity appears to be a key factor in visual processing, particularly for low-involvement audiences. These results show that a visual of plastic pollution could give the image condition in the study an inherent advantage.

On the other side, textual content demands cognitive effort but can prevail audiences have both the motive and the time to process. Carefully framed text-based messages can raise climate engagement (Hart and Feldman, 2016). Furthermore, a study conducted by Zhang et al. (2022) showed that under certain conditions, text-based messages have a better performance than image-based messages their text campaigns reduced single-use-plastic consumption more than pictures alone.

In sum, the message format, whether visual or textual, is not a neutral design choice but a theoretically grounded variable that influences attention, memory, emotional response, and behaviour. This distinction provides the rationale for the present study's focus on format as the independent variable.

Accordingly, the following hypothesis persists that:

H1: Image-based campaigns will result in higher recall of content elements (e.g. organizational name, key message) than text-based campaigns.

H2: Image-based campaigns will lead to a more positive attitude toward the advertisement than text-based campaigns.

H3: Image-based campaigns will influence environmental concern more than text-based campaigns.

2.4 Conceptual Model and Hypothesis

The proposed hypotheses have been conceptualized in a hypothesized conceptual model shown in Figure 1 and formulated in Table 1.

Figure 1.

Hypothesized conceptual model of the effect of presentation format on environmental concern, attitude towards the ad, recall and recognition

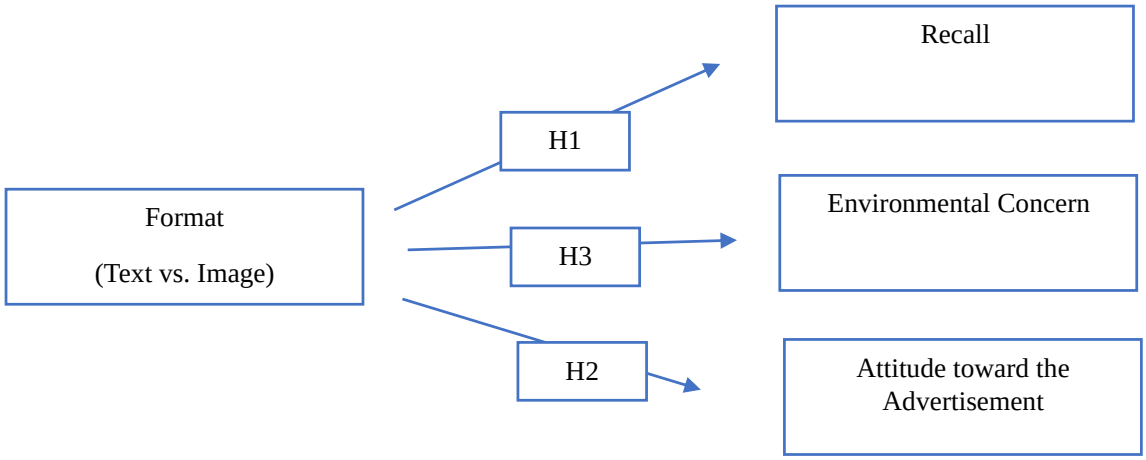


Table 1.

Overview of formulated hypothesis

Hypothesis number	Hypothesis
H1	Image-based campaigns will result in higher recall of content elements (e.g., organizational name, key message) than text-based campaigns.
H2	Image-based campaigns will lead to a more positive attitude toward the advertisement than text-based campaigns.
H3	Image-based campaigns will positively influence environmental concern more than text-based campaigns.

3. Method

3.1 Research Design

This study adopted an exploratory sequential mixed-methods design. In Phase 1 (qualitative), a small group of volunteers interpreted a Greenpeace billboard on plastic pollution and collaboratively transformed it into a short first-person testimonial. In Phase 2 (quantitative), that validated text stimulus was pitted against the original image in a between-subjects experiment. Such a sequence is feasible because the qualitative insights ensure that the two formats convey identical content before statistical testing; it mirrors Silverman's (2011) argument that qualitative work can "let hypotheses emerge from the data" before quantitative verification. In addition, the study was approved by the BMS Ethics Committee on the 22nd of April 2025 (Application number 250797).

Bus-shelter billboards were chosen over social-media ads because commuters typically wait two to five minutes, creating a "captive" processing window unavailable in fast-scrolling feeds. Observational studies report means dwell times of 90–180s for transit-shelter posters (Katkar & Vidyapeeth, 2024). That interval comfortably accommodates a ≤ 40-word testimonial, yet still resembles real-world poster constraints (large font, high contrast). A first-person narrative also mirrors the humanised copy style often used in public-service billboards, while photographs rely on rapid affective capture. This naturalistic setting, therefore, allows a fair test of visual versus text formats under realistic exposure conditions.

3.2 Preliminary Study: Qualitative Story Validation

3.2.1 Design

The preliminary study employed an exploratory design that served two purposes: on the one hand, to uncover how lay observers interpret a Greenpeace campaign picture on plastic pollution, and on the other hand, to transform those interpretations into a text stimulus

that mirrors the image in content. The visual stimulus (see Figure 3) depicts a female skeleton unearthed in a shallow grave, surrounded by discarded consumer plastics like sunglasses, a plastic cup, a bracelet, shoes, and a handbag.

3.2.2 Participants

In summary, five participants were recruited to create a text based on the Greenpeace image. Further, these texts created a validated story. The participants creating the text were primarily recruited from the researcher's network, including family and friends, ensuring a diverse range of perspectives. The study sample consisted of 5 participants, of whom 2 were male (40%) and 3 were female (60%). The ages of the participants ranged from 28-47, with a mean age of 32 years.

3.2.3 Procedures and Protocol

The preliminary procedure was structured into three stages. In the first stage, the participants were shown the Greenpeace image and were asked to write a short story (50-120 words) that narrated the background or context of the picture. In the second stage, these drafts were collected, and recurring themes and motifs were identified (e.g., the idea that plastic outlives humans). Based on these shared elements, a composite story was created. In the third and final stage, the story was further refined with the assistance of ChatGPT-4, which was used to suggest alternative phrasing on impactful writing. Finally, the revised story was reviewed and validated by an expert, more precisely, a faculty member from the Department of Communication.

3.2.4 Analysis and Results of Preliminary Study

The resulting testimonial, which is shown in Figure 2, mirrors key visual elements of the photograph. Appendix C and Appendix D contain the billboard testimonials in an enlarged, high-quality format. The opening line, “When we die, our bones return to dust, but plastic remains”, directly verbalises the grave-site skeleton juxtaposed with intact plastic artefacts in the image. Furthermore, the second sentence enumerates specific objects as “sunglasses, shoes, implants, and packaging”, which visually correspond to the original image. The third sentence introduces Greenpeace as the agent of change, mirroring the logo on the board, while the closing question, “What do you want to leave behind in your grave?”, paraphrases the visual headline and reinforces the viewer’s moral self-assessment. By line-matching each pivotal image element with an explicit verbal counterpart, the testimonial achieves semantic equivalence with the original Greenpeace image while remaining a text-based format, thereby satisfying the study’s requirement.

Figure 2

Final Stimulus design as a testimonial

Figure 3

Image-based stimulus testimonial design

3.3 Quantitative Online Experiment

3.3.1 Measures

This section will go into detail on the measurement methods used in the study (Appendix E). The scales used for measuring environmental concern, as well as attitude towards the advertisement, were adapted from existing and validated sources and are described in greater detail in the following section. Free Recall and aided recall were designed on the conducted billboard stimuli.

The New Ecological Paradigm was used to measure environmental concern both before and after participants were presented with the stimuli (Dunlap et al., 2000). This measurement method was proven to be valid and reliable in previous research. Originally, the model consisted of fifteen statements. However, since not all statements were relevant for this study, the scale was limited to five statements. An item such as “When humans interfere with nature, it often produces disastrous consequences” was included. Participants were asked to indicate the extent of their agreement with the adapted items on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree”. The pre-five-item scale yielded a Cronbach’s alpha of $\alpha = 0.65$, indicating borderline acceptable reliability. For the post-exposure measurement, internal consistency was lower, with a Cronbach's alpha of $\alpha = 0.58$, suggesting limited reliability. These limitations should be taken into account when interpreting changes in environmental concern from before to after measurement.

Attitude towards the advertisement was evaluated using a seven-item bipolar scale adapted from measures used in the studies of Donthu (1998). After viewing the stimulus and completing the post-test environmental concern measurement, participants indicated their impression of the billboard using statements such as “unappealing-appealing” and “unimpressive-impressive”. The reliability of this measure is acceptable, with a Cronbach’s Alpha score of $\alpha = 0.72$.

To assess recall, one open-ended free recall question and four aided-recall questions were constructed based on the billboard advertisement. After stimulus exposure, participants were asked: “Please write down in keywords what you still remember from the billboard.” Responses were later dichotomously coded by the researcher, which will be further elaborated on during the method section. Subsequently, four aided-recall items were administered. First, participants indicated whether they remembered a specific content element (yes/no). If they answered yes, they were prompted to freely recall the element in an open-text field. If they answered no, they were presented with a four-option multiple-choice question to identify the correct answer. The four targeted content elements were (a) the organization behind the advertisement (WWF, Greenpeace, UN Environment, Fridays for Future), (b) the main topic (renewable energy advocacy, ocean and marine-life protection, plastic-waste reduction, air-quality improvement), (c) a comparison about human and plastic, and (e) examples objects (sunglasses and shoes, tries and batterie, food packaging and toothbrushes, key and mobile phone). Aided-recall responses were coded as correct if participants either provided an accurate free recall after a yes answer or selected the correct option after a no answer; all other responses were coded as incorrect. To enable a broader comparison of recall performance across conditions, an index factor was created for the aided recall (range 0-4). Statistical analyses of group differences between text-based and image-based conditions were planned using Pearson's Chi-square test for the individual recall item and an independent sample t-test for the aided-recall index.

3.3.2 Procedure

The survey was created in English in an online environment using the online survey tool Qualtrics. At the outset of the questionnaire, respondents were shown an introductory information outlining the study procedures while withholding the specific research objective. After consenting to anonymously take part in the study, participants were asked to answer questions about their gender, age, and educational level. Then, participants were presented with the New Ecological Paradigm to measure their environmental concern, including five items on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree”. In addition, the experiment recorded the exact time participants spent processing the stimuli, as captured in seconds by Qualtrics. Further, participants were randomly presented either with the image-based or text-based format in the design of a blackboard advertisement. Before exposure to the stimulus, participants were shown an instruction designed to create a realistic context and encourage engagement with the upcoming content. The full instruction text is presented in Figure 4.

After the stimulus exposure, participants were presented with the New Ecological Paradigm again, followed by a 7-point bipolar scale to measure participants' attitude towards the advertisement. Subsequently, participants completed a brief manipulation-check questionnaire to verify that the manipulation worked as intended. On a two-item semantic-differential scale, they indicated the extent to which they perceived the billboard content they just viewed as “text-oriented” or “image-oriented”. Lastly, participants’ memory was tested through one free recall and four aided recall questions.

The quantitative data collection took place from 6th May to 26th May.

Figure 4

Instruction text participants were shown before the stimulus

Imagine you're waiting at a bus stop, and your bus is due to arrive in 5 minutes. While you wait, you notice some information displayed on a nearby billboard. With time to spare, you take a moment to read and process it.

3.3.3 Participants

Data were collected from 102 adults via snowball convenience sampling: a Qualtrics link was distributed through Microsoft Teams and WhatsApp. However, 44 respondents did not complete all mandatory items, listwise deletion reduced the dataset to 58 valid cases. Of these, 31 were randomly allocated to the image condition and 27 to the text condition. The overall age ranged from 18 to 56 years, M = 33.97 (SD = 13.29). Participants in the image group were on average slightly younger, M = 31.65 (SD = 12.77), than those in the text group, M = 36.70 (SD = 13.72). A chi-square test (χ^2 (2, N = 58) = 4.43, p = .035), whereas educational level (χ^2 (2, N = 58) = 2.70, p = .61) yielded non-significant results, indicating an equitable distribution of this variable among the conditions. Detailed demographics are presented in Table 2.

Taken together, the sample provides sufficient variation in age and education, but the significant gender skew necessitates cautious generalisations beyond the present participant pool.

Table 2

Distribution of sample statistic

		Image (N=31)		*Text (N=27)*	
Age [a]		M = 31,65 / SD = 12,77		M = 36,70 / SD = 13,72	
Gender [b]	Male	11 / 35,5%	Male	18 / 66,7%	
	Female	20 / 64,5%	Female	9 / 33,3%	
Educational level [c]	1)	07 / 23,3%	1)	03 / 11,1%	
	2)	05 / 16,7%	2)	03 / 11,1%	
	3)	10 / 33,3%	3)	12 / 44,4%	
	4)	7 / 23,3%	4)	09 / 33,3 %	
	5)	1 / 3,3%	5)	0 / 0%	

a) Mean + SD of self reported age

b) Frequency / percentage: Male / Female

c) Frequency / percentage: 1)=High school level / 2)= Vocational level / 3)=Bachelor level / 4)=Master level / 5)=Doctorate

The following result section of this thesis will open with a preliminary check, consisting of a manipulation check to confirm stimulus format recognition. Further, means and SDs for all dependent variables are listed, where a recall among the two conditions are compared. Lastly, the result chapter will test the format effects on environmental concern and attitude towards the advertisement through an independent t-test, reporting effect sizes at $\alpha = .05$. The discussion will finish with a brief conclusion summarizing contributions, limitations, and implications.

4. Results

4.1 Manipulation Check

A manipulation check was performed to determine if the stimuli fulfilled the intended aim. An independent t-test was conducted to compare ratings between the visual and textual versions. The results indicated that the visual version (M = 6.1, SD = 1.1) was rated significantly higher than the textual version ((M = 2.41, SD = 1.62), $t(58) = 9.98$, $p < .001$). These results confirm that the manipulation was successful, as participants clearly distinguished between the two versions in the intended direction.

4.2 Descriptive Statistics

Table 2 summarises the mean scores and standard deviations for the three focal dependent variables—pre-exposure environmental concern, post-exposure environmental concern, and attitude toward the advertisement—across the two message formats (image-based vs. text-based).

Starting with environmental concern, participants who viewed the image version reported slightly higher concern ($M = 4.32$, $SD = 0.51$) than those who read the text version ($M = 4.04$, $SD = 0.77$), yielding an overall mean of 4.19 (SD = 0.64). After the exposure, the mean concern scores declined in both conditions, converging at 3.97 (SD = 0.71) for the image group, and 3.90 (SD = 0.92) for the text group, resulting in an overall mean score of 3.94 (SD = 0.81).

Analysis of mean scores pertaining to attitude toward the advertisement unveils consistent trends across both format conditions. The image condition averaged 5.03 (SD = 1.01), whereas the text condition averaged 5.11 (SD = 1.18), producing a combined mean of 5.07 (SD = 1.11).

Table 3

Descriptive statistics of the dependent variables

	Image		*Text*		*Totals*	
	Mean	SD	Mean	SD	Mean	SD
Statistical Evidence						
Environmental Concern (Pre) [a)]	4,32	0,51	4,04	0,77	4,19	0,64
Attitude towards the ad [b)]	5,03	1,04	5,11	1,18	5,07	1,11
Environmental Concern (Post) [a)]	3,97	0,71	3,90	0,92	3,94	0,81

a) 7-point likert scale (1=strongly disagree / 7=strongly agree)

b) 7-point bipolar matrix table

To verify that both message formats were processed for comparable lengths of time, Qualtrics automatically recorded the latency between page load and page submission for every participant. On average, participants in the image condition spent 20s, which is less time on the stimulus page (M = 19.44, SD = 158.99), whereas participants in the text condition devoted approximately 30s, which is more time to the material (M = 32.02, SD = 148.38). The longer viewing time for the text stimuli suggests that participants engaged with this content in a considered and appropriate manner.

4.3 Analysis of Recall

The analysis of the variable recall, which was measured through one open-ended free recall and four aided-recall items, revealed high frequencies in both conditions. Table 4 offers a thorough examination of the raw frequencies of the responses for each of the five recall questions, separated by experimental condition.

Table 4

Frequencies of the dependent variable Recall

		Image (N=31)	*Text (N=27)*	*Correct Recall*
Free Recall	no	0 / 0%	1 / 3,7%	/
	yes	31 / 100%	26 / 96,3%	/
Recall Organization	no	11 / 35,5%	2 / 7,4%	6 / 50%
	yes	20 / 64,5%	25 / 92,6 %	
Recall Topic	no	9 / 29,0%	13 / 48,1%	2 / 15,4%
	yes	22 / 71,0%	14 / 51,9%	
Recall Comparison	no	21 / 67,7%	10 / 37,0%	16 / 10%
	yes	10 / 32,3 %	18 / 66,7%	
Recall Objects	no	21 / 67,7%	10 / 37,0%	18 / 70%
	yes	10 / 32,3 %	15 / 55,6%	

Free recall reached ceiling levels in both conditions. All participants in the image group and nearly all on the text group produced at least one correct idea. A Fisher's exact test indicated that this small difference was not statistically significant, $p = .47$. Because free recall exhibited minimal variability, it was treated descriptively and excluded from the composite index.

The proportion of participants who could recall the organization's name of the content was higher in the text condition 92,6% than in the image condition 64,5%. The Chi-square test ($\chi^2(1) = 5.03$, $p = .025$) yielded a significant result. Therefore, textual presentation enhanced recall for the organization's name more than the image-based format.

Recalling the central topic showed no significant group difference. 71% of the image group and 51,9% of the text group mentioned the main topic ($\chi^2(1) = 1.50$, $p = .22$). The absence of a significant effect suggests that mode of presentation did not influence recall of this broad thematic element.

Participants were asked to recall the specific comparison highlighted in the material, namely that plastic outlives humans. A greater proportion of the text group (66,7%) than the image group (32,3%) correctly reproduced this comparison. A Chi-square test ($\chi^2(1) = 5.53$, $p = .019$) indicated significant differences between the two groups. Therefore, in this context, textual presentation better supported recall for the comparison than in the image-based format.

A similar, though non-significant trend emerged for object details. 56% of the text group and 32,3% of the image group recalled the everyday objects that were asked for in the last online experiment question.

A composite recall score was obtained by summing the four dichotomous recall items for each participant, yielding a range of 0 (recalled none) to 4 (recalled everything). Mean performance was higher in the text group ($M = 2.67$, $SD = 1.04$) than in the image group ($M = 2.00$, $SD = 1.18$). An independent sample t-test revealed significant results ($t(56) = 2.29$, $p = .026$). Collectively, these findings echoed the overall pattern captured by the total recall index: the text-based format yielded significantly better recall of the organization's name as well as the comparison people were asked about. Images on the other side showed non-significant numerical advantages on topic recall, and the text-based format displayed a nonsignificant edge on object recall.

Further, participants who required an aided recall were presented with a multiple-choice question. Among these participants, correct recall rates varied across the categories. In the text condition, of those who needed an aided recall, 50% for the organization, 15,4% for the topic, 10% for the comparison, and 70% for the object details correctly identified the target information. In the image condition, correct recall rates were 45,5% for the organization, 0% for the topic, 28,6% for the comparison, and 38,1% for the object details. These findings suggest that even though spontaneous recall was unsuccessful, participants in both conditions were still able to recognize the relevant information at varying levels, with notably higher recognition accuracy for object details in the text group.

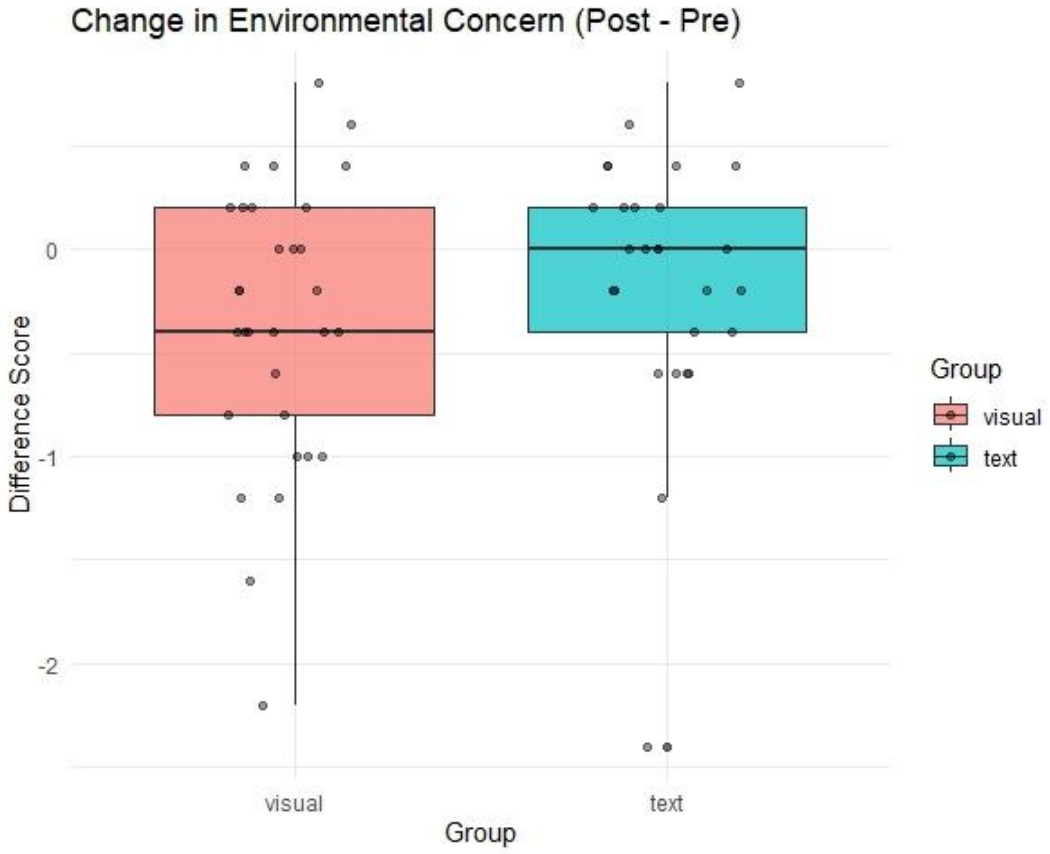
4.4 Analysis of Environmental Concern (Pre and Post)

To evaluate whether the mode of message delivery affected shifts in environmental concern, a difference score (mean post minus mean pre) was calculated. Positive values denote increased concern after exposure to the stimuli, whereas negative values indicate a decline. In the visual condition, participants' environmental concern decreased from M = 4.32 (pre to M = 3.97 (post). A comparable, though smaller, decline was observed in the text condition, where the mean fell from M = 4.04 (pre) to M = 3.90 (post). However, this descriptive difference did not approach statistical significance, and the effect size suggests only a trivial practical impact. Since the scores in the text group were not normally distributed Welch t-test showed that there was no significant difference $t(55.74) = -1.25$, $p = p = .218$, $d = -0.33$. The following Figure 5 illustrates considerable overlap in the distribution of change scores, reinforcing the absence of a meaningful group difference.

In summary, the data provided no evidence that presenting the material visually versus textually leads to differential changes in environmental concern. Any observed variations are small and cannot be attributed to experimental manipulation.

Figure 5

Comparison of Environmental Concern Difference Scores (Post-Pre) across visual and text conditions



4.5 Analysis of Attitude towards the Advertisement

For the variable attitude towards the ad, assumption checks were made through the Shapiro-Wilk test, which confirmed that composite scores were approximately normally distributed in both groups (visual: W = 0.97, p = .515; text: W = 0.95, p = .172). Hence, parametric procedures were retained for the main comparison. The text-based billboard (M = 5.03, SD = 1.04) produced a slightly higher attitude score than the image-based billboard (M = 5.03, SD = 1.04). However, an independent t-test showed that the difference between these formats was not statistically significant, t(52.45) = -0.27, p = .790. The results show that both

formats evoked equally positive attitudes, and the presentation format did not meaningfully influence participants' affective response to the advertisement.

4.6 Results Recap

Table 5 shows the result recap or more specifically the supported and non-supported hypotheses.

Table 5

Overview of the results of the hypotheses

Hypothesis number	Hypothesis	Result
H1	Image-based campaigns will result in higher recall of content elements (e.g., organizational name, key message) than text-based campaigns.	Rejected, no significant evidence
H2	Image-based campaigns will lead to a more positive attitude toward the advertisement than text-based campaigns.	Rejected, no significant evidence
H3	Image-based campaigns will influence environmental concern more than text-based campaigns.	Rejected, no significant evidence

5. Discussion

5.1 Discussion of the Findings

The present study set out to determine whether an image-based billboard or a crafted text-based billboard would produce higher recall for a message about plastic pollution. Using an exploratory sequential mixed-methods design, the qualitative phase generated a narrative that conveyed the same substantive content as the original Greenpeace photograph; the quantitative phase then pitted the two versions against one another. Thus, the study helps to create further knowledge about effective campaign communication in an age where most people tend to consume information quickly and digitally. The analysis in this study highlighted that the presentation format (image or text-based) neither influenced environmental concern and attitude towards the advertisement nor recall and recognition.

Contrary to expectations and in contrast to the findings of Kahn (2013) and Percy and Rossiter (1991), the results of the concurrent study revealed no statistically significant differences between image-based and text-based formats. Both researchers emphasize recall in a real-world scenario, a factor absent in the current study. The fictional online experiment failed to establish this connection, potentially explaining the lack of distinction between online and field study scenarios. Future quantitative research in an authentic setting may be more conducive to assessing recall in participants.

Further, two recall items, more precisely the name of the organisation and the comparative claim question, showed medium-sized but statistically fragile advantages for the text condition. As mentioned in Paivio's Dual Coding Theory (1991), a plausible explanation may involve the text-based testimonial supplying the sort of semantic elaboration that the Dual Coding Theory deems necessary for durable verbal memory. Hence, an affect-laden and easy-to-picture text can offset the usual mnemonic edge of images.

The results revealed that there was no significant difference between the groups concerning environmental concern, since it was hypothesized that image-based campaigns would influence environmental concern more than text-based campaigns. This deviates from the results of O'Neill et al. (2013).

Several factors might contribute to the lack of significance between these two groups. Originally, the New Ecological Paradigm implements 15 questions; however, in the final research experiment, only five were used. This may indicate a potential item-stimulus mismatch, where the chosen items may not map directly onto plastic pollution, introducing measurement error and further weakening sensitivity to change.

Another reason may be that the image-based billboard has shown numerous small and peripheral details. As an example, the picture contained details that were not mentioned in the text. In contrast, the text-based content deliberately pared those details down to a few salient nouns, for example: "sunglasses", etc. This reason can be explained by the Elaboration-Likelihood Model, which centres on the route of information processing. According to this model (Petty & Cacioppo, 1986), people encode persuasive messages either via the peripheral route, relying on surface cues, or via the central route, engaging in effortful, message-relevant thought. Therefore, the image may include many different peripheral cues, like colours and gradients, that readily draw peripheral attention but do not necessarily prompt deeper semantic elaboration. The text-based content only offered a handful of words and minimal decorative clutter, nudging viewers toward the central route. Because the central route typically creates stronger, more retrievable memory traces than peripheral scanning, the text condition could match the image condition despite lacking pictorial vividness. Shortly, the image may have invited low elaboration and peripheral processing, whereas the text channelled cognitive resources into sustained thought about the core issue, thereby narrowing the expected picture superiority gap.

5.2 Limitations and Future Research

As a result of and following the research, some limitations can be identified. These limitations give valuable insights for future research.

First, the generalizability of the study is limited. A potential item-stimulus mismatch could be emphasized here since the chosen items may not map directly onto plastic pollution, introducing measurement error and further weakening sensitivity to change. Future research should employ the full 15-item scale or even a validated measurement form that purely concentrates on plastic pollution. Another reason that limits the generalizability of the study is the sample size. Future research should recruit a larger sample to obtain a stable parameter.

Secondly, participants were encouraged in the online experiment to imagine themselves in a waiting situation. This fictional background poses a challenge in establishing an authentic scenario, therefore contributing to outcomes deviated from the anticipated results. Further, participants saw the stimuli mostly on a mobile or a computer screen, which further inhibits the authenticity of the experiment. To counteract this limitation, immersive virtual reality could create more realistic situations and therefore could provide a deeper understanding of the message format, environmental concern, attitude towards the advertisement and recall.

Lastly, stimulus design limitations could be identified. The image-based billboard has shown numerous small details that could not be mentioned later in the text. To counteract this, future research could create stimulus sets with balanced visual and verbal elements to match for informational richness, based on Paivio's Dual-Coding Theory (Paivio, 1991).

5.3 Implications for Practice

A critical practical implication emerging from this study is the need for further research within the domain of environmental advertisement in offline communication. The absence of statistically significant differences in the current research emphasizes the need for more nuanced investigations to precisely delineate the distinctions between text-based and image-based advertising formats. Given, that environmental campaigns strive to achieve goals with broad socio-economic relevance, marketers should exercise caution before committing to any single message format.

5.4 Conclusion

Plastic pollution and the associated environmental problems underscore its pivotal role in our society and put pressure on effective environmental communication. Large charities and municipal bodies now invest sizeable portions of their outreach budgets in campaign media, yet clear guidance on whether imagery or concise textual appeals drive stronger cognitive and attitudinal outcomes has been lacking. The present study addressed this gap through a sequential mixed-methods design that first created a participant-generated billboard testimonial from a Greenpeace image and then experimentally compared the image-based format and text-based format versions on memory, attitude towards the advertisement, and environmental concern.

Contrary to widespread assumptions of picture superiority, the findings revealed functional equivalence across format: neither recall and recognition nor attitudinal and concern measures differed robustly between groups. In practical terms, this suggests that when dwell time is sufficient and message content is tightly matched, a carefully crafted testimonial can match the mnemonic and persuasive power.

At the same time, the study highlights critical contingencies, issue involvement, emotional valence and dual coding synergy, that can tip the balance toward visuals under other conditions. Future research should therefore expand the stimulus set,

Through such cumulative evidence, environmental communicators can fine-tune their message strategies, maximise efficiency, and ultimately, deepen public engagement with the urgent problem of plastic pollution. Shortly, while the metaphor “a picture is worth a thousand words” remains a useful rule of thumb, results caution that the right chosen words, if thoughtfully distilled, can be worth a picture as well.

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Appendices

Appendix A: AI Statement

During the preparation of this work, I used “ChatGPT” to help me with the formulation of sentences. After using this tool, I carefully reviewed and edited the content as needed, taking full responsibility for the final outcome of this paper.

Appendix B: Literature Log

The Data Search Log shows the systematic search of the key topics/variables.

Database	Search string	Total hits	Remarks
Science Direct	("Environmental Concern" AND "Campaigning")	89,694	~7 relevant articles
Sage Journals	("Environmental Campaigns" AND "Recall")	166	~ 2 relevant articles
Sage Open	("Attitude towards the ad" AND "Environmental Campaigns")	62	0 relevant articles
Google Scholar	(Presentation Format" AND "Environmental Campaigns")	189,000	~10 relevant articles
Google Scholar	("Environmental Campaigns" AND "Attitude towards the Ad")	224,000	~ 3 relevant articles
Google Scholar	("Billboard Advertising" AND "Environment")	78,100	~ 4 relevant articles
Google Scholar	("Recall" AND Billboard Advertisement")	38,300	~ 15 relevant articles

Appendix C: Stimuli Image-Based Billboard Testimonial

Appendix D: Stimuli Text-Based Billboard Testimonial

Appendix E: Overview Measures Statement

Construct	Statements	Source
New Ecological Paradigm	When humans interfere with nature it often produces disastrous consequences.	Anderson (2012)
	Humans are severely abusing the environment.	
	The balance of nature is strong enough to cope with the impacts of modern industrial nations	
	The so-called “ecological crisis” facing humankind has been greatly exaggerated.	
	Humans were meant to rule over the rest of nature.	
Attitude towards the Advertisemt	unappealing - appealing	Donthu (1998)
	unimpressive - impressive	
	uninformative - informative	
	unconvincing - convincing	
	overall disliking - overall liking	
	non eye-catching - eye-catching	
Recall	Please write down in keywords what you still remember from the billboard.	Created on the basis of the stimuli
	Do you recall the organization from the billboard? What organization created the environmental message?	
	Do you recall the topic of the billboard? What topic was the focus of the billboard?	
	Do you recall what comparison was made about humans remains and plastic in the message? What comparison was made about human remains and plastic in the message?	
	Do you recall what everyday objects were mentioned as examples of long-lasting plastic waste? What everyday objects were mentioned or shown as examples of long-lasting plastic waste?	

Appendix F: Introduction Text and Active Consent

Thank you for participating in this survey!

This study is about environmental concerns with regards to plastic pollution.

My name is Paulina Roters, and I am conducting this study as part of my Bachelor's Thesis at the University of Twente.

Please be assured that your responses will be anonymous and the data will be treated confidential. No personal identifying information will be collected, and all data will be used strictly for research purposes.

Your participation is entirely voluntary. You can withdraw from the survey at any time without any consequences. Your feedback is greatly appreciated, but it is up to you whether you wish to continue or not.

By continuing with this survey, you are giving your informed consent to participate. If you have any questions or concerns, please feel free to reach out to me at p.roters@student.utwente.nl

After reading the information above, do you understand and agree to participate in this study?

- ○ Yes, I understand and want to participate
- ○ No, I do not wish to participate