



# Relational Verbal Behavior and Eco-Friendly Purchasing: A Preliminary Translational Analysis and Implications

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Accepted: 30 September 2022

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## Abstract

Consumer behavior is impacting Earth's climate, and solving the climate change crisis will necessarily involve influencing the anthropogenic causes of behavior. The present study evaluated relational frames involving comparative climate relations on consumer choices in a simulated purchasing task. In baseline, participants selected among common household commodities that differed along three dimensions: color, an unfamiliar symbol (Y and Z), and price. Price was sequentially increased for the product with the Z symbol. All participants showed maximum sensitivity to price in baseline, where any increase for Z led to selection of Y across commodities. Relational training involved selecting among climate related stimuli in the presence of the symbols Y and Z, where correct responding occurred when participants selected the more harmful stimulus in the presence of Y and the less harmful stimulus in the presence on Z. A generalization test showed that correct responding transferred to novel stimulus arrangements based on climate impact. In the post-training purchasing phase, six of the seven participants showed reduced sensitivity to increases in price, where price and symbol appeared to interact to influence purchasing. These results have implications for a science of consumer behavior related to climate change from an RFT account.

**Keywords** Climate change · Consumer behavior · Relational frame theory · Sustainability

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Post-industrial global temperatures have continued to increase producing the warmest years on record in the past two decades (NASA Earth Observatory, 2022). Climate hazards, such as droughts, heatwaves, and flooding have also increased during this period with clear correlations with warming that could reach beyond a point of recoverability in 20 years if carbon dioxide and other emissions continue to increase alongside rising temperatures (Intergovernmental Panel on Climate Change IPCC; Masson-Delmotte, 2021). The point of no return (PNR) is a significant turning point that we must attempt to delay or avoid by altering human behavior that produces greenhouse gas emissions and can be defined as the point in which the reduction of emissions will no longer be enough to reverse the impacts of climate change (Aengenheyster et al., 2018). Although usage and consumption of products by households and their ecological footprints are unevenly distributed across regions and countries, a study in 2015 estimated that more than 60% of global greenhouse gas emissions and between 50% and 80% of total land, material, and water use were associated with the production and consumption by households (Ivanova et al., 2015).

Moreover, while corporations remain the greatest contributor to harmful emissions (CDP Carbon Majors Report, 2017), consumer purchasing directly influences products and production practices adopted by corporations (Ivanova et al., 2015). Consumer behavior is affected by both the economic and technical properties of a product as well as the social context surrounding that product (Quiñones et al., 2000). According to Quiñones et al. (2000) consumer behavior involves the differential allocation of purchasing that can occur in three stages, which include the establishment of relational verbal behavior that influences consumer preference among products and brands, the generalization of relational function from familiar products to new products with similar branding, and transformation of stimulus function through greater purchasing of preferred brands. This account is consistent with Relational Frame Theory (RFT; Barnes-Holmes et al., 2002) that describes how arbitrary or unrelated features of stimuli can influence behavior in terms of verbal relations between stimuli. For example, if product brand X is *worse* along some dimension than product brand Y ( $X < Y$ ), and if product brand Y is *worse* along the same dimension than product brand Z ( $Y < Z$ ), then one may derive that X is *worse* than Z and Z is *better* than Y. Assuming that the comparative property is valuable to the consumer (e.g., along dimensions such as health, availability, social class), transformation of stimulus function can occur when the participant reliably selects Z over other available brands (X and Y), even when unit price is increased. In the context of environmentally related consumerism, this is important because more eco-friendly products may be more expensive given means of production that are more costly to ensure eco-sustainability.

This general RFT framework has been supported in research on gambling behavior as a form of consumer behavior that could have implications for more targeted research related to climate change. Zlomke and Dixon (2006) evaluated how a property such as slot machine color could influence gambling behavior in terms of established relational frames. In their study, two computerized “slot machines” appeared on a screen with equal payout rates that differed only in color – yellow (Y) and blue (B). Baseline results failed to support a clear bias in allocation of play between the two machines. In a relational training phase, participants were presented with

familiar stimuli on a screen with the colors operating as contextual cues, where selection of the *greater* stimulus was reinforced in the presence of yellow and the selection of the *lesser* stimulus was selected in the presence of blue. Following relational training, participants showed increased bias toward the yellow slot machine, supporting the transformation of stimulus function in terms of the relational frames.

This procedure has been replicated in multiple translational evaluations of gambling behavior (Dymond et al., 2010; Wilson & Dixon, 2014). Notably, Wilson and Dixon (2014) used commercially available slot machines with three unfamiliar symbols as a way to analyze gambling as it relates to verbal rule formation and following. Ambiguous symbols operated as the unfamiliar or unrelated “branding” stimulus to avoid pre-experimental biases that may have existed based on color. Using a similar relational training procedure as Zlomke and Dixon (2006), the researchers successfully established one of the symbols as *greater* than the other symbols that influenced slot machine play for five of six participants. These results were consistent with previous research findings regarding the contextual control of relational responding surrounding non-arbitrary stimuli such as color and extends upon previous gambling research through the use of arbitrary stimuli and rule following. Slot machine gambling provides clear translational value when examining the interaction between relational behavior and consumer behavior because chance wins and losses can be manipulated or held constant within the gambling task similar to the manipulation of price for varying consumer products.

When evaluating consumer behavior related to purchasing of high emission household items, prices are known and are not probabilistic at the point of purchase unlike in gambling. Simulated purchasing tasks, such as those developed by Epstein and colleagues (Epstein et al., 2010) could provide a translational research framework when evaluating pro-climate purchasing. Epstein et al. (2010) evaluated the influences of taxes on purchasing of high-calorie-for-nutrient foods and low-calorie-for-nutrient foods. Participants were told to imagine there was no food in their household and to use the provided amount of money to purchase groceries for their family for the week. As the price of low-calorie-for-nutrient foods decreased, researchers observed an increase in purchasing of low-calorie-for-nutrient foods as well as an increase in overall energy intake in calories. Conversely, when the low-calorie-for-nutrient foods price increases, high-calorie-for-nutrient food purchasing increased, representing a healthier choice that appears sensitive to changes in unit price.

This research and its replications (Ball et al., 2015; Waterlander et al., 2019) cohere with predictions that are consistent with the matching law that states that higher rates of reinforcement at a lower cost will produce highest behavior rates, in this case product purchasing and consumption. Conversely, data reported by Wilson and Dixon (2014) suggest that matching responding to unit price may be only one factor that influences consumer behavior when comparative frames exist around arbitrary or verbal symbols that accompany consumer choice alternatives. If unit price is the only factor that influences purchasing of products that impact Earth’s climate, a significant risk is that less harmful products are often produced at a greater unit cost because of differences in material, labor, and transportation of goods and products (Sachdeva & Zhao, 2020). However, if relational framing can influence consumption in addition to unit price, then targeting relational frames could support

consumer patterns that have the potential to influence corporate decision making and, in turn, to slow climate change. This is already seen in advertising which could benefit from translational work in behavior science.

According to Foxall (2016), advertising works to change how individuals verbally relate to stimuli in hopes of increasing the likelihood of an individual buying a product. Therefore, the purpose of the present study was to replicate and extend previous translational research on consumer behavior based on pro-climate and anti-climate relational frames. We developed a purchasing task similar to those reported in previous research where unit prices were systematically increased for products branded with an unfamiliar symbol. Then, relational training was conducted to establish differences among the symbols in terms of Earth's impact. Finally, the purchasing task was replicated to determine if unit price operated as the only factor influencing choices of the consumers, or if the experimentally established relational frames also had an impact.

## Method

### Participants

A total of seven participants took part in the research study (six identified as Caucasian/white and one participant identified as biracial). The ages of the participants ranged from 20 years to 66 years (The average age was 38.29; the standard deviation was 20.85). Of the seven participants in the study, six participants lived in the state of Missouri and one participant lived in Massachusetts. The participants' median income was \$38,639. Three of the participants identified as politically leaning democrat (P1, P3, P7), three identified as politically leaning independent (P2, P4, P5), and one identified as politically leaning republican (P6). All participants identified as believing that human behavior contributed to climate change. A beta-version 20-item climate behavioral inventory, the Environmental Assessment of Responses Toward Habitability (EARTH-beta version; Matthews et al., 2021) was used to estimate engagement in daily consumer behavior related to climate change. Number of total items endorsed as yes on the EARTH-beta version ranged from 0 to 10 out of 20 possible items, suggesting that participants engaged in variable levels of pro-climate consumer behavior as a potential covariate in the present study. The participants selected for this study were contacts recruited for the study through social media platforms of the first and third authors and received no monetary compensation or any other type of reward for participating in the study and could withdraw from the study at any point.

### Materials

We developed the EARTH-beta version to provide a behavioral estimate of real-world engagement in pro-climate consumer behavior. As noted by Matthews et al. (2021), the EARTH-beta version was developed by generating a list of 100 behaviors potentially related to climate change and the result of a principal component analyses with a convenience sample of 92 participants yielded a three-factor model, where factor 1 contained

20 items related to consumer behaviors that were most predictive of estimated individual greenhouse emissions using the *Global Footprint Calculator* (Global Footprint Network, 2017; Matthews et al., 2021). Further development of items on the EARTH-beta version are currently underway with larger and more representative samples and the beta-version was used simply as an inventory of behavior for comparison among the participants. Example items on the EARTH-beta version include: “At least 25% of house lights are energy efficient (e.g., LED smart)”, “At least 50% of purchased clothing is responsible, second hand, or is worn more than 30 times”, and “All hygiene and/or makeup products are natural (i.e., do not contain unrecognizable chemicals)”. The full beta-version of the EARTH-beta version is provided as a supplementary file.

The computerized purchasing task was developed in Qualtrics (Qualtrics, 2022), an online software that allows for confidential collection of participant responses. In the purchasing task, participants were presented with two concurrent household items that differed along three stimulus dimensions: color, price, and an unfamiliar wingding symbol. The household items used in the study are shown in Table 1. Each concurrent product choice was presented on multiple occasions and with varying unit prices throughout the purchasing task.





The relational training task was created using Microsoft PowerPoint adapted from the remote programming task analysis developed by Belisle et al. (2021). We created a relational training task that could be delivered virtually through Zoom to increase the potential for replication of this research with a potentially diverse participant sample unrestricted to a given location or region. The task involved the presentation of two comparative stimuli that differed in their potential impact on Earth’s climate, as shown in Tables 2 and 3. One of three unfamiliar symbols was also presented at the top of the screen, as shown in Fig. 1. The relational training was set up using a 100 pt font wingding placed in the middle of the slide toward the top and two 2.5” pictures equally spaced apart. When the participant selected the correct stimulus in the array, the program automatically progressed to a screen “correct” and the participant could initiate the next trial by selecting a return arrow in the middle of the screen that operated as a centering response (i.e., equidistant from the two sample stimuli on the subsequent trial).

The experiment was conducted through Zoom, with both the researcher’s and the participant’s cameras and microphones turned on. We conducted the study through Zoom due to COVID-19 distancing protocols and to test this as a method that could allow for recruitment of participants outside of the geographic university location. To avoid reactivity during the purchasing task (our primary dependent variable), participants did not share their screen when completing the purchasing task so experimenters could not observe their responses. To register the selection responses during relational training, participants took remote control of the experimenter’s screen.

## Dependent Variables and Interobserver Agreement

We utilized a titrating concurrent choice arrangement in the purchasing task. The participants were presented with two versions of the same household item that differed in price, color, and an unfamiliar symbol Y and Z, where Z operated as the contextual cue for pro-climate selection during the relational training task. On the first selection,

**Table 1** Starting price points per item as determined by the averages using Amazon's incognito Google Chrome browser

Anti-Environmental	Pro-Environmental	Starting Price from Average Amazon Prices
		\$4.00
		\$3.00
		\$3.00
		\$0.25
		\$4.00
		\$2.00

the price was equal for both products and based on the starting price in the table. Starting prices were identified by averaging the unit price of the first five items on Amazon and rounding to the nearest \$0.25 when searched using an incognito Google Chrome browser to avoid individual search histories. We then increased the unit price by \$0.25 on the Z product for each subsequent choice up-to a greater overall cost of \$1.50 for the product. Switch points were calculated by determining the point at which participants were no longer willing to increase their spending for the Z product minus the initial cost of the product (i.e., how much more were participants willing to spend for Z over X). For example, if the initial price of the item was \$4.00 and the amount the participant was willing to spend for product Z was \$4.50, the recorded switch point would be \$0.50. Interobserver agreement (IOA) was not collected for the purchasing task because data collection was automated through Qualtrics.

For the relational training task, data were collected on percentage of correct responding in the presence of the symbols Y and Z. In the presence of Y, a correct response

**Table 2** Relational training task: Testing stimuli

Pro-Environmental	Neutral	Anti-Environmental
		

occurred when the participant selected the more harmful stimulus and in the presence of Z, a correct response occurred when the participant selected the less harmful stimulus. Percent correct was evaluated in a test phase following relational training and was calculated by dividing the total number of correct responses by the total number of opportunities, divided by 100. A second observer collected data during 57% of sessions. During instances where IOA was collected by a separate researcher, their cameras and microphones were turned off. To calculate interobserver agreement, data was compared on a trial-by-trial basis. The number of intervals in which both researchers agreed were divided by the total number of trials, multiplied by 100. IOA was 99%.

**Procedure**

**EARTH-Beta Version and Pre-Relational Training** The progression of the study for participants is shown in Fig. 2. All participants completed the EARTH-Beta Version as an initial estimate of climate related behavior. The participants then completed a

**Table 3** Relational training task: Testing stimuli

Pro-Environmental	Neutral	Anti-Environmental

baseline evaluation simulated purchasing pretest in 7 trial blocks, with values titrating upward for items with the Z stimulus. The ordered presentation of the items was randomized, and the length of the baseline phase was staggered across the participants (P1–2, 18 trial blocks; P3–4, 30 trial blocks; P5–7, 42 trial blocks) consistent with the multiple baseline experimental design (Belisle et al., 2021).



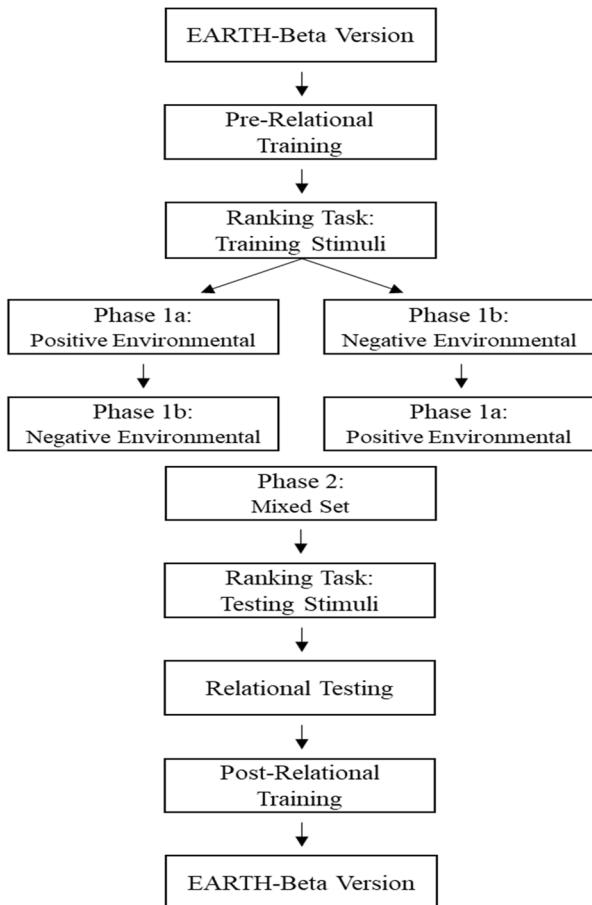
**Fig. 1** An example of the relational training task



**Relational Training** Following baseline, participants completed a ranking task using the relational training stimuli to determine which stimuli they viewed as most harmful and least harmful. This was done to ensure their comparative relational responses cohered with the relations assumed by the experimenters. A slide with three images was presented for each stimulus, with the letters A, B, C below the three images, respectively. Participants were then asked to rank the pictures based on which image was the most environmentally friendly to the least environmentally friendly. If the participant failed to rank them in the predetermined order, the experimenter corrected and explained the reasoning behind the ranking and provided the participant with the correct order. The participants were then asked to rank the items again until the correct order was identified.

Participants then completed the relational training task to establish the unfamiliar symbols as comparative contextual cues related to climate impact (more harmful, Y, and less harmful, Z). The participants were instructed to “select the correct answer” with no further instructions. Six sets of three stimuli and two arbitrary symbols were

**Fig. 2** The progression of the study using phasic descriptions



used throughout the initial three phases of training, and an additional six sets of three stimuli were introduced during the test phase to ensure generalization of the contextual cue across climate related items. The 12 sets of three stimuli contained three images representing a lower impact (e.g., plant-based chicken, electric car), a medium impact (e.g., chickens in a cage, gas-powered car), or a greater impact (e.g., chickens crowded with no room to move, diesel truck) each measuring at approximately 6.35 cm by 6.35 cm.

A total of four phases of training tasks and two ranking tasks were administered. The sequence of phase 1a and 1b were randomized across participants to control for sequence effects.

**Phase 1a:** *Positive Environmental.* For this task, the participant was instructed to select the correct image without further instructions. Each trial consisted of the presentation of the unfamiliar sample stimulus Z and two items from the same category (e.g., an electric car and a diesel truck, or a diesel truck and a gas-powered sedan).

When the less harmful stimulus was selected, the word “correct” would appear on the screen and an arrow symbol appeared below the word, prompting the participant to move to the next set of images (i.e., centering response). The phase consisted of 18 trials (each category was presented three times) and the mastery criteria was set at 90% correct responding or higher. If this goal was not reached, the participant would undergo an additional 18 trials until the mastery criteria was met.

**Phase 1b:** *Negative Environmental.* This phase was identical to phase 1a except that the sample stimulus Y was presented on all trials and the correct response involved selecting the more harmful stimulus.

**Phase 2:** *Mixed.* In this phase, Y and Z symbols were randomly intermixed throughout the phase and presented 12 times each for a total of 36 trials. When the correct image was selected given the corresponding symbols as the contextual cue, the “correct” screen was presented and the opportunity to progress to the next trial.

**Relational Testing** After completing the mixed training phase, the participant was introduced to a new testing set of stimuli. This ranking task was identical to the one used during the training phases to ensure that participants ranked the images consistent with the pre-experimental ranking developed by the experimenters.

The testing phase then occurred across 54 total trials that included 30 trials containing the training stimulus set and 24 trials containing the new stimuli. Before the trial began, the following instructions were provided for the participant: “*You will no longer be provided with feedback for your responses. Continue to do your best, and the experimenter will record your score.*” The predetermined mastery criterion for this phase was set at 85% correct responding or higher (i.e., 46 out of 54 trials).

If the participant scored less than an 85%, the participant was then re-exposed to the mixed training set of 36 pictures used during phase 2 and then re-exposed to the testing phase until the criterion was met.

**Post-Relational Training and EARTH-Beta Version** We implemented the simulated purchasing task again following relational training and testing using the same design as was used in the baseline phase. The total number of trial blocks for all participants was 80 and the number of trial blocks in the present phase was 80 minus the baseline trial blocks. We also conducted the EARTH-Beta Version assessment again at the end of the experiment. This was done to determine if our task produced changes in measurable climate related behavior (we assumed that it would not because of the use of unfamiliar symbols and the simulated conditions of the task) and to provide an initial test of retest reliability of the EARTH-Beta Version.

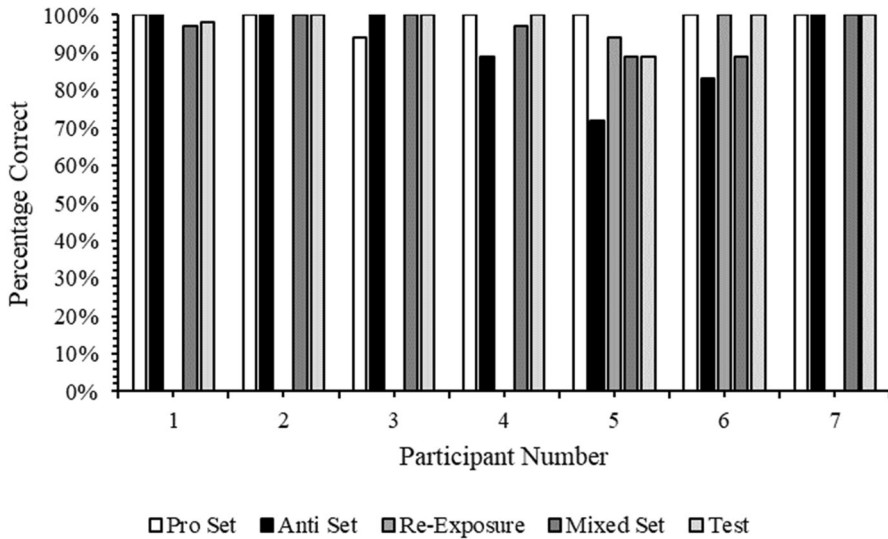
## Results

Results are reported in Fig. 3 (relational testing outcomes) and Fig. 4. As seen in Fig. 3, all of the participants showed correct responding that exceeded both chance levels (50%) and the mastery criterion (90% or above), suggesting that the relational training procedure was effective in promoting the emergence of relational responding with generalization to the novel stimuli. The mean percent correct responding during phases 1a and 1b (conditional discrimination in the presence of Y (more harmful) and Z (less harmful) was 99% with a standard deviation of 2.27 (Y), and 92% with a standard deviation of 11.2 (Z). In the mix trial phase, correct responding remained high with a mean of 96% and standard deviation of 5. Of the seven participants, P5 and P6 required re-exposure training with a mean score of 97% and a standard deviation of 4.2. Finally, the mean percent correct responding in the final test was 98% with a standard deviation of 4.1.

P1 consistently spent \$0.75 more on the bananas, \$1.25 more on the cleaning spray and the light bulb. P1 had the most variability for the dish soap where identified indifference points ranged from \$1.25 to \$0.50. P2 showed increased spending on most items, including \$1.25 for the lightbulb and variable increased spending for the other commodities. However, P2 did not increase spending on the t-shirt. When asked after the study why this was the case, the participant said that they would not wear a yellow shirt, suggesting that pre-existing rules may influence other sources of control over responding.

P3 had the least variability in responding and consistently increased spending on every item up to the maximum of \$1.25, aside for trial number 45 where they spent \$1.00 more on the dish soap. P4 consistently spent \$0.75 more on the dish soap and the bananas, and variable increased spending for the other commodities, for the cleaning supplies P4 spent an average of \$0.80 more on the cleaning spray, \$0.70 on the lightbulbs, \$0.95 on the shirt, and \$0.80 on the deodorant.

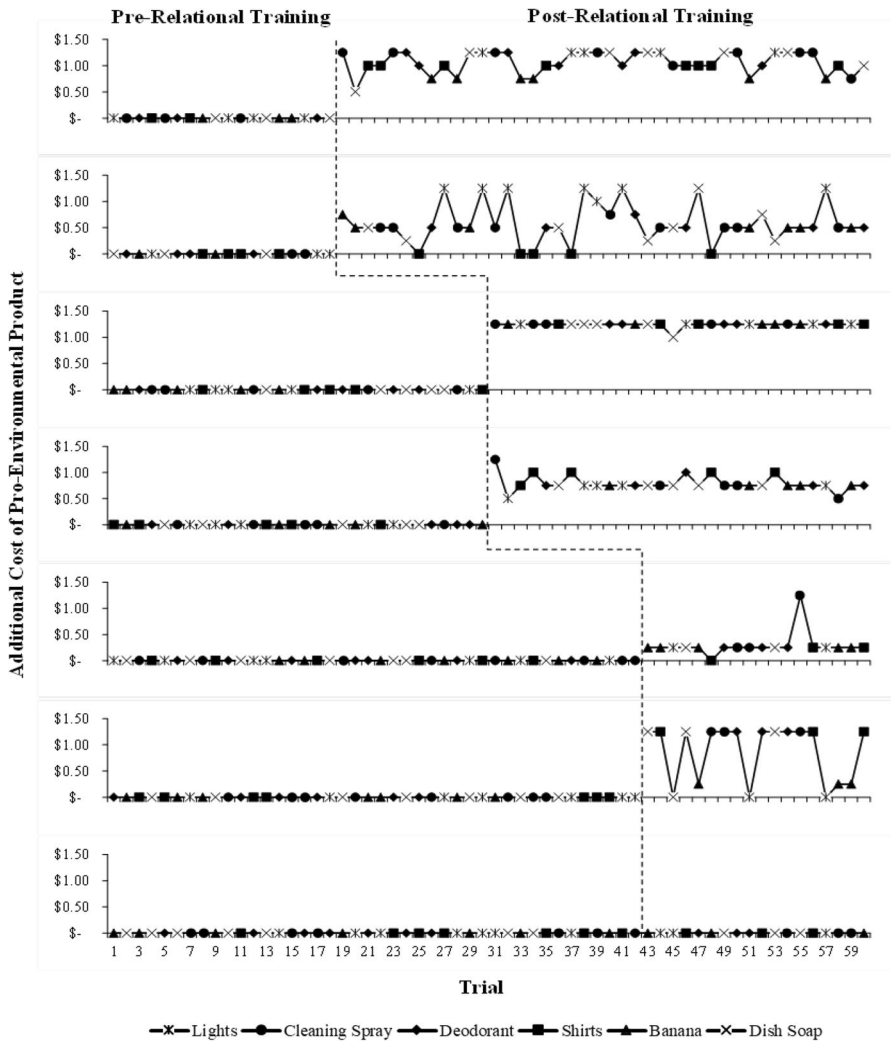
P5 consistently spent \$0.25 more on every item aside for two trials. For trial number 48, P5 did not increase spending on the pro-environmental shirt; however, during



**Fig. 3** Percentage correct for the relational training and testing conditions displayed per participant

trial number 55, they increased spending by \$1.25. P6 consistently spent \$1.25 on the dish soap, cleaning spray, deodorant, and the shirt, and they spent \$0.25 more on the bananas. However, they did not increase spending on the light bulbs. When asked after the study why this was the case, the participants said they did not believe there was a difference in light bulbs and chose not to spend additional money on them. Taken together, these results suggest clear changes in level from baseline to data collected following relational training. No increasing or decreasing trends were observed suggesting that the effect is immediate (i.e., minimal latency to change). P7 was the only participant in the present study that did not engage in any increase in purchasing of the eco-friendly products within the study. Interestingly, the same participant endorsed 0 items on the EARTH-beta assessment at the onset of the study, suggesting that this response pattern is consistent with their behavior outside of this contrived experiment.

Finally, we evaluated potential changes in responses on the EARTH-beta version using a scatterplot as shown in Fig. 5. These data show that responses on the EARTH-beta version were similar across administrations, suggesting that the task did not lead to a change in behavior outside of the experimental arrangement. We did not anticipate that it would be because of the use of unfamiliar symbols that do not operate in the natural environment and because of our use of the simulated purchasing task. However, these results provide very preliminary support for the potential of the retest reliability of the EARTH-beta version as a sample of climate related behaviors, although more research is needed with a greater time period between assessments.

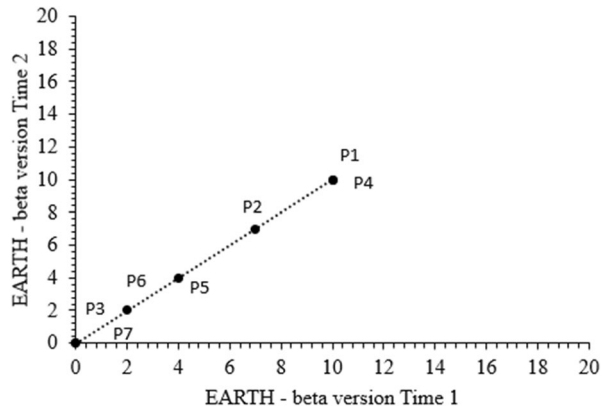


**Fig. 4** Additional increase in amount of money spent on pro-environmental products displayed in a multiple baseline across participants. Each data point represents a new trial

### Discussion

As we continue to approach and accelerate toward a climate point of no return (Aengenheyster et al., 2018), policy makers, businesses, and individuals may look for ways to slow economic and ecological damage that has and will continue to occur. Efforts to curb climate change must be multi-faceted and multi-leveled targeting the decisions and actions of organizations and people. For example, Belisle et al. (2021) evaluated how preferences for restrictive policies that may delay the point of no return can be modeled within a delay discounting framework with implications

**Fig. 5** Results of the EARTH-beta version. Pretest scores are on the x-axis, and the posttest scores are on the y-axis



for top-down control strategies (i.e., from governments to the actions of corporations and people). Another strategy involves influencing consumer behavior related to climate change that can exert bottom-up purchasing pressure on ecological impacts of goods and services produced by organizations (Meinrenken et al., 2020). Moreover, we know that purchasing behaviors contribute significantly to carbon emissions (Ivanova et al., 2015), and therefore individual efforts must play a part in helping to slow the climate point of no return.

In the present study, baseline purchasing results replicate and extend relevant research by Epstein and colleagues (Ball et al., 2015; Epstein et al., 2010; Waterlander et al., 2019) by showing that consumption is sensitive to changes in unit price. Any increase in price on one commodity led to exclusive selection of the less expensive commodity in all cases. This is consistent with the matching law (Reed & Kaplan, 2011) that states that relative rates of behavior will be equal to the relative contingencies, in this case the economic contingencies of increased spending. The arbitrarily applicable properties of color and symbol appeared to exert no influence. Following relational training, however, all but one of the participants showed an overall increase in willingness to spend money, suggesting that economic matching alone is not the only relevant factor. Rather, relational framing based on impact to Earth's climate can establish previously neutral stimuli as contextual cues that, when presented concurrently with the product, can further influence purchasing.

In many ways, these symbols can operate similar to branding or other use of symbols designed to influence purchasing and the importance of creating pro-climate frames around brands or sub-brands that can effectively and positively impact Earth's climate. This can be accomplished through commercials or advertising that presents relational content that could influence purchasing. For example, climate activists could infer from this data that commercials or advertisements that promote pro-climate alternative products could involve relating the product with the direct and indirect climate impacts that this type of consumption could have. In our study, pro-climate imagery was related to the presence of ice sheets, lush forests, and thriving wildlife; conversely, anti-climate imagery was related to eroding ice sheets, deforestation, and the suffering of wildlife. From an RFT perspective, what is critically important is that these

outcomes operate in the psychological present at the moment of purchasing to influence a transformation of stimulus function in the form of purchasing. That is, the symbols that indicate “pro-climate” cue the pro-climate relational network in the study. Of course, this strategy may not be effective for consumers who deny climate change as the result of human action, where we may anticipate that the transformation of function is disrupted by the absence of pre-experimental causal relations between purchasing and climate impact, which is an important avenue for future research. Indeed, it may be the case that relational frames established in the current translational study are a necessary but not a sufficient condition for changes in purchasing behavior if other coherent relational patterns are also necessary.

In this work, the purchasing task developed here could be used to evaluate and compare the efficacy of commercial or advertising approaches and the degree to which switch-points are altered as a function of exposure. This current study is a preliminary translational investigation that could open the door for these more focused types of studies. More than that, as real-world images and stimuli are utilized to impact real purchasing behavior, this is where we might expect to see changes in inventories such as the EARTH-beta version or other measures such as the Stanford Climate Change Scale (Armell et al., 2011).

Another potential translation of this work could involve the development of standardized symbolic referents of climate impact that could provide eco-feedback to guide purchasing (Piccolo et al., 2012). Eco-feedback occurs when information is provided about earthly impact, although no standardized unit has been developed (Piccolo et al., 2012). In the area of health sciences, calories are such a unit that through relational responding, people can make comparisons among various food options. In what has now been several studies, researchers have established that presenting caloric information on a menu can significantly influence foods that people order with implications for individual and public health (Kiszko et al., 2014). In this same way, a standardized unit could operate as a relatively consistent form of eco-feedback. To evaluate translationally, does adding a second or third symbol create even more levels of comparison across commodities (e.g.,  $ZZZ > ZZ > Z$  and  $YYY < YY < Y$ ). In practice, images like a leaf or tree could signal relative ecological impact, although as our research may suggest, it is critically important that relational frames around ecological impact have been established for these symbols to have any effect.

Finally, our results supported a general trend where increased spending for the less harmful item occurred following relational training. The results were variable, where larger increases in spending were observed for some commodities over others that differed across participants. Moreover, this value changed for the same commodities within participants, suggesting that choices at one time might not always be perfectly predictive of choices at another time. This is not entirely problematic because it is likely that population-level variance that leans more toward pro-climate patterns of consumer behavior is something that could help mitigate climate change, rather than any singular choice of an individual at one point in time. P7 was an exception to this overall trend. Where resistance to relational training occurs as it may inevitably when attempting to replicate this work with new samples, efforts should be made to identify relational behavior that may be competing with those relations established through training. For example, if rules exist around climate change being a hoax or the belief that consumer choices will not have an impact

(i.e., purchasing less harmful products is not valued by the individual), then there is no reason to expect that relational training would result in transformation of stimulus function. A theoretical model like Relational Density Theory (Belisle & Dixon, 2020) could provide such a framework by estimating the relative resistance of relational classes to change.

A first limitation was our use of a convenience sample of personal contacts for the study. While age, gender, and levels of education among participants were varied, all the participants lived in a similar geographical location. Future research would benefit from recruiting a larger sample size with participants from different states or countries, if possible, as purchasing behaviors can vary widely between various locations and operate within different cultural contingencies (Ivanova et al., 2015). Several other factors such as political beliefs, religion, ethnicity, and occupation may also predict purchasing behavior and how one views challenges related to climate change.

A second limitation was that due to the COVID-19 restrictions, this study was completed in the participants' homes remotely over a Zoom interface rather than a controlled laboratory setting. We attempted to control for distractions by having a researcher present throughout the entirety of the study with cameras and audio active. This is both a strength and a limitation as this design may be more amenable when recruiting a more diverse sample from different geographic locations. Furthermore, in the present study we utilized a stimulus–stimulus pairing; however, future research may find utility in translating this information into a story or a commercial. There are a multitude of different avenues that can be pursued in order to determine whether these findings make a difference. This limitation is also a strength of this study because it provides a procedure that could be replicated in various geographic locations with the necessity for travel (which is critical given climate related behaviors are a focus of the research study). Moreover, purchasing is increasingly occurring through online platforms such as Amazon, Target, Walmart, and other retail and grocery outlets (United Nations Conference on Trade and Development, 2020). Future research may consider constructing the purchasing task to resemble these platforms more so for greater external validity of the research findings.

A fourth limitation was that the purchasing task was simulated and did not involve the use of real money or real products. Therefore, we do not know how the results would be different in a less simulated or real-world purchasing task. We chose to scale the price of commodities by these increments because the smaller the increments, the more sensitive the measure is going to be to those small changes, and conversely, the larger the increments, the less sensitive the measure will be to those changes. In addition, the more increments that are added to a given study will increase the likelihood of participant fatigue when completing the study. However, when looking at the data, for some of the commodities for some of the participants, there seems to be a ceiling effect (e.g., P1 and the shirts; P3 and the deodorant) who were willing to spend all the way up to the maximum additional price which was \$1.25 meaning that in a future study it might make sense to have more increments or titrate the price up by \$0.50 increments. While this analysis would be less sensitive, it may be sufficient in capturing more of the variation. In addition, we did not provide the participants with a hypothetical sum of money, and they were expected to respond to the concurrent choices given their own knowledge of their income. Providing a relatively constant sum of money across participants could address insensitivity to relational framing that could emerge when, for example, a participant is less wealthy



and could not afford the increased costs associated with less harmful commodities. This also illustrates the potentially complex interplay between relational frames, pre-existing relational behavior and rules, and interlocking metacontingencies that can all influence events at point of purchase. Therefore, this study, although conducted in isolation of these factors, merely exists to explore one of these factors more deeply.

Opportunities for future research related to consumer behavior in the area of climate change are numerous. One potential extension of this work could involve altering or adapting the dosage of relational training to see if that leads to lesser or greater influence on purchasing, as well as adjusting the content or delivery mode. For example, we opted for an operant or selection-based training strategy, but relational frames may be established through more passive listener processes like stimulus–stimulus pairing. The Stimulus Pairing Observation Procedure (SPOP; Leader et al., 1996) is one that has been used in similar translational evaluations that could have utility here that also can allow for greater control of factors such as exposure. Another readily available avenue for future research could involve probing for maintenance of both relational responding as well as changes in purchasing. We do not yet know if the relational frames maintain over time or if periodic exposure is necessary to maintain less harmful patterns of purchasing. Finally, we might also evaluate how factors such as climate believability (van Valkengoed et al., 2022) or climate anxiety (Clayton, 2020) predict performance on the purchasing task. This may necessitate the development of a shorter task version that could be embedded into correlational research design strategies in future research.

In summary, our results suggest that relational framing operates as one factor that could influence consumer behavior related to climate change in addition to unit price. Translational research plays a necessary role in the development of behavior analytic procedures and technologies to help resolve important issues of our time (Mace & Critchfield, 2010). Given the now clear relationship between Earth's climate and other areas of human suffering (Portier et al., 2010), it is critical now more than ever to evaluate the multitude of factors that influence human decision making. Our species' existence depends on it.

**Data Availability** De-identified aggregate data will be made available upon request to the corresponding author.

## Declarations

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

**Conflict of Interest** The authors declare that they have no conflict of interest.

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