

The Psychology and Neuroeconomics of Pro-Environmental Behavior

Risa Bernier¹ & Roshni Lulla²

¹American School in Japan, Tokyo, Nomizu

²Brain and Creativity Institute, Department of Psychology, University of Southern California

Abstract

For several years, society has faced climate change catastrophes ranging from wildfires to rising sea levels. To combat these effects, researchers have focused on creating technological and societal shifts. However, understanding and influencing an individual's behavior is often overlooked but can provide a benefit. Pro-environmental behavior, or PEB, is an individual's tendency to consciously reduce negative environmental impacts while improving environmental conditions. Research has shown the advantages of using behavioral findings and neuroeconomics to deepen our understanding of PEB to promote and nudge, or influence consumers subconsciously, to act with PEB. Though this interdisciplinary approach to climate change is relatively new and unexplored, research reveals that it is a growing field.

This literature review provides an overview of PEB in the fields of psychology, neuroscience, and marketing. We first examine the psychological factors, such as personality and motivation, that influence PEB and pro-environmental attitudes (PEA). We then move to neuroscience findings based on an individual's brain size and brain activation when engaging in sustainable behavior. Lastly, the neuroscience findings are applied to construct efficient marketing techniques for firms to apply to consumers and promote sustainable behavior.

1. Introduction

The black, polluted air covers the world as you step outside. The wind blows; plastic bags and air pollutants fly into your eyes. You try to avoid the disaster, but it surrounds you. The sun radiates, deteriorating your skin but also the planet. Wildfires, droughts, storms—, the list goes on as the world loses biodiversity, creating a dystopian world in which no one wants to live. We are not far from this. Global temperatures are projected to rise by 1.5 degrees Celsius by 2050, which will trigger a cascade of tipping points such as Greenland's ice sheet collapsing. [1] However, we are already seeing the real effects of climate change. New York City topped the list of unhealthy air pollution as a result of the wildfires in Canada. [2] 750 billion tons of ice have been melting annually, adding 24,000 tons of melted water to the ocean every second. [3]

To combat these effects, researchers have been focused on creating technological and societal shifts. Despite the rapid advancement and change, scientists delivered a final warning message in March 2023, stating that not enough has been done. [4] Corporations can ameliorate climate change by increasing demand for and engagement with green products. To promote change, corporations should understand and influence the behavior of individuals. Here, we analyze and summarize the factors influencing pro-environmental behavior (PEB), examine the neuroscience findings on PEB, and explore different marketing techniques that can encourage and limit PEB.

PEB is often defined as an individual's behavior that consciously reduces negative impacts on the environment while improving environmental conditions. [5] Unlike environmentally conscious behavior, PEB focuses on behavior that directly helps the environment, whereas environmentally conscious

behavior is indirect and focuses on environmental awareness. Although environmentally conscious behavior may lead to PEB, it emphasizes the mindset of environmental consideration.

Increasing an individual's engagement with PEB is crucial to meet sustainability goals and mitigate climate change. According to the United Nations, acting sustainably means meeting the needs of the present without compromising the needs of future generations. [6] Therefore, sustainable behavior can be displayed when an individual has the values, responsibility, and willingness to provide for the well-being of all living beings in present and future generations. Some sustainable behaviors include utilizing renewable energy, reducing food waste, and avoiding plastic usage. In contrast, unsustainable behavior is something we can't continue at its current rate, such as depending on fossil fuels and continuing to overpopulate cities. Currently, society is trying to switch from unsustainable to sustainable behavior by increasing PEB.

1.2. Measuring PEB

There are numerous ways to measure PEB, and the most common methods are self-reporting, field observation, and lab observation. [7] Self-report assessment is an informal and easy method to measure PEB by asking questions through a survey or interview. The respondent is responsible for marking their daily behaviors, which may result in inaccurate information. This self-reporting system is subjective. One respondent might self-report their recycling behavior as an eight on a scale of 10, believing they recycle a lot. However, another individual may self-report their recycling behavior as a six because they believe they don't recycle as much when they recycle more than the other respondents. Another limitation is that the self-reported survey consists of reporting of "how often do you do ...". Although this type of questionnaire may be accurate for some, most respondents' behavioral consistency fluctuates due to situational factors. Lastly, individuals are more likely to be inattentive to their behavior, causing them to provide an estimated answer. Despite the limitations of self-reports, it is possible for self-reports to be accurate and demonstrate an individual's propensity to engage in PEB.

The second method to measure PEB is through field observations based on informants, trained observers, or measurement devices. The type of observation is chosen based on convenience and available population size. Informant reports from well-acquainted individuals account for a retrospective observation of an individual's behavior or deliberately observe an individual for a given period before reporting their behavior. The informant reports have a questionnaire similar to the self-reported questionnaire. Therefore, similar limitations arise. In contrast, trained observers lack a personal relationship with the target, increasing accuracy. Lastly, measurement devices often measure the product of PEB, such as the distance traveled by car, instead of PEB directly. However, some devices can measure PEB. For example, GPS data can identify an individual's travel mode in a car.

The third method to measure PEB is laboratory observations, which offer greater accuracy. In the laboratory, individuals are placed in a contrived situation and condition to observe PEB directly. Some laboratory experiments observed the participants' recycling behavior and recorded whether they put it in the correct bin. Other laboratory experiments may be more explicit by providing a task in which they can behave with PEB or not. Usually, these tasks include allocating money for sustainable causes, such as spending extra money on green products or donating money to environmental organizations. Despite the accuracy of these tasks, laboratory studies lack ecological validity as they fail to take external factors into account. Although each method contains different drawbacks, experimenters have been able to limit errors by increasing sample size and using multiple methods. However, as mentioned before, understanding an individual's behavior is often discounted, resulting in a lack of fundamental information.

2. Factors Influencing PEB

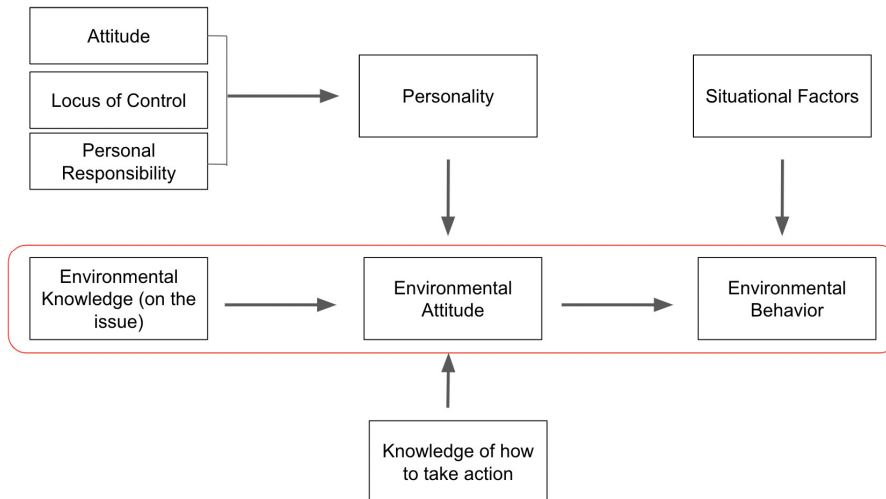


Figure 1: This illustrates the factors that influence PEB. The red section highlights the linear process of promoting PEB that was believed to be accurate until the 1980s.

For many years, researchers have believed that PEB was based on a linear process (see Figure 1) of environmental knowledge leading to environmental attitude, then environmental behavior. [8] Environmental knowledge is the knowledge of environmental problems and consequences and how to take action. However, researchers soon changed this model to a web-like process, as it failed to account for other influential factors of PEB. Despite the model's inaccuracy, a meta-analysis of 17 studies, based on actual observation or self-reports, has revealed that environmental knowledge has a weak but positive correlation to PEB ($r = .299$). [9] The meta-analysis also revealed that actual observations had a greater correlation ($r = 0.37$) with the knowledge-behavior relationship than those who self-reported their behavior ($r = 0.291$). In addition, a meta-analysis of 11 studies found that highly educated individuals were more likely to engage with PEB ($r = .185$). Both meta-analyses demonstrated a weak, positive correlation, making the effects of environmental knowledge on PEB inconclusive. Environmental knowledge can influence PEB but cannot accurately determine if an individual will behave with PEB.

2.1. Influence of Values on PEB

Taking action for the environment includes sacrificing the price or the quality of a good. However, individuals with certain characteristics may be more prone to act with PEB. The first reason why an individual might employ PEB is for their self-interest. [10] Often, the government implements incentives that can benefit an individual if they engage in a pro-environmental task. Individuals may also get benefits from non-materialistic things, such as status, respect, and being perceived as generous. Individuals also seek hedonic benefits that make them feel more impactful. Therefore, people will donate less for operational costs of materials and labor, as there is a smaller connection between the donor and less sympathy for the cause.

Another motivating factor to behave pro-environmentally may be self-perception. To make individuals feel better about themselves, they may donate more to feel self-sacrifice and “more meaning.” Individuals may also donate more when others donate more to match social norms. However, this also applies to donating less. In addition, individuals may not participate in public projects as it may take away the reputational benefits of not being truly generous.

2.2. Influence of Personality on PEB & PEA

The HEXACO was used to measure an individual's six-dimensional personality traits: honesty-humility, extraversion, neuroticism (inverse of emotionality), agreeableness, conscientiousness, and openness. Kieboom Lee and Michael Ashton created the HEXACO to add honesty-humility to the Big Five personality traits. [11] The six personality traits contain ten questions covering a wide range of content, with at least two items representing each of the four narrow facets of personality. Then, they measure an individual's level of each factor. The facets of the personality are listed below.

H: Sincerity, fairness, greed avoidance, and modesty.

E (N): Depression, emotional reactivity, anxiety, and mood instability.

X: Social self-esteem, social boldness, sociability, and liveliness.

A: Forgiveness, gentleness, flexibility, and patience.

C: Organization, diligence, perfectionism, and prudence.

O: Aesthetic appreciation, curiosity, creativity, and unconventionality.

According to a meta-analysis of 38 sources with a sample size of 45,000 individuals, openness and honesty-humility had the greatest correlation to pro-environmental attitudes (PEA) and pro-environmental behavior (PEB) ($r = .22$ and $r = .21$, $r = .20$ and $r = .25$, respectively). [12] Openness had the greatest correlation to PEA and PEB because it represents crystallized intelligence, an individual's accumulated knowledge over the years. Conscientiousness, agreeableness, and, to a lesser extent, extraversion were correlated with PEA ($r = .15$, $r = .12$, and $r = .09$) and PEB ($r = .10$, $r = .11$, and $r = .10$). In contrast, neuroticism had no significant correlation with PEA and PEB even though individuals with lower belonging are less likely to consume sustainable products. [13] Similarly, a national study in New Zealand with 19,100 participants revealed that greater environmental value was associated with high agreeableness, conscientiousness, and openness. [12] However, this study found that honesty-humility didn't directly correlate to PEB but influenced PEA, which then affected PEB, displaying an indirect correlation between honesty-humility and PEB. Greater neuroticism and extraversion were associated with less environmental value. However, the correlation between neuroticism and ecological engagement is inconsistent.

Additionally, researchers have found that neurotic people are more likely to have negative environmental concerns because they tend to worry more about adverse outcomes. Neurotic individuals and agreeable and conscientious individuals are more likely to act with stability. Extroverted and open individuals are more likely to act with plasticity by incorporating new information. [14] Apart from understanding an individual's type of PEB, stability (staying the same) and plasticity (adapting) can underline an individual's PEA. PEA can be categorized into preservation (save) and utilization (use). Those with preservation PEA are likely to use stable PEB to preserve nature at its original state. Contrary to this, individuals with utilization PEA are more inclined to engage in plasticity PEB of exploiting the environment.

Despite these correlations between PEB and personality traits, the type of PEB can also influence the correlation. For example, greater electricity conservation is associated with high agreeableness, conscientiousness, and neuroticism. [15] In contrast, agreeableness and openness positively correlated with environmentalism, and agreeableness negatively correlated with consumerism.

An individual may not be able to control their personality, but they can control their PEA. PEA can influence the self-concept and openness of an individual, which ultimately affects an individual's ability to engage with PEB. For example, individuals who verbally commit to a task are more likely to behave with PEB because the commitment gives them a goal to seek and accomplish. It also hints that the individual

can achieve this goal by providing a positive outlook on PEB. A meta-analysis of 15 studies found that individuals with an internal locus of control, or the belief that their action will make a difference, were more likely to act with PEB. [9]

2.3. The connection with the environment (i.e., meditation, nature, & jobs)

Individuals who meditate tend to reduce reactivity and increase flexibility, tolerance to uncertainty, and interaction with their environments. Understandably, a survey of 300 individuals found that meditators were more likely to act with PEB and increased their motivation to act with PEB. [17] Meditation can promote greater PEB by increasing awareness, connection with nature, prosocial tendencies, stronger intrinsic values and ethical decision-making, and openness to new experiences. In addition, meditation nurtures greater compassion and connectedness with nature, promoting higher motivation to perform PEB due to feelings of guilt, sympathy, value, and responsibility.

Apart from meditational practices, individuals with connections to environmental organizations had a substantially higher correlation coefficient ($r = .691$) than individuals from a general population ($r = .192$). [9] Similarly, two studies with 760 individuals revealed that environmentalists and humanitarians were more likely to act upon PEB due to their connection with nature. [17] Exposure to nature can spark self-transcendent emotions of compassion, gratitude, and awe, creating greater PEB. Therefore, a large survey has found that self-transcendent emotions positively correlate with PEB. [18] Since open people are more likely to value the self-transcendence of protecting the environment, being in unity with nature, and enjoying the world's beauty, these findings help explain the strong correlation between openness and PEB. [14]

2.4. Situational Factors Affecting PEB (i.e., income, gender)

Most situational factors don't play a major role in determining whether an individual acts with PEB. Studies from the University of Bordeaux and the University of Surrey found that gender had no relationship with PEB. [9, 19] Ten studies have found that age and PEB correlate insignificantly, and income weakly correlates to PEB. This is because individuals who are more financially stable can invest in green products and focus less on basic needs. Lastly, an individual's cultural background may play a role in feeling personal responsibility toward environmental problems. A meta-analysis of 6 studies found that individuals with greater personal responsibility towards the environment were more likely to engage with PEB. [9]

3. Neuroscience findings

Apart from personality and situational factors, an individual's brain activity can relate to their tendency to promote sustainability. The use of neuroscience can help researchers and companies gain a deeper understanding of the role of brain structure, specific behaviors, and marketing techniques in activating sustainable behavior. To measure the region of activation of the brain, a Functional Magnetic Resonance (fMRI) scan is used to assess the blood flow levels. When activated, neurons require more oxygen from red blood cells, resulting in a rush of oxygenated blood to the active brain region. [20] This indirect measurement of electrical activity and blood flow is used to detect changes in the fMRI. Scientifically, this is referred to as the blood-oxygen-level-dependent (BOLD) response.

3.1. The Effect of Cortical Thickness on Sustainable Behavior

Using fMRI, researchers can find similarities and differences when comparing brain scans of individuals who act sustainably and unsustainably. Researchers from the University of Bern, Switzerland, found that individuals with a bigger brain size, are more inclined to act sustainably. [21] Researchers used the Intergenerational Sustainability Dilemma, a situation where an individual will make sacrifices for future

generations and sustainability. The study revealed that individuals with greater cortical thickness in the dorsomedial (dlPFC) and dorsolateral prefrontal cortex (dmPFC) correlated to sustainable behavior. The dlPFC has been shown to promote individuals to take perspectives and have self-control by being strategic and goal-directed. These findings could potentially explain why individuals with greater thickness in the dlPFC take the perspective of the future generation and resist impulsive behavior that would maximize self-benefit but detriment future generations. In contrast, the dmPFC is shown to be involved with socially distant and objective perspectives taking, thus, increasing sustainable behavior.

The bilateral temporoparietal junction (TPJ) is involved in perspective-taking and cognitive empathy. Research has linked activity in the TPJ to Theory of Mind, which describes the process in which individuals understand another person's beliefs, feelings, and intentions and use this information in predicting their actions. [22] However, an individual's TPJ thickness had no difference between sustainable and unsustainable individuals. Despite these findings, directly stimulating the TPJ can increase sustainability. This may be because the TPJ indirectly activates the dmPFC through changes in functional connectivity, resulting in behavior change. [21]

3.2. Brain Activation in Sustainable vs. Unsustainable Behavior

Acting sustainably can have various meanings. For example, an individual may increase sustainable behavior ("do more"), while another may decrease unsustainable behavior ("do less"). Although both of these approaches increase the PEB of an individual, the brain is activated differently. When an individual engages in "do more," the ventromedial prefrontal cortex (vmPFC) is activated. [23] The vmPFC triggers an individual to match their values and behavior to make a decision. With "do less," the dorsolateral prefrontal cortex (dlPFC) is stimulated to perform executive functions of self-regulation and cognitive effort to override habitual behavior. The dlPFC suppresses an individual's initial response to evaluate the long-term consequences, alternatives, and in this specific case, sustainability.

3.3. Nudging Consumers through Advertising

An individual's values can shape how they perceive green marketing. Specifically, green consumers had higher activation in the prefrontal cortex than non-green consumers when processing advertisements. [25] However, there is no activation difference when the price is evaluated, meaning that individuals don't consider sustainability when purchasing a product. In addition, priming a green advertisement can increase sustainable behavior and stimulate an individual's relational reasoning in the lingual gyrus and superior parietal lobule, where visual imagery is processed. Green logos can also activate the ACC, associated with increased attention and emotional awareness. When a consumer sees an ecologically friendly label or watches an advertisement video with priming of the environment, consumers increase their PEB and willingness to pay for the green product. [26] While green priming can promote sustainable behavior, consumers don't want a firm to be "too" green as green products are often lower in quality and higher in price. Additionally, standard advertising stimulates the ventromedial prefrontal cortex (vmPFC) and the ventral striatum, which is associated with personal value and reward. [27]

4. Marketing techniques

Although the demand for eco-friendly products has increased, the most effective tactic to attract consumers is yet to be discovered. Marketers are attempting to create marketing techniques that tackle the three main barriers that limit PEB. According to a study conducted by Environmental Leader, 82% of consumers identified green claims, but only 43% of consumers trusted the claims. [28] An individual's lack of trust in sustainable items can stem from their past experiences, cynicism, and lack of trust in the organization. [29] Another barrier is that individuals typically value quality and price over sustainability. Lastly, the lack of knowledge and awareness of sustainable products can restrict PEB. [30]

4.1. Types of Messaging

The types of messages can play a major role in influencing an individual to act with PEB or not. Provincial normative messages highlight the advantage of a consumer's choice to a specific local setting, making a personal connection. As a result, provincial messages are typically more effective than standard messages in promoting PEB. [31] In addition, individuals are more likely to respond to human-caused damages than natural damages. [32] Because participants feel more guilt and conscience with human-caused damage, marketers try to create connections between the message and the consumer. Since guilt and connections play a role in influencing PEB, marketers may use the victim effect. Individuals prefer to give more with their hearts; therefore, individuals with no PEA tend to increase PEA after encountering guilt. [33] The victim effect is very effective. However, using statistics and the victim effect can inhibit emotional response and decrease PEB. [10] Hence, marketers should utilize the victim effect properly and responsibly.

4.2. Types of Appeals (E.g., Scarcity, Intrinsic, Extrinsic, etc.)

The type of appeals marketers implement also plays a prominent role in persuading PEB. According to a study by Jilin University, marketers should avoid scarcity appeals (E.g., "limited time offer: green products for \$14"). Scarcity appeals foster a greater negative attitude towards sustainable products because consumers' competitive orientation refers to the effects of the scarcity appeal. [34] Sustainable products are mostly promoted with intrinsic appeals (E.g., "buy this product & do something good for the environment") as purchase intention increases. Adding extrinsic appeals (E.g., "buy this product & show others how sustainable you are") to intrinsic appeals creates joint appeals, which can reduce consumers' interest in sustainable products. [35] However, joint appeals (E.g., "do something good for the environment but also yourself") are effective for individuals who are less involved in sustainability or when individuals perceive a brand as sustainable. [36] When individuals perceive a brand as a follower by joining the "trend," joint appeals can decrease purchase intentions. The difference between the positive and the negative effects of joint appeals is due to the mechanisms of emotional value and consumer skepticism, respectively.

Green appeals and green demarketing appeals (E.g., "don't buy this reusable straw") can strengthen or weaken sustainable behavior. Companies like Patagonia have been testing green demarketing appeals, which change traditional "buy less" messages to "don't buy." Consumers favored green appeals as companies were seen as more concerned for the environment. [37] However, when companies shifted from a product appeal to institutional appeal consumers had no preferences for green or green marketing appeals. Institutional appeal emphasizes the company's sustainability rather than just the sold product. When demarketing appeals are applied to overconsumption and institutional appeals, it can increase the attractiveness of the advertisement compared to traditional appeals.

The type of appeal can also have varying effects on PEB depending on the type of benefit, such as individual and collective benefits. For example, abstract appeals can promote greater sustainable purchases when the benefit is associated with others. [38] Whereas concrete and abstract appeals are less effectively associated with individual benefit. Additionally, public self-awareness can moderate the effects of the appeal type. Individuals with high public self-awareness tend to purchase more green products through abstract appeals of vague explanation than concrete appeals. However, this effect diminishes when it is utilized for self-benefit.

Similarly, a consumer's attitude towards a mainstream and luxury brand can change depending on the type of benefit. When marketers communicate for self-benefits, mainstream brands can increase consumer

purchases compared to luxury brands. [39] By contrast, when marketers communicate for other benefits, consumer purchase for luxury brands increases while it decreases for mainstream brands.

4.3. Types of Visuals

Marketers also use visuals to nudge consumers to purchase green products. Generally, marketers use strong, vivid visuals with fewer words, as these are known to promote greater PEB for sustainable and non-sustainable consumers. [40] To enhance the effectiveness of strong visuals, companies should try to teach about sustainability but limit jargon. Educational posters are often seen as a key component of promoting sustainability. However, when educational posters are misused, the effects can be counterproductive. Consumers may perceive educational posters as counter-informative if the information highlights something weaker than their beliefs. Consumers may lean towards unsustainable behavior when the educational poster promotes behavior different from descriptive norms.

To encourage undesirable behavior, companies provide free product trials, promote exclusivity, and turn to social media. Consumers tend to trust social media influencers because they shape consumers' attitudes and behaviors, and consumers trust other consumers' opinions more than advertisements. Lastly, companies limit the usage of educational posters because conveying that a product is green and recyclable encourages greater purchase than conservation. Apart from using strong visuals and fewer words with posters such as graphics, marketers use nature-based imagery to stimulate greater PEB. Nature-based imagery, especially water, significantly increases the PEB of an individual. [41]

Imbuing inanimate objects with humanlike characteristics with anthropomorphism can also enhance PEB. In a laboratory study, anthropomorphism with sad faces increases more sustainable behavior than with no-face and happy faces. [42] The visual images make an individual feel sympathetic and guilty, but guilt isn't a significant mediator. This is because sympathy represents a shift from their own perspective to a harmed person's perspective, while guilt is only an internal process. When payment was required for consumers, the anthropomorphic message lost the perception of victimization and instead is perceived as an agent for the marketer, which undoes the savior effect.

4.4. Incentives

Similar to the type of visual appeal, the type of customer involvement can influence PEB. A meta-analysis of 87 reports with 253 experimental treatments, or methods to promote PEB, found that the primary treatment types are making it easy & prompts; justification & instructions; feedback & reward; social modeling, cognitive dissonance, commitment, & goal-setting, respectively. [43] Out of the 253 treatments, goal setting, cognitive dissonance, and social modeling promoted the greatest PEB. To a smaller extent, easy rewards, justification, and commitment promoted PEB. Feedback and instructions were not effective.

However, no one treatment is effective across all PEBs, such as water conservation, energy consumption, and recycling. When marketers promote energy conservation, social modeling, and commitment are the most effective treatments. In contrast, for curbside recycling, making it easy and rewards are the most effective. Engagement can determine the treatment if the company doesn't target a specific behavior but wants to promote PEB. The treatment's high to low engagement level is goal setting, commitment, feedback, cognitive dissonance, social modeling, reward, instructions, justification, prompts, and making it easy. Goal setting is not only the most engaging treatment but can also facilitate PEB through cognitive psychology. Individuals with high environmental mental imagery or motivation and emotional connection to help the environment could amplify their PEB. [41] Commitment techniques rank high in engagement and can also foster greater PEB. When an individual agrees to a small request, the likelihood that the

individual will engage in another activity significantly heightens. Also known as the foot-in-the-door effect, this technique is often used to nudge individuals to act sustainably. [30]

Financial incentives are often projected as a valuable technique to promote a specific behavior. However, when these incentives are applied to consumers for conservation behavior, they have little to no effect when implemented and removed. [44] Therefore, when addressing consumers, companies decrease financial incentives and increase competition. Researchers from Vrije Universiteit Amsterdam found that increasing competition increases sustainable behavior. [45] However, the statement only applies to individuals who are pro-selves and seek personal benefit, and not to individuals who are pro-social. The end outcome of sustainability influences pro-social individuals; therefore, competition doesn't alter their behavior. Pro-selves aren't motivated by the end outcome and are more engaged in the competition. Regardless of the varying effects of promoting PEB, firms should use competition as an educational opportunity to teach individuals about sustainability.

5. Conclusion

By understanding the determinants that influence and promote pro-environmental behavior, firms can better target consumers with carefully crafted marketing techniques to act sustainably. Personality can significantly influence an individual's sustainable behavior through their perception of specific tasks, such as competition, meditation, and connectedness to nature. Interestingly, demographics of income, gender, and age play little or no role in determining PEB, although one might expect it to. As expected, the neuroscience findings have shown that sustainable behavior requires societal connection and intergenerational perspective-taking. In contrast, self-regulation and evaluation of alternatives are involved when reducing unsustainable behavior. Strong visuals with a few words and green priming is an effective marketing strategy to nudge sustainability. Surprisingly, using multiple techniques together or even educational posters can be counterproductive in promoting PEB. Ultimately, firms should consider their target audience before deciding their marketing strategy, as personality traits, behavior, and even physiology can also influence their perception of specific advertisements.

References:

- [1] Hills, J. (2022). Two Degrees Too Many: Average Global Temperatures Increase Will Trigger Climate Tipping Point. *Columbia Climate School*. <https://news.climate.columbia.edu/2022/11/15/two-degrees-too-many-average-global-temperature-increase-will-trigger-climate-tipping-points/>
- [2] Dam, D. V., & Ramirez, R. (2023). New York City's air pollution among the world's worst as Canada wildfire smoke shrouds northeast. *CNN*. <https://edition.cnn.com/2023/06/06/us/new-york-air-pollution-canada-wildfires-climate/index.html>
- [3] The World Counts. (n.d.). *The Melting Ice Caps*. <https://www.theworldcounts.com/challenges/climate-change/global-warming/the-melting-ice-caps>
- [4] IPCC. (2023). *Climate crisis report delivers "final warning" on 1.5C*. *The Guardian*. <https://www.theguardian.com/environment/video/2023/mar/20/ipcc-climate-crisis-report-delivers-final-warning-on-15c-video>
- [5] Tian, H., & Liu, X. (2022). Pro-Environmental Behavior Research: Theoretical Progress and Future Directions. *International Journal of Environmental Research and Public Health*, 19(11). <https://doi.org/10.3390/ijerph19116721>
- [6] United Nations. (n.d.). *Sustainability | United Nations*. Retrieved August 22, 2023, from <https://www.un.org/en/academic-impact/sustainability>
- [7] Lange, F., & Dewitte, S. (2019). Measuring pro-environmental behavior: Review and recommendations. *Journal of Environmental Psychology*. <https://doi.org/10.1016/j.jenvp.2019.04.009>

- [8] Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260.
- [9] Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1987). Analysis and Synthesis of Research on Responsible Environmental Behavior: A Meta-Analysis. *The Journal of Environmental Education*, 18(2), 1–8.
- [10] Small, A. D., & Cryder, C. (2016). Prosocial Consumer Behavior <https://www.google.com/url?q=https://www.sciencedirect.com/science/article/abs/pii/S2352250X16000038&sa=D&source=docs&ust=1692694832704939&usg=AOvVaw08JtZ5H4p5myVH8ZYaHEAY>
- [11] Ashton, M. C., & Lee, K. (2009). The HEXACO-60: a short measure of the major dimensions of personality. *Journal of Personality Assessment*, 91(4), 340–345.
- [12] Soutter, A. R. B., Bates, T. C., & Möttus, R. (2020). Big Five and HEXACO Personality Traits, Proenvironmental Attitudes, and Behaviors: A Meta-Analysis. *Perspectives on Psychological Science: A Journal of the Association for Psychological Science*, 15(4), 913–941.
- [13] Schultz, A. E., Newman, K. P., & Wright, S. A. (2022). The Negative Effect of Low Belonging on Consumer Responses to Sustainable Products. *Journal of Business Ethics: JBE*, 1–20.
- [14] Milfont, T. L., & Sibley, C. G. (2012). The big five personality traits and environmental engagement: Associations at the individual and societal level. *Journal of Environmental Psychology*, 32(2), 187–195.
- [15] Hirsh, J. B., & Dolderman, D. (2007). Personality predictors of Consumerism and Environmentalism: A preliminary study. *Personality and Individual Differences*, 43(6), 1583–1593.
- [16] Thiermann, U. B. (2021). *Uncovering the link between mindfulness and sustainability: does mindfulness practice influence pro-environmental behaviours?* [Imperial College London]. <https://doi.org/10.25560/89320>
- [17] Otto, S., Pensini, P., Zabel, S., Diaz-Siefer, P., Burnham, E., Navarro-Villarreal, C., & Neaman, A. (2021). The prosocial origin of sustainable behavior: A case study in the ecological domain. *Global Environmental Change: Human and Policy Dimensions*, 69, 102312.
- [18] Zelenski, J. M., & Desrochers, J. E. (2021). Can positive and self-transcendent emotions promote pro-environmental behavior? *Current Opinion in Psychology*, 42, 31–35.
- [19] Félonneau, M.-L., & Becker, M. (2008). Pro-environmental attitudes and behavior: Revealing perceived social desirability. *Revue Internationale de Psychologie Sociale*, 21(4), 25–53.
- [20] *fMRI Scans: What are They & How They Work*. (n.d.). Baptist Health. Retrieved August 22, 2023, from <https://www.baptisthealth.com/care-services/conditions-treatments/fmri>
- [21] Guizar Rosales, E., Baumgartner, T., & Knoch, D. (2022). Interindividual differences in intergenerational sustainable behavior are associated with cortical thickness of the dorsomedial and dorsolateral prefrontal cortex. *NeuroImage*, 264, 119664.
- [22] *Theory of Mind*. (n.d.). <https://doi.org/10.1016/j.dcn.2011.05.003>
- [23] Brevers, D., Baeken, C., Maurage, P., Sescousse, G., Vögele, C., & Billieux, J. (2021). Brain mechanisms underlying prospective thinking of sustainable behaviours. *Nature Sustainability*, 4(5), 433–439.
- [24] Sawe, N., & Chawla, K. (2021). Environmental neuroeconomics: how neuroscience can inform our understanding of human responses to climate change. *Current Opinion in Behavioral Sciences*, 42, 147–154.
- [25] Lee, E.-J., Kwon, G., Shin, H. J., Yang, S., Lee, S., & Suh, M. (2014). The Spell of Green: Can Frontal EEG Activations Identify Green Consumers? *Journal of Business Ethics: JBE*, 122(3), 511–521.
- [26] Leeuwis, N., van Bommel, T., & Alimardani, M. (2022). A framework for application of consumer neuroscience in pro-environmental behavior change interventions. *Frontiers in Human Neuroscience*, 16, 886600.
- [27] Vezich, I. S., Gunter, B. C., & Lieberman, M. D. (2017). The mere green effect: An fMRI study of pro-environmental advertisements. *Social Neuroscience*, 12(4), 400–408.

- [28] Minton, P., Lee, C., Orth, L., Kim, C., & Kahle L. (2013). <https://www.google.com/url?q=https://www.tandfonline.com/doi/abs/10.1080/00913367.2012.10672458&sa=D&source=docs&ust=1692694832716121&usg=AOvVaw227EqWqgwEX0x38YnvrJAa>
- [29] Thøgersen, J., Haugaard, P., & Olesen, A. (2010). Consumer responses to ecolabels. *European Journal of Marketing*, 44(11/12), 1787–1810.
- [30] McKenzie-Mohr, D. (2000). Fostering sustainable behavior through community-based social marketing. *The American Psychologist*, 55(5), 531–537.
- [31] Reese, G., Loew, K., & Steffgen, G. (2014). A towel less: social norms enhance pro-environmental behavior in hotels. *The Journal of Social Psychology*, 154(2), 97–100.
- [32] Rees, J. H., Klug, S., & Bamberg, S. (2015). Guilty conscience: motivating pro-environmental behavior by inducing negative moral emotions. *Climatic Change*, 130(3), 439–452.
- [33] Moore, M. M., & Yang, J. Z. (2020). Using Eco-Guilt to Motivate Environmental Behavior Change. *Environmental Communication*, 14(4), 522–536.
- [34] Xu, W., Jin, X., & Fu, R. (2021.). The Influence of Scarcity and Popularity Appeals on Sustainable Products <https://www.sciencedirect.com/science/article/abs/pii/S2352550921000877?via%3Dihub>
- [35] Edinger-Schons, L. M., Sipilä, J., Sen, S., Mende, G., & Wieseke, J. (2018). Are two reasons better than one? The role of appeal type in consumer responses to sustainable products. *Journal of Consumer Psychology: The Official Journal of the Society for Consumer Psychology*, 28(4), 644–664.
- [36] Rostiani, R., Purwanto, B. M., Septianto, F., & Chiew, T. M. (2023). When I'm First, I Can Use More: The Divergent Effects of Joint Appeals on Likelihood of Purchasing Sustainable Products. *Australasian Marketing Journal*, 31(3), 228–238.
- [37] Reich, B. J., & Soule C. A. A. (2016). https://www.google.com/url?q=https://www.tandfonline.com/doi/abs/10.1080/00913367.2016.1214649&sa=D&source=docs&ust=1692694832712357&usg=AOvVaw0DfaujxK1zh-7hIFKz_I0I
- [38] Yang, D., Lu, Y., Zhu, W., & Su, C. (2015). Going green: How different advertising appeals impact green consumption behavior. *Journal of Business Research*, 68(12), 2663–2675.
- [39] Adıgüzel, F. (2020). Does Advertising Appeal Type Make a Difference? A New Sustainable Fashion Product by a Luxury and Mainstream Brand. In S. S. Muthu & M. A. Gardetti (Eds.), *Sustainability in the Textile and Apparel Industries: Consumerism and Fashion Sustainability* (pp. 53–70). Springer International Publishing.
- [40] Goldsmith (auth.), E. (n.d.). *Social Influence And Sustainable Consumption [PDF] [4go1pdvq60o0]*. Retrieved August 22, 2023, from <https://vdoc.pub/documents/social-influence-and-sustainable-consumption-4go1pdvq60o0>
- [41] Boomsma, C., Pahl, S., & Andrade, J. (2016). Imagining Change: An Integrative Approach toward Explaining the Motivational Role of Mental Imagery in Pro-environmental Behavior. *Frontiers in Psychology*, 7, 1780.
- [42] Ketron, S., & Naletelich, K. (2019). Victim or beggar? Anthropomorphic messengers and the savior effect in consumer sustainability behavior. *Journal of Business Research*, 96, 73–84.
- [43] Osbaldiston, R., & Schott, J. P. (2012). Environmental Sustainability and Behavioral Science: Meta-Analysis of Proenvironmental Behavior Experiments. *Environment and Behavior*, 44(2), 257–299.
- [44] Maki, A., Burns, R. J., Ha, L., & Rothman, A. J. (2016). Paying people to protect the environment: A meta-analysis of financial incentive interventions to promote proenvironmental behaviors. *Journal of Environmental Psychology*, 47, 242–255.
- [45] Van Horen, F., van der Wal, A., & Grinstein, A. (2018). Green, greener, greenest: Can competition increase sustainable behavior? *Journal of Environmental Psychology*, 59, 16–25.