Attention and Green Delivery

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Abstract

We show that attention is a key determinant of household contributions to the green transition. Using transaction-level data from Singapore's largest online supermarket, we study a 'green delivery' option that reduces carbon emissions by consolidating routes but requires giving up scheduling flexibility. We find that households are less likely to adopt green delivery under extreme weather, measured by abnormal temperature, absolute temperature and wet-bulb temperature. By contrast, nationwide sustainability campaigns sharply increase participation, functioning as salience shocks that redirect attention toward environmental goals. However, this salience effect is significantly attenuated under high environmental pressures. A behavioral inattention framework explains these patterns, showing how stress narrows attention to immediate comfort and cost, while salience cues restore focus on future environmental benefits. Our results highlight attention as a key mechanism in sustainable consumption.

Keywords: attention, cognitive scarcity, sustainability, green delivery, household behavior, environmental economics, pro-social behavior

JEL Classification: D12, D83, D91, Q54, Q58

1 Introduction

Households are central to the low-carbon transition. Their everyday decisions about energy use, transportation, recycling, and consumption aggregate into outcomes that determine both the pace and the cost of climate mitigation. Yet household contributions remain limited even as concern about climate change is widespread. Since the seminal work of Wicker (1969), research has consistently shown that stated environmental attitudes often fail to translate into realized behavior. In financial contexts, Anderson and Robinson (2022) show using Swedish survey and administrative data that pro-environment households are no more likely to hold green assets. Similar patterns appear in energy and housing markets, where consumers underreact to information on energy efficiency or rely on simplified heuristics such as color-coded labels (Sejas-Portillo et al. 2025). A large-scale survey across 37 nations finds that purchase of household energy-saving products has a limited effect on energy consumption expenditure(Piao and Managi 2023). In this paper, we focus on the role of attention and consumer green choices.

A large literature shows that cognitive scarcity distorts decision-making (DellaVigna 2009; Gabaix 2019). Limited bandwidth has been linked to weaker financial capability, lower labor productivity, and poorer educational attainment. When individuals face stress, attention narrows toward immediate concerns (Allcott and Mullainathan 2010; Mullainathan and Shafir 2013). In the context of environmental risk, this narrowing shapes how households perceive and respond to changing conditions. Recent work shows that salience can heighten private protective behavior. Households are more likely to purchase insurance when air pollution worsens (Chang et al. 2018) or when extreme heat raises perceived risks (Agarwal et al. 2025). These findings suggest that environmental shocks can focus attention on self-protection and amplify demand for private risk-mitigation instruments.

Nonetheless, the same attentional mechanism may operate in the opposite direction for collective environmental actions. When environmental stress heightens immediate concerns, it can crowd out attention to longer-term or prosocial goals such as energy conservation or sustainable consumption. In this sense, insurance and environmental behaviors are two outcomes of a common attentional process. Both respond to environmental risk, but one reflects a shift toward private adaptation while the other requires public mitigation. Economic models of climate behavior emphasize that these responses may be substitutes rather than complements (Bayramoglu et al. 2018). If attention scarcity systematically reallocates effort from collective mitigation toward private protection, the aggregate consequences for the low-carbon transition could be substantial.

Understanding when environmental shocks trigger defensive adaptation rather than cooperative mitigation is therefore essential for designing policies that sustain household contributions to climate goals. Nonetheless, empirical evidence remains limited. Most studies rely on stated preferences, survey experiments, or investment decisions that only indirectly capture behavioral responses. We contribute by providing real-time evidence on revealed household behavior involving tangible trade-offs between private convenience and collective environmental benefit. Our analysis identifies how transient shocks to stress and salience influence household attention and whether these shifts reallocate effort from public mitigation to private adaptation.

Empirically, addressing this question is challenging along two dimensions. The first concerns data: real-time, high-frequency observations of pro-environmental choices that entail tangible trade-offs between private convenience and environmental benefit are scarce. The second is empirical design: it is difficult to obtain plausibly exogenous variation in the salience of environmental concerns. We overcome both challenges in the following ways. On the data front, we use unique administrative transaction-level records from RedMart, Singapore's leading online grocery platform, which capture household delivery choices at checkout. On the research design front, we combine these microdata with multiple sources of exogenous variation, including weather shocks, air quality, temporary electricity price caps, and government-led environmental campaigns that allow us to isolate shifts in salience and attention.

Singapore provides an especially suitable setting for this analysis. The country experiences frequent weather variability and recurrent air-quality shocks, and its electricity market features a transparent price cap that automatically activates under extreme conditions, heightening the salience of energy costs. In parallel, the government regularly organizes highly publicized environmental campaigns such as Clean & Green Singapore and Go Green SG, which generate sharp, short-lived increases in the visibility of sustainability concerns.[1] Together, these institutional features provide multiple, plausibly exogenous sources of variation that can be directly linked to household consumption choices in real time.

To study how attention shapes pro-environmental behavior, we rely on unique administrative data from Singapore's leading online grocer, RedMart. As Lazada's dedicated grocery platform, RedMart offers scheduled delivery of fresh produce and household essentials and serves as a major channel for online grocery purchases in Singapore. At

[1] Clean & Green Singapore is an annual national campaign launched in 1990 to promote environmental awareness, tree planting, and community-level participation in waste reduction and energy conservation. It is typically anchored by large-scale public events, exhibitions, and school programs coordinated by the National Environment Agency (NEA). Go Green SG is a more recent initiative, launched in 2022 as a whole-of-nation sustainability movement under Singapore's Green Plan 2030. It consolidates a month-long series of outreach activities across government agencies, firms, and communities, emphasizing everyday sustainable actions in areas such as energy, transport, and waste. Both campaigns attract extensive media coverage and social engagement, temporarily increasing the salience of environmental issues across households and firms.

checkout, customers choose among delivery slots that differ in convenience and cost. Some slots are labeled 'Less CO_2' because they enable logistics consolidation and reduce emissions. Importantly, the green label appears only once a slot has been pooled with at least one other order in the same area. Early buyers in a slot may not see the label, while later buyers do. These 'green delivery' options carry no financial incentive and differ only by the environmental label, providing a clean measure of willingness to trade off private convenience for environmental benefit.

Our dataset covers roughly 100,000 anonymized delivery orders between March 2023 and March 2025. About 60,000 orders display only standard slots, while 36,000 include at least one labeled 'Less CO_2'. We focus on this latter subset to analyze adoption behavior conditional on availability. For each order, we observe the full menu of delivery slots, the slot chosen, and detailed basket characteristics including expenditure, quantity, and weight. We augment these data with district-level weather conditions, high-frequency air-quality measures, temporary electricity price caps, and a hand-collected database of environmental campaigns. Together, these sources provide rich, quasi-experimental variation to examine how exogenous shocks to salience and attention influence household contributions to collective environmental goods in everyday consumption decisions.

We find three complementary mechanisms through which attention shapes sustainable behavior. First, the structure of the choice environment plays a central role. When a greater share of available slots is labeled as green, adoption rises sharply: a 10–percentage-point increase in green slot availability raises uptake by 5–6 percentage points. This shows that salience within the menu directly affects whether sustainability enters the consideration set. However, this sensitivity to choice architecture is moderated by household circumstances. High-value orders are 12 percentage points less likely to go green, and larger, more complex baskets systematically reduce adoption. These patterns suggest that when financial stakes are higher or cognitive load is greater, immediate convenience dominates environmental considerations, consistent with the idea that limited attention constrains sustainable decision-making.

Second, environmental stressors further deplete available attention and crowd out sustainable choices. Poor air quality (1 unit PSI increase) reduces green adoption by 0.1 percentage points, while heat-humidity stress (1 unit increase in wet-bulb temperature) lowers uptake by 4 percentage points (up to 21 percentage points across the observed range). Temporary electricity price-cap events reduce adoption by about 7 percentage points. Although these events do not alter the price of green delivery itself, they heighten public awareness of energy costs and shift attention toward financial security. In doing so, they divert cognitive resources away from environmental goals. These effects are large relative to the baseline green adoption rate of 39 percent, underscoring how discomfort, cost salience, and stress weaken contributions to collective goods.

Our findings align with evidence that environmental pressures reduce cognitive performance and narrow attention. Heat impairs learning (Park et al. 2020), undermines decision quality (Heutel et al. 2021), and increases aggression and violence (Hsiang et al. 2013). Air pollution lowers test performance (Zhang et al. 2018), depresses workplace productivity (Chang et al. 2019), and raises crime rates (Bondy et al. 2020). Heat also increases rejection rates for immigration applications by U.S. judges (Heyes and Saberian 2019). Yet this literature focuses mainly on productivity, learning, and judgment under stress. We extend these insights to the domain of sustainability, showing that the same environmental pressures also reduce pro-social contributions to climate mitigation. Even when actions are low-cost and easily accessible, environmental stress diminishes households' willingness to engage in sustainable behavior.

Third, targeted policy interventions can effectively enhance sustainable choices in short-term by refocusing attention on environmental goals. Nationwide events such as Clean & Green Singapore increase green delivery uptake by 7 percentage points on the day of exposure, which is a 17 percent increase relative to baseline. This demonstrates the effectiveness of salience-based interventions or "green nudges" (Carlsson et al. 2021). Placebo tests show no anticipatory or lagged effects, indicating that campaigns operate through short-lived shifts in attention rather than persistent preference changes. Together, these results show that attention is both scarce and elastic: environmental stress depletes it, while policy salience can restore it in ways that materially affect sustainable behavior.

We also conduct a comprehensive set of robustness checks confirming that these effects are highly specific. Environmental shocks and campaigns leave order value, basket size, delivery fees, and platform pricing unchanged. The impact is confined to the environmental dimension of the decision, ruling out income effects, substitution between delivery options, or supply-side pricing responses. The evidence points instead to a reallocation of attention as the key channel through which salience shapes behavior.

To interpret these findings, we develop a simple behavioral inattention framework of green delivery choice. A central challenge in sustainable consumption is that the benefits of pro-environmental actions are diffuse, delayed, and non-monetary, while the costs are immediate and salient (Gabaix 2019; DellaVigna 2009). Our model formalizes the idea that households allocate scarce attention across these dimensions. Our model formalizes the idea that households fully attentive to the long-term and diffuse benefits of green delivery. Correspondingly, their green decisions are shaped by the allocation of scarce attentional resources, which maps directly to our empirical results:

Physical stressors such as heat and air pollution narrows this attention and create a tunneling effect (Mullainathan and Shafir 2013). This explains the sharp reductions in green delivery adoption we observe during adverse conditions. Electricity price-cap events operate through the same channel by heightening awareness of financial strain and shifting attention to immediate costs rather than environmental goals, even though the monetary price of green delivery itself does not change. In contrast, salience shocks redirects this attention. On one hand, sustainability campaigns increase the perceptual prominence of environmental benefits (Bordalo et al. 2013). This mechanism explains the immediate surge in adoption on event days. On the other hand, order characteristics such as more green delivery options in the choice menu, high value, etc. shift the focus to immediate costs. This mechanism is consistent with the findings that higher-value, bigger size, heavier orders are associated with lower green choices. The model also predicts, and our estimates confirm, that the effect of salience shocks is weaker under high stress because tunneling crowds out the cognitive capacity needed to process external prompts (Mani et al. 2013).

The behavioral inattention framework, therefore, provides a unifying explanation for both sets of results. Adverse conditions reduce contributions to collective goods by narrowing attention to the present, while salience interventions counteract this tendency by shifting attention back toward the future, but only when sufficient cognitive bandwidth is available.

Related Literature This paper contributes to several strands of research. First, we add to the literature on cognitive scarcity and decision-making. The foundational work by Mullainathan and Shafir (2013) and Shah et al. (2012) establishes that when individuals face stress, whether financial, physical, or psychological, their effective attentional capacity narrows, creating a 'tunneling' effect that focuses attention on immediate concerns at the expense of longer-term goals. This cognitive scarcity framework has been validated across diverse domains, including finance, education, and productivity. Recent experimental evidence has also shown how cognitive load affects specific types of decisions. Dean (2024) demonstrates that noise increases reduce productivity, with participants remaining unaware of this degradation. Deck and Jahedi (2015) provide consistent evidence that cognitive load increases both risk aversion and money-related impatience, while Dohmen et al. (2010) show that lower cognitive ability correlates with greater risk aversion and more pronounced impatience. The neural mechanisms underlying these effects have been traced by Huijsmans et al. (2019), who demonstrate that a scarcity mindset affects brain networks governing goal-directed decision making. Individuals may experience a self-control conflict between the temptation to act selfishly and the better judgment to act pro-socially (Martinsson et al. 2012; Wyss et al. 2022).

Second, we connect to research on environmental stress and economic performance. Temperature effects have been extensively documented: Dell et al. (2012) find that warming significantly depresses growth and industrial output in developing countries. Air pollution presents another well-established channel. Zivin and Neidell (2012) demonstrate that even moderate pollution significantly reduces farm worker productivity, while Chang et al. (2019) find similar effects in communication-intensive services, where higher pollution reduces completed calls and efficiency. These productivity effects extend to cognitive performance: Zhang et al. (2018) show that air pollution exposure lowers test performance, and Bondy et al. (2020) documents increased crime rates during polluted periods.

The physiological mechanisms underlying heat effects are well understood. Heat generated during activity must be dissipated to maintain body temperature and avoid heat stress (Kjellstrom et al. 2009). When body temperatures cannot be maintained at a given activity level, work intensity must be reduced. The efficiency of this thermoregulatory process depends primarily on ambient temperature but is also influenced by humidity and wind speed (Parsons 1993). Laboratory studies therefore, often employ wet-bulb temperature (WBT), which accounts for these combined factors (Lemke and Kjellstrom 2012). Recent evidence by Somanathan et al. (2021) confirms that hot days depress daily output and increase absenteeism in Indian manufacturing.

Third, we contribute to the literature on household sustainability choices. Research highlights heterogeneity in environmental preferences. This literature reveals substantial heterogeneity in how households respond to environmental information, incentives, and choice contexts. High-frequency feedback mechanisms demonstrate that real-time information makes consumers significantly more price-responsive to energy costs (Jessoe and Rapson 2014). Social comparison interventions provide compelling evidence that peer benchmarking induces economically meaningful energy conservation, with effects that decay over time but remain partially persistent even after direct mailings cease (Allcott and Rogers 2014).

The relative effectiveness of different intervention types has been examined through field experiments comparing moral suasion with monetary incentives. von Zahn et al. (2025) run a large-scale field experiment and find that notifying customers of the negative environmental impact of returns successfully reduced them by 2.6% without hurting sales. Ito et al. (2018) show that both approaches generate conservation, but through distinct behavioral dynamics and with pronounced heterogeneity across households, suggesting potential complementarity rather than simple substitution between policy tools. This heterogeneity extends to information processing mechanisms: structural demand studies reveal that eco-labels versus precise energy-bill information sort consumers into distinct behavioral types, highlighting fundamental differences in attention allocation and preference structures (Houde 2018).

In durable goods markets, household sustainability choices exhibit systematic patterns of incomplete optimization. Consumers fail to fully capitalize future fuel costs when purchasing vehicles and demonstrate heterogeneous valuations of fuel economy, creating important implications for the welfare and emissions impacts of environmental tax policies (Allcott and Wozny 2014; Grigolon et al. 2018). These patterns of bounded rationality extend to investment decisions: randomized and quasi-experimental evaluations of home energy retrofits consistently show that realized savings fall substantially short of engineering forecasts, highlighting implementation frictions and selection effects that vary systematically across household types (Fowlie et al. 2018). Households are only willing to pay a fraction of the net financial and environmental value generated by energy-efficient products, a gap largely driven by credit constraints rather than inattention to savings (Berkouwer and Dean 2022).

Building on these insights into preference heterogeneity and context-dependent choice, our platform setting provides a unique opportunity to isolate how same-day environmental prompts interact with price and availability constraints in real purchasing decisions. Unlike previous studies that examine long-term investments or monthly consumption patterns, we observe immediate behavioral responses to salience shocks, allowing us to estimate heterogeneous treatment effects across buyers and environmental contexts while controlling for stable preferences through individual fixed effects.

The paper proceeds as follows. Section 2 describes the background and data. Section 3 presents the empirical results. Section 4 interprets these results using a simple behavioral inattention framework. Section 5 discusses implications and future directions. Section 6 concludes.

2 Background and Data

2.1 Background

To isolate how salience and attention drive sustainable choices, we use a unique dataset of household purchases alongside exogenous sources of variation: local weather conditions and environmental events.

Our unique high-frequency administrative data comes from RedMart, a leading online grocery retailer in Singapore operating under Alibaba Group via Lazada. Similar with companies such as Amazon Fresh, RedMart offers scheduled deliveries of fresh produce, dairy, meat, and other household essentials through the Lazada app. RedMart was initially founded in 2011 to provide home delivery of groceries and household essentials. It was acquired by Lazada, one of Southeast Asia's largest e-commerce platform (owned by Alibaba Group) in 2016. In 2019, RedMart was fully integrated into the Lazada app.

The sustainable behavior we examine is linked to RedMart's strategy of encouraging users to choose "green delivery" options over standard ones: At checkout, customers will be prompted to select a delivery time slot (as shown in Figure ??) after choosing their delivery address. If a time slot allows multiple orders to be delivered together (i.e., 2 or more at once), choosing that slot over others helps reduce carbon emissions, making it a 'green delivery' option. RedMart highlights these slots with a 'Less CO_2' label, as seen on options like '2pm-4pm' and '3pm-5pm' in Figure ??. These green delivery slots offer no financial or other incentives beyond the environmental label itself.

[Insert Figure **??***]*

The delivery service pricing consists of two components: a slot fee and a shipping fee. The slot fee varies based on delivery urgency and flexibility—longer, less specific time windows incur lower fees. For example, a 6-hour slot (e.g., 8am-2pm) is free of charge, while a 2-hour slot (e.g., 1pm-3pm) incurs a fee of $3.99. Express slots, defined as 2-hour windows available for same-day or next-morning delivery, carry an even higher surcharge. In contrast, the shipping fee is a flat rate of $5.99, which is waived for orders exceeding $60.

2.2 Administrative Data

We randomly sampled 100,000 delivery orders from RedMart, covering the period from March 2023 to March 2025. All data were anonymized by RedMart to ensure user privacy. Our analysis focuses on the 36,907 orders in the sample where customers were shown at least one green option.

Panel A of Table **??** presents summary statistics for this dataset, which captures information across three main dimensions for each order:

First, for each order, the dataset summarizes the delivery time slots availability presented to the customer at the time of selection. *avail entries* indicates the total number of delivery slots available. *eco entries* represents the number of green delivery slots—those labeled "Less CO2." *eco avail entries* denotes the number of green slots actually available to the user. *charged entries* captures the number of delivery slots that incur a slot fee (i.e., the fee is greater than zero). *charged avail entries* refers to the number of available slots among those that are charged.

We construct a new variable, *proportion*, defined as the share of green delivery slots in the menu at the time of choice (*eco avail entries* divided by *avail entries*). It is one of the key independent variables in our analysis, averaging 23.6% with substantial variation (SD=19.1%, range: 0.6%-100%). This variation is crucial for identification, as it reflects quasi-random fluctuations in delivery capacity that are plausibly orthogonal to individual environmental preferences. The typical customer faces approximately 17 total delivery slots, of which 2.2 are available green options.

Second, the dataset includes a summary of the order characteristics, including the expenditure, weight, and quantity. *expensive* is a dummy variable for high-value orders. *qty* represents the basket size in units, defined as the sum of the quantities of all individual items. *order weight* measures the total weight of the order. *shipping fee* and *slot fee* show the two parts of expenses paid for the delivery service of each order. In our sample, orders span a wide value range, with 56.9% classified as high-value. Basket sizes are substantial with correspondingly large weights, reflecting the nature of grocery delivery, where consumers consolidate household shopping into single orders.

Third, the dataset provides variables capturing the user's actual delivery choice in each order: *green* is a binary indicator of whether the selected time slot was a green delivery option, coded as one when the customer selects the low-emissions alternative. It is the key dependent variable in our analysis, providing a high-frequency measure of households' environmental-friendly behavior. It exhibits meaningful variation with 38.6% of orders selecting the environmentally-friendly option. *delivery postcode 2d* records the first two digits of the delivery postcode, providing coarse geographic information while maintaining privacy.

Overall, the summary statistics of this dataset shows that green choices are common rather than rare, and that *proportion* varies meaningfully within buyer and district over time. The distributions of *qty* and *order weight* are wide and right-skewed. Together these features support identification that relies on short-run variation within buyer, district, year by month, and day of week.

[Insert Table **??***]*

2.3 Meteorological Data

To measure local weather conditions, we employ several datesets, including Historical Daily Records Dataset, developed by Meteorological Service Singapore, and high-frequency data from Singapore's open data portal, developed by Singapore government. We also get daily air pollution data from Singapore's open data portal.

The first dataset compiles daily meteorological records from 22 stations across Singapore, starting in 1980. It includes key variables such as maximum, minimum, and mean temperature, wind speed, and rainfall, and most of them are only available after 2011.

The second dataset includes minute-by-minute air temperature and relative humidity readings at the weather-station level, starting in 2016. Weather data are aggregated to the district level using a nearest-station algorithm. We map stations to the nearest 28 districts, averaging the four closest stations for each district, and then linking each district to its corresponding postal sectors.

We also get the Historical Pollutant Standards Index dataset from the Singapore's open data portal, starting from 2023 to 2025. This dataset records daily historical pollutant standards index (PSI) for Singapore by region. It includes five regions across Singapore, east, west, north, south, and central. Besides, we also use electricity data from Energy Market Authority (EMA) in Singapore. For our analysis, we also match the region-level PSI data to the postal level. Both yield postal measures that align with our green delivery dataset.

Our analysis focuses on three key meteorological measures. The first is heat. It includes the mean temperature, the maximum temperature, the abnormal temperature, and the wet-bulb temperature (Twb). Mean temp and Max temp are daily mean and maximum temperatures (in $\circ$C) on the purchase day. For abnormal temperature, Abn_temp_k2 is daily abnormal temperature (in $\circ$C) at the district level, defined as the deviation from the historical maximum temperature. We employed the historical data from 2011 to 2022, calculating the historical average of maximum temperature as the normal temperature of every weather station. Then we use the perchase-day maximum temperature minus the historical maximum temperature and get the district-level abnormal temperature by averaging the nearest four weather stations and it is in $\circ$C. The wet-bulb temperature (Twb), capturing the stress feeling of heat and humidity. To calculate this temperature, we first get the 5-minute level temperature (T, in °C) and relative humidity (RH, in %) by station level. Then, to match the postal level data in our main dataset, we use the nearest four stations and get district-level data by averaging the four values of temperature and humidity. Then we use the following approximation (Stull 2011).

The second is air pollution, measured using Singapore's Pollutant Standards Index (PSI). The PSI is the official composite indicator of air quality, published daily by the National Environment Agency. It aggregates concentrations of six major pollutants, including fine particulate matter ($PM_{2.5}$ and PM_{10}), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), and carbon monoxide (CO), into a single index. Values below 50 are classified as 'good', 51 to 100 as 'moderate', 101 to 200 as 'unhealthy', and higher values as 'very unhealthy' or 'hazardous'. To link this measure to household choices, we match each postal sector in our delivery dataset to the corresponding district, as residents in different regions experience different levels of air pollution and may respond differently to their local air quality conditions. Since Singapore does not have official, standardized geographic boundaries for these five regions, we mapped them to postal code areas using a combination of NEA's regional classifications for PSI reporting, Urban Redevelopment Authority (URA) district definitions, and common geographical knowledge of Singapore's areas.

The third is rainfall. ...

In our dataset, each postal code is matched to one of the five PSI regions, and all postal codes within the same region are assigned the same PSI value for each calendar day between 2023 and 2025. This approach ensures that each individual's pollution exposure reflects the air quality in their specific geographic area, allowing us to capture potential regional differences in how pollution affects consumer behavior.

$$
\begin{aligned}
T_w \approx T \cdot \arctan\Big(0.151977\sqrt{RH + 8.313659}\Big) \\
+ \arctan(T + RH) - \arctan(RH - 1.676331) \\
+ 0.00391838\, RH^{3/2} \cdot \arctan(0.023101\, RH) - 4.686035. \qquad (1)
\end{aligned}
$$

Extreme weather will lead to extreme electricity prices. Thus, to illustrate extreme weather days, we use the temporary price cap (TPC) as a binary indicator, defined as 1 if the temporary price cap is triggered, otherwise 0. It was introduced by Singapore's Energy Market Authority (EMA) on 1 July 2023 as a short-term safeguard for consumers against unusually high electricity prices in the wholesale market. The idea is to set a ceiling (cap) on the Uniform Singapore Energy Price when extreme spikes occur. The cap kicks in only when wholesale market prices exceed a specified threshold. Prices above the cap are absorbed and settled by the Market Support Services or balancing arrangements, rather than passed directly to consumers.

Table **??** Panel B summarizes the meteorological, air-quality, cost, and event variables. The temporary price-cap indicator (TPC) equals one when the cap is triggered; its mean is 0.058 and its standard deviation is 0.234, with a range of 0 to 1. During our sample period, we had 1,653 observations that triggered TPC. District-day wet-bulb temperature (Twb) averages 25.069 degrees Celsius with a standard deviation of 0.751, ranging from 22.01 degrees Celsius to 27.54 degrees Celsius. Air quality, measured by the Pollutant Standards Index (PSI), averages 45.424 with a standard deviation of 11.972, and ranges from 14.292 to 108.375. The same-day green-event indicator (*HasEvent*) has a mean of 0.086 and a standard deviation of 0.280, with values from 0 to 1.

2.4 Green Events Data

In addition to weather shocks, we compile a dataset of environmental awareness events in Singapore between 2023 and 2025. We systematically hand-collected these events from official announcements by the National Environment Agency (NEA), the Ministry of Sustainability and the Environment (MSE), and affiliated public campaigns (e.g., *Clean & Green Singapore Day, Go Green SG, World Cleanup Day*). Each event is coded with its start and end dates, scope, and category. It includes both weather-related disruptions (such as prolonged dry spells or oil-spill cleanups) and publicity-driven environmental campaigns (such as recycling drives and sustainability awareness initiatives).

To integrate these events into our empirical analysis, we expand each event into a daily panel, matching the event period to the transaction-level dataset by calendar date. We then construct an indicator variable, *HasEvent*, equal to one on days when at least one green event took place, and zero otherwise. This construction allows us to isolate the incremental effect of policy-driven awareness campaigns. Table 1 in the Online Appendix presents a listing of the events.

This dataset of green events represents a novel effort to link Singapore's environmental publicity campaigns with high-frequency consumer choice data. Prior work has often relied on survey-based measures of environmental attitudes or cross-sectional exposure to policy initiatives. By contrast, our daily coding of campaigns and disruptions allows us to study short-run variation in exposure within a quasi-experimental framework. Since most campaigns are nationwide in scope and receive broad media coverage, their timing is plausibly exogenous to individual transaction-level choices. Their short duration and clear documentation provide useful within-period contrasts to evaluate whether consumer choices respond to government-led environmental cues.

3 Empirical Results

We now present our main findings. Section 3.1 examines how heat affects consumer green choice, including abnormal temperature, absolute temperature and wet-bulb temperature. Section 3.2 explores whether consumers adjust consumption choice in response to green events. Section 3.3 presents how internal order characteristics influence green-consuming behavior. Our large sample size (approximately 250,000 observations for most specifications) provides sufficient power to detect economically meaningful effects. Standard errors are appropriately clustered at the individual level to account for repeated observations, and the comprehensive fixed effects structure ensures that our estimates reflect true behavioral responses rather than selection or confounding factors.

3.1 Heat and Green Delivery

We begin by testing our central hypothesis: environmental stressors systematically reduce sustainable behavior by narrowing attention to immediate comfort and cost concerns. We examine four complementary measures of thermal stress that theory suggests should crowd out environmental considerations in household decision-making.

Our analysis employs abnormal temperature (deviations from seasonal norms), mean temperature, maximum temperature, and wet-bulb temperature. Each of them captures distinct dimensions of heat exposure that can impair cognitive performance and redirect attention toward immediate comfort. Abnormal temperature isolates the effect of unexpected thermal deviations from seasonal patterns, to which households may be less adapted. Maximum temperature captures peak daily heat exposure when thermal stress is most acute, while mean temperature reflects sustained heat conditions throughout the day. Wet-bulb temperature proves particularly informative as it integrates heat and humidity to measure the body's actual cooling capacity through perspiration, providing a direct indicator of physiological strain beyond what air temperature alone reveals. Together, these measures allow us to test whether different manifestations of heat stress systematically reduce the weight households place on environmental considerations in daily consumption choices, with results consistently demonstrating that thermal discomfort undermines sustainable behavior across all four metrics. Formally, we estimate:

$$\begin{aligned} Green_{i,t} = \alpha + \beta_1 \, \mathrm{Temp}_{d,t} + \beta_2 \, \mathrm{Proportion}_{i,t} + \beta_3 \, \mathrm{OrderChar}_{i,t} \\ + \gamma_i + \delta_d + \theta_t + \eta_t + \varepsilon_{i,t}. \end{aligned} \tag{2}$$

In this specification, the main explanatory variable $\mathrm{Temp}_{d,t}$ measures different kinds of temperatures, abnormal temperature, mean temperature, maximum temperature and district-day wet-bulb temperature. A negative β_1 implies that higher heat stress reduces the probability of choosing green delivery. $\mathrm{Proportion}_{i,t}$ measures green slot availability, and $\mathrm{OrderChar}_{i,t}$ includes order characteristics. The specification controls for $\mathrm{OrderChar}_{i,t}$, which includes $\mathrm{Expensive}_{i,t}$, $\mathrm{Qty}_{i,t}$, and $\mathrm{Orderweight}_{i,t}$.

Table **??** presents our central findings on how thermal stress undermines sustainable behavior. We examine four complementary temperature measures, each capturing distinct dimensions of heat exposure that theory suggests should narrow attention toward immediate comfort. The results strongly support our attention-based framework: all four measures show negative and highly significant effects on green delivery choice.

[Insert Table **??***]*

Panel A examines abnormal temperature, which measures deviations from historical seasonal norms, to isolate unexpected heat shocks to which households may be less adapted. The coefficient of -0.0043 (Column 1) indicates that each degree Celsius of abnormal heat reduces green delivery adoption by 0.43 percentage points. This effect persists when controlling for delivery characteristics (Column 2, -0.0036), suggesting that unusual heat directly shifts attention away from environmental considerations.

Panels B through D employ log-transformed temperature measures, allowing us to interpret coefficients as semi-elasticities: the percentage-point change in green choice probability for a 1% increase in temperature. Panel B shows that mean temperature—capturing sustained daily heat exposure—exhibits a strong negative effect. The coefficient of -0.1184 (Column 1) implies that a 10% increase in mean temperature reduces green delivery choice by approximately 1.18 percentage points. Given Singapore's mean temperatures range from approximately 25°C to 29°C in our sample, moving from cooler to hotter conditions (e.g., from 26°C to 28.5°C, roughly a 10% increase) would substantially diminish sustainable behavior.

Panel C examines maximum temperature, which captures peak daily heat when thermal stress is most acute and immediate comfort concerns are most salient. The coefficient of -0.0830 indicates that a 10% increase in maximum temperature reduces green choice by 0.83 percentage points. This measure is particularly relevant for delivery decisions made during or shortly after peak heat hours, when physiological discomfort directly competes with environmental considerations for cognitive attention.

Panel D presents results for wet-bulb temperature, which provides the most comprehensive measure of human thermal stress by integrating heat and humidity effects. Unlike dry-bulb temperature, wet-bulb temperature directly measures the body's capacity to cool through evaporative sweating—when wet-bulb temperatures approach skin temperature (around 35°C), the body cannot effectively dissipate heat, creating severe physiological stress. The coefficient of -0.2996 (Column 1) represents the strongest effect among all measures: a 10% increase in wet-bulb temperature reduces green delivery adoption by approximately 3.0 percentage points. Singapore's wet-bulb temperatures in our sample range from roughly 22°C to 27.5°C. Moving from comfortable conditions (23°C) to physiologically stressful levels (27°C)—approximately an 17% increase—would reduce green choice by roughly 5.1 percentage points based on our estimates. Such extreme wet-bulb conditions, while currently occasional during heat waves, are projected to become increasingly frequent under climate change, suggesting that rising humidity-adjusted temperatures could dramatically undermine sustainable behavior precisely when environmental action becomes most critical.

The consistency of negative effects across all four temperature measures—whether capturing abnormal shocks, sustained exposure, peak stress, or physiological cooling capacity—demonstrates the robustness of thermal stress in crowding out environmental considerations. The particularly large magnitude for wet-bulb temperature underscores that combined heat-humidity stress, rather than heat alone, most powerfully redirects attention toward immediate comfort and away from pro-environmental choices. This mechanism is distinct from general temperature effects: it directly relates to human thermoregulatory capacity and the cognitive burden imposed when the body struggles to maintain thermal equilibrium.

3.2 Environmental Events and Green Delivery

Having documented how environmental stressors reduce sustainable behavior, we now test whether targeted interventions can counteract these effects by redirecting attention toward environmental goals. Environmental awareness campaigns provide a natural experiment to test attention-based theories: if green choices depend on the salience of environmental considerations, then promotional events that highlight sustainability should increase green delivery adoption, particularly on the day of exposure.

Singapore's environmental campaigns offer an ideal setting for this analysis. The National Environment Agency and Ministry of Sustainability and the Environment regularly organize nationwide environmental awareness events that receive broad media coverage. These campaigns are typically announced in advance and focus public attention on sustainability themes through various channels, including social media, traditional media, and public installations. If attention mechanisms drive sustainable behavior, we expect these events to create sharp, temporary increases in green delivery choice.

To establish that attention to environmental issues causally affects sustainable behavior, we examine the impact of prominent environmental events in Singapore. These events, ranging from Earth Day and World Environment Day to climate summits and major sustainability announcements, create exogenous shocks to environmental salience through media coverage and public discourse. If attention allocation drives green choice, we should observe increased sustainable behavior surrounding these events. Critically, environmental events do not change the cost, convenience, or material attributes of green delivery options. They operate purely through information and salience channels, making sustainability considerations more cognitively accessible at the moment of decision.

3.2.1 Event Study Design

A key empirical challenge is that environmental events occur repeatedly throughout our sample period and may span multiple consecutive days. To obtain a clean identification of dynamic effects and avoid contaminating the comparison group with overlapping event windows, we implement a spell-based event-time design that aligns observations to the start and end of each event spell.

Constructing event spells and relative-time indicators. Let HasEvent_d indicate whether day d is part of a green event, where HasEvent_d is a dummy variable equal to one on dates when at least one environmental awareness campaign is active (see Appendix Table 1 for the complete listing). We define an *event spell* as a maximal consecutive block of days with $\text{HasEvent}_d = 1$. Using the daily time series, we identify the *start* of a spell as the first day of a block ($\text{HasEvent}_d = 1$ and $\text{HasEvent}_{d-1} = 0$) and the *end* as the last day of a block ($\text{HasEvent}_d = 1$ and $\text{HasEvent}_{d+1} = 0$). To prevent missing calendar days from generating spurious starts and ends, we first fill the daily calendar and set missing HasEvent to zero.

For each day we construct relative-time indicators in a symmetric window of $K = 14$ days. Specifically, for $k = 1, \ldots, K$, we define: (i) $pre_k(d) = 1$ if day d is k days *before* the start of a spell; and (ii) $post_k(d) = 1$ if day d is k days *after* the end of a spell. Importantly, these lead and lag indicators are assigned *only on non-event days* ($\text{HasEvent}_d = 0$) so that the event period itself is not mechanically included in the pre-event or post-event windows. When two spells are close in calendar time, a day can fall into both the post-window of the previous spell and the pre-window of the next spell. We drop these *overlap-window* days to ensure each remaining observation maps to a unique event-time position. This procedure yields a discrete event-time index $\tau \in \{-K, \ldots, -1, 0, 1, \ldots, K\}$, where $\tau = 0$ denotes event days and $\tau = -1$ is the day immediately preceding an event spell.

Estimation strategy. We estimate the following event-time specification at the order level:

$$green_{id} = \sum_{t \neq -1} \beta_t \cdot 1\{event\_time_{id} = t\} + X'_{id}\gamma + \alpha_i + \delta_{district} + \delta_{ym} + \delta_{dow} + \delta_{slot} + \varepsilon_{id}, \quad (3)$$

where $green_{id}$ is an indicator for choosing green delivery. The omitted category is $t = -1$, so each β_t is interpreted as the change in green choice relative to the day immediately before the event spell. X_{id} includes order characteristics (proportion, expensive, quantity, and order weight). We absorb high-dimensional fixed effects for buyer (α_i), district, year-month, day-of-week, and time slot. Because treatment varies at the day level (all consumers face the same event-day environment), residuals can be correlated within a day across individuals. We therefore use two-way clustered standard errors by buyer and date. To eliminate direct pricing confounds, we focus on orders with zero slot fee.

3.2.2 Event Study Results

Figure **??** presents the core event study results, plotting estimated coefficients for days $t = -5$ through $t = 5$ relative to the event spell, with 90% confidence intervals. The pattern reveals three key findings that support our attention-based framework.

*[Insert Figure **??**]*

First, the event period ($t = 0$) produces a clear and economically meaningful increase in green delivery choice. The coefficient of approximately 4 percentage points indicates that environmental events raise green adoption by roughly 15 to 20% relative to the baseline adoption rate on the day immediately preceding the event. This effect is statistically significant at the 10% level under two-way clustering, demonstrating that heightened environmental salience substantially boosts sustainable behavior in real time.

Second, coefficients in the pre-event window ($t = -5$ to $t = -2$) are small in magnitude and statistically indistinguishable from zero. This absence of pre-trends provides strong evidence against anticipation effects or spurious correlation. Consumers do not systematically alter their behavior in the days leading up to environmental events, confirming that our event indicator captures genuine shocks to environmental salience rather than reflecting broader trends or seasonal patterns in green choice.

Third, post-event coefficients ($t = 1$ to $t = 5$) quickly return to near zero and lack statistical significance. The effect dissipates within one day after the event ends, suggesting that the behavioral response reflects a temporary elevation of environmental considerations in working memory rather than a persistent shift in underlying preferences or values. This rapid decay aligns with an attention-based mechanism: once media coverage subsides and the event recedes from public discourse, cognitive resources return to their typical allocation across competing concerns.

3.2.3 Pooled Event Effects

To complement the event study and provide a summary measure of event impacts, Table **??** estimates pooled regressions where *HasEvent* equals one for all days within event spells. The coefficient on *HasEvent* is positive and highly significant: environmental events increase green delivery choice by 7.03 percentage points without controls (Column 1) and 5.18 percentage points when controlling for delivery characteristics (Column 2). Both estimates are statistically significant at the 1% level. The magnitude in Column 2 indicates that a typical environmental event increases green adoption by approximately 20% relative to baseline, comparable to the effect of moving the green option from low to high prominence in the delivery menu.

*[Insert Table **??**]*

3.2.4 Interpretation and Implications

The event study findings provide critical evidence for our attention-based framework. The fact that pure informational shocks produce immediate and substantial behavioral responses demonstrates that attention allocation represents a binding constraint on sustainable behavior. When media coverage and public discourse direct cognitive resources toward environmental concerns, individuals readily act on these concerns even in mundane daily transactions like grocery delivery. The temporary nature of these effects further illuminates the attention mechanism: environmental events work by temporarily elevating the priority of sustainability considerations in decision processes, but this elevation dissipates once the salience shock fades.

This baseline finding establishes the mechanism that environmental stressors later disrupt. Absent physiological or cognitive burdens, consumers respond strongly to environmental salience and willingly make sustainable choices. The subsequent analysis examines how heat, humidity, and other climate stressors systematically crowd out these environmental considerations by narrowing attention to immediate comfort concerns. The contrast between attention-expanding events (which boost green choice) and attention-constraining thermal stress (which reduces green choice) demonstrates that cognitive attention represents a fundamental determinant of pro-environmental behavior. As climate conditions deteriorate, rising temperatures create persistent rather than temporary barriers to sustainable action, potentially undermining the very behaviors needed to address environmental challenges.

3.2.5 Interaction of Environmental Stress and Salience

The preceding analysis establishes two key findings: environmental events substantially increase green delivery choice through heightened salience, while thermal stress systematically reduces sustainable behavior by narrowing attention to immediate comfort. A critical question remains: do these mechanisms operate independently, or does thermal stress specifically undermine the effectiveness of environmental messaging? Table **??** addresses this question by examining interactions between environmental events and our four temperature measures.

[Insert Table **??***]*

The results reveal a striking pattern: thermal stress systematically erodes the behavioral impact of environmental events across all temperature specifications. Columns 1 and 5 examine abnormal temperature. While the main effect of abnormal temperature is small and insignificant, the interaction term HasEvent $\times$ Abn_temp_k2 is negative and highly significant (-0.0364 in Column 1, -0.0296 in Column 5). This indicates that each degree Celsius of unexpected heat reduces the event boost to green choice by approximately 3 percentage points. Given that our earlier analysis showed environmental events increase green choice by roughly 5 to 7 percentage points, a 2 degree abnormal heat shock would cut this effect nearly in half.

Columns 2 and 6 present interactions with mean temperature in logarithmic form. The main effect of Ln_mean_temp is negative but statistically insignificant, while the interaction HasEvent × ln_mean_temp is large, negative, and highly significant (−0.4276 in Column 2, −0.3664 in Column 6). The coefficient implies that a 10% increase in mean temperature reduces the event effect by approximately 3.7 to 4.3 percentage points. The large positive coefficient on HasEvent alone (1.4918 in Column 2) reflects the baseline event boost under cooler conditions, but this advantage dissipates rapidly as temperatures rise. At mean temperatures around 28°C to 29°C (common during Singapore's warmer months), the net event effect becomes substantially smaller or potentially negative.

Columns 3 and 7 examine maximum temperature, capturing peak daily heat exposure. The pattern mirrors that of mean temperature: the main effect of Ln_max_temp is close to zero and insignificant, but the interaction HasEvent × ln_max_temp is strongly negative (−0.3878 in Column 3, −0.3184 in Column 7). A 10% increase in maximum temperature reduces the event boost by roughly 3.2 to 3.9 percentage points, suggesting that environmental campaigns lose much of their effectiveness when delivered during periods of acute heat stress.

Columns 4 and 8 present the most striking results using wet-bulb temperature, our most comprehensive measure of physiological heat stress. The main effect of ln_Twb is negative and significant (−0.1423 in Column 4, −0.1081 in Column 8), confirming that humidity-adjusted heat directly reduces green choice even outside event periods. But the interaction HasEvent × ln_Twb reveals an even stronger pattern: the coefficient of −1.0654 (Column 4) implies that a 10% increase in wet-bulb temperature reduces the event effect by approximately 10.7 percentage points. The baseline event coefficient of 3.4954 indicates that under comfortable wet-bulb conditions (around 22°C to 23°C), environmental events would boost green choice by roughly 35 percentage points. However, as wet-bulb temperature rises to physiologically stressful levels (26°C to 27°C, roughly a 15 to 20% increase), this boost shrinks dramatically or reverses entirely. When controlling for delivery characteristics (Column 8), the interaction remains large and significant (−0.8403), demonstrating that thermal stress undermines event effectiveness through attention mechanisms rather than simply altering order patterns.

Interpretation: competing for scarce attention. These interaction effects provide powerful evidence that thermal stress and environmental salience compete for the same limited cognitive resource: attention. If heat simply reduced baseline willingness to choose green options through a separate channel (such as general irritability or impatience), we would expect the event boost to remain constant in percentage terms even as the baseline shifted. Instead, the strong negative interactions indicate that heat specifically crowds out the attention-directing effect of environmental events. When thermal discomfort captures cognitive resources and forces attention toward immediate cooling needs, individuals have less capacity to process environmental messaging or maintain sustainability considerations in working memory during decision making.

This finding has troubling implications for climate policy. Environmental campaigns, public awareness efforts, and sustainability messaging represent primary tools for encouraging pro-environmental behavior at scale. Our results suggest these interventions become substantially less effective precisely when they are most needed: during heat waves and periods of climate stress. As global temperatures rise, the periods when environmental action becomes most urgent coincide with conditions that undermine the cognitive prerequisites for such action. This creates a behavioral feedback loop where climate change itself erodes the effectiveness of efforts to address it, potentially accelerating the gap between needed and actual environmental behavior change.

The asymmetry between main effects and interactions across temperature measures also illuminates mechanism. Abnormal temperature shows the strongest interaction but weak main effect, suggesting that unexpected heat particularly disrupts attention allocation during events when individuals might otherwise be primed to consider environmental issues. Mean and maximum temperature show moderate interactions, capturing sustained and acute heat exposure respectively. Wet-bulb temperature exhibits both strong main effects and the largest interaction, confirming that combined heat and humidity stress operates through the most direct physiological channel, simultaneously reducing baseline green choice and eliminating the cognitive space for environmental messaging to influence behavior. Together, these patterns demonstrate that thermal stress represents a fundamental barrier to attention-based environmental interventions under climate change.

3.3 Internal Drivers of Green Delivery Choice

Having established how external environmental factors shape sustainable behavior through attention mechanisms, we now examine internal platform features that influence green delivery adoption. Understanding these baseline drivers is essential for interpreting how environmental stressors interact with choice architecture and order characteristics to affect decision making.

We estimate the following transaction-level regression to identify the key internal determinants:

$$\text{Green}_{i,t} = \alpha + \beta_1 \text{Proportion}_{i,t} + \beta_2 Z_{i,t} + \gamma_i + \delta_{district} + \delta_{ym} + \delta_{dow} + \delta_{slot} + \varepsilon_{i,t}, \qquad (4)$$

where $\text{Green}_{i,t}$ is an indicator equal to one if order i on day t selects the green delivery option. The key variable $\text{Proportion}_{i,t}$ measures the share of green slots available in the choice menu. $Z_{i,t}$ represents order characteristics, which in different columns of Table **??** is defined alternatively as $\text{Expensive}_{i,t}$ (indicator for orders $\geq$ S\$100), $\text{Qty}_{i,t}$ (number of items), or $\text{Order\_weight}_{i,t}$ (total weight in kilograms). The model includes individual fixed effects (γ_i) to control for time-invariant consumer heterogeneity in environmental preferences, along with district, year-month, day-of-week, and time slot fixed effects. Standard errors are clustered at the individual level.

Table **??** presents results examining how menu design and order characteristics shape green delivery adoption. Each column isolates a different internal driver while maintaining the comprehensive fixed effects structure to ensure identification comes from within-individual variation over time.

[Insert Table **??***]*

Menu prominence and choice architecture. Column 1 demonstrates the powerful effect of menu design on sustainable behavior. The coefficient on $\text{Proportion}_{i,t}$ is 0.4798, statistically significant at the 1% level. This implies that a 10 percentage point increase in the share of green slots available raises the probability of choosing green delivery by approximately 4.8 percentage points. Given that the baseline green adoption rate is around 25 to 30%, this represents roughly a 16 to 19% increase in sustainable choices from a simple change in menu structure.

This large menu effect provides foundational evidence for our attention-based framework. When green options occupy greater share of the choice set, they become more salient and cognitively accessible, leading to higher adoption rates even though the underlying attributes of green delivery remain unchanged. The effect operates purely through the visual and cognitive prominence of sustainable options in the interface. This finding has important implications: subtle changes to platform design can generate meaningful shifts in environmental behavior without relying on price incentives or explicit persuasion. The magnitude suggests that choice architecture represents a first-order determinant of sustainable consumption, comparable in size to many traditional policy interventions.

Order value and risk aversion. Column 2 examines whether customers prioritize sustainability differently across order values. The coefficient on $\text{Expensive}_{i,t}$ is -0.0742, statistically significant at the 1% level. This indicates that when the same individual places a high-value order (total price $\geq$ S\$100), they are 7.42 percentage points less likely to choose green delivery compared to their lower-value orders. This pattern reveals a striking tension between financial stakes and environmental goals: as monetary value increases, immediate concerns about delivery reliability and timing crowd out sustainability considerations.

The negative effect of order value challenges conventional assumptions that higher spending correlates with greater willingness to support environmental attributes. Instead, the within-individual comparison shows that when significant money is at stake, the same person becomes more risk-averse about potential delays or scheduling constraints associated with green delivery. This finding aligns with our attention framework: financial salience captures cognitive resources and redirects them toward ensuring successful fulfillment, leaving less attention available for secondary considerations like environmental impact. The result suggests that promoting sustainable behavior may be more challenging precisely when transactions involve higher stakes, as material concerns naturally dominate attention allocation.

Basket complexity and cognitive load. Column 3 reveals how order complexity affects green choice. The coefficient on $\text{Qty}_{i,t}$ is -0.0029, statistically significant at the 1% level. Each additional item in the basket reduces green delivery probability by 0.29 percentage points. For a one-standard-deviation increase in quantity (approximately 15 to 16 items), this translates to a 4.4 to 4.6 percentage point reduction in green choice, representing roughly a 15 to 18% decrease relative to baseline adoption rates.

This negative effect of basket size directly supports cognitive scarcity theories. As customers evaluate larger numbers of items, cognitive resources become taxed, reducing the attention available for processing secondary attributes like environmental sustainability. Each additional item shifts focus toward logistical concerns: will everything arrive intact, will substitutions be necessary, how long will fulfillment take. These immediate practical questions compete for the same limited working memory capacity needed to consider delivery timing flexibility and consolidation benefits. The finding demonstrates how everyday decision complexity can systematically undermine sustainable behavior, even when individuals hold pro-environmental values. It also suggests that interventions promoting green choices may be most effective when targeting simpler transactions, where cognitive bandwidth remains available for environmental considerations.

Order weight and fulfillment concerns. Column 4 examines how physical order characteristics affect green choice. The coefficient on $\text{Order\_weight}_{i,t}$ is -0.8853, statistically significant at the 1% level. A one-kilogram increase in order weight reduces green delivery probability by approximately 0.89 percentage points. For heavier grocery orders (for example, orders including beverages, rice, or bulk items that might add 5 to 10 kg), this translates to a 4.4 to 8.9 percentage point reduction in green adoption.

This pattern indicates that as orders become more logistically complex, customers prioritize delivery reliability and speed over environmental considerations. Heavier orders may increase perceived risk of handling issues, delivery delays, or scheduling complications, making customers less willing to accept the timing constraints that green delivery consolidation requires. The effect reinforces our interpretation that immediate practical concerns systematically crowd out sustainability goals when fulfillment stakes are elevated. Together with the order value and basket complexity results, this finding paints a consistent picture: as transaction characteristics make successful completion more salient or cognitively demanding, environmental considerations recede from decision making even within the same individual over time.

Implications for attention-based interventions. The internal drivers analysis establishes baseline patterns that inform our interpretation of environmental stressor effects. Menu prominence demonstrates that when cognitive attention is available, choice architecture powerfully shapes sustainable behavior. Order characteristics reveal the types of immediate concerns (financial stakes, complexity, logistics) that naturally compete with environmental considerations for limited attention. These findings set the stage for understanding how external stressors like heat and humidity further constrain attention: thermal discomfort adds another layer of cognitive burden on top of existing transaction complexity, amplifying the tendency for immediate concerns to dominate sustainability goals. The consistency of attention-based patterns across both internal and external factors strengthens confidence in our theoretical framework and highlights attention allocation as a fundamental constraint on pro-environmental behavior.

4 Behavioral Framework

To explain the observed patterns, we propose a simple behavioral inattention framework of green delivery choice. A core challenge in promoting sustainable consumption is that the benefits of pro-environmental actions are often diffuse, delayed, and non-monetary, while their costs are immediate and salient. This creates a wedge between the objectively optimal choice for societal welfare and the subjectively perceived choice for a cognitively constrained individual. We draw upon the burgeoning literature on behavioral inattention (Gabaix 2019) to propose that a household's decision to opt for green delivery is fundamentally governed by the allocation of scarce cognitive resources, or attention, toward future environmental benefits.

This framework conceptualizes the choice of green delivery as an intertemporal tradeoff, where attention modulates the weight placed on future utility. We formalize this intuition using a parsimonious model that unifies two key drivers of attention: cognitive scarcity induced by physical stress, which narrows attention, and salience shocks from green events, which redirect attention toward future environmental consequences.

4.1 A Simple Model of Inattentive Intertemporal Choice

Consider a household making a discrete choice $a \in \{G, N\}$ between Green delivery (G) and Non-green (standard) delivery (N). A fully rational agent derives utility from two dimensions: the immediate convenience or cost of delivery, and the future environmental impact. The utility of option a is given by:

$$U(a) = u_0(a) + \delta\, u_1(a), \tag{5}$$

where $u_0(a)$ is the immediate utility, $u_1(a)$ is the utility from the future environmental consequence, and $\delta \in (0, 1)$ is the standard discount factor.

The core trade-off is characterized by two key assumptions. First, the green option entails an immediate cost, such that $u_0(G) < u_0(N) \leq 0$, as it typically requires accepting less convenient delivery slots. Second, it provides a future environmental benefit, such that $u_1(G) > u_1(N) \geq 0$.

Following Gabaix (2019), we posit that individuals do not fully attend to the future environmental component. This yields a subjectively perceived utility:

$$U_a^s = u_0(a) + m\delta u_1(a), \tag{6}$$

where $m \in [0, 1]$ is the *attention weight* on the future utility. When $m = 1$, the household is fully attentive and behaves according to the standard rational model. In contrast, when $m < 1$, the household underweights the future environmental impact, exhibiting a form of hyperbolic discounting (Laibson 1997) but with a clear cognitive foundation.

The household chooses Green delivery if and only if $U^s(G) > U^s(N)$. Substituting the utilities, this condition becomes

$$[u_0(G) - u_0(N)] + m\delta\,[u_1(G) - u_1(N)] > 0. \tag{7}$$

Given that $u_0(G) - u_0(N) < 0$ (immediate cost) and $u_1(G) - u_1(N) > 0$ (future benefit), the inequality is more likely to hold when the attention parameter m is higher. Thus, the probability of choosing green delivery, $P(G)$, is an increasing function of m:

$$P(G) = \Phi(m). \tag{8}$$

For simplicity, we apply a logit choice model, so

$$\Phi(m) = \frac{1}{1 + \exp([u_0(N) - u_0(G)] - m\delta\,[(u_1(G) - u_1(N)])}. \tag{9}$$

In our empirical context, the choice of green delivery is not an extreme event; the baseline probability $P(G)$ is around 40%. Therefore, for the range of m we consider,

$$\frac{\partial^2 \Phi}{\partial m^2} \geq 0, \tag{10}$$

is a reasonable assumption. This implies that the marginal effect of attention on green choice is non-decreasing: when attention is low, initial increases may have a small effect, but as attention rises, the marginal effect may strengthen.

4.2 Cognitive Scarcity and Salience Shocks

The central premise of our framework is that external factors influence the choice $P(G)$ primarily through their impact on attention m. Let $P(G) = \Phi(m)$. We model attention as a function of physical stress S (e.g., heat, pollution) and green events E (e.g., World Cleanup Day), i.e.,

$$m = m(S, E).$$

Cognitive Scarcity. An increase in physical stress S depletes mental bandwidth. According to the theory of cognitive scarcity, this depletion triggers a tunneling effect (Mullainathan and Shafir 2013): attention narrows automatically and compulsively onto the immediate pressing need—in this case, alleviating discomfort or managing financial strain—and away from future-oriented goals like environmental protection. This implies the marginal effect of stress on attention is negative:

$$\frac{\partial m}{\partial S} < 0. \tag{11}$$

Salience Shock. While cognitive scarcity narrows attention, external cues can actively redirect it. Green events E such as World Cleanup Day, function as salience shocks that increase the perceptual prominence of the environmental attribute (Bordalo et al. 2013). In standard choice contexts, the future environmental benefit of a decision is often a less immediate and less salient attribute compared to cost or convenience. These events disrupt this default by making the environmental consequence more mentally accessible, thereby drawing a larger share of an individual's limited attention toward the future utility of the decision (Gabaix 2014, 2019). This implies the marginal effect of an event on attention is positive:

$$\frac{\partial m}{\partial E} > 0. \tag{12}$$

Attenuated Salience Effect under Scarcity. We further propose that cognitive scarcity not only directs attention away from future goals but also impairs the cognitive capacity to process new informational cues. The cognitive burden of coping with high stress depletes the mental resources necessary to attend to external prompts (Shah et al. 2012). Consequently, when stress is high, individuals are less receptive to salience shocks; their attention is already monopolized by immediate pressures, leaving fewer resources to process non-essential, pro-environmental information (Mani et al. 2013). This implies that the effectiveness of a green event in boosting attention diminishes as stress increases, as the 'tunneling' effect of scarcity limits the cognitive capacity needed to fully respond to the nudge (Mullainathan and Shafir 2013).

$$\frac{\partial^2 m}{\partial E\,\partial S} < 0. \tag{13}$$

The total effect of a change in S or E on green delivery is the product of its effect on m and the effect of m on $P(G)$. Therefore, the effect of physical stress S on the probability of choosing a green delivery option is

$$\frac{\partial P(G)}{\partial S} = \frac{\partial \Phi}{\partial m} \times \frac{\partial m}{\partial S} < 0. \tag{14}$$

Similarly, the effect of a green event is

$$\frac{\partial P(G)}{\partial E} = \frac{\partial \Phi}{\partial m} \times \frac{\partial m}{\partial E} > 0. \tag{15}$$

Based on our assumptions in Equations (10) and (13), the cross-effect is

$$\frac{\partial^2 P(G)}{\partial E\,\partial S} = \frac{\partial^2 \Phi}{\partial m^2} \times \frac{\partial m}{\partial E} \times \frac{\partial m}{\partial S} + \frac{\partial \Phi}{\partial m} \times \frac{\partial^2 m}{\partial E\,\partial S} < 0. \tag{16}$$

Equation (16) indicates that the marginal benefit of a green event decreases as physical stress increases.

4.3 Linking Theory and Evidence

The empirical patterns presented in the previous section can be coherently interpreted through the lens of our behavioral inattention framework. The systematic decrease in green delivery under physical stress, its increase during green awareness events, and the attenuation of the latter effect under high stress are all consistent with the proposed role of attention as a key mechanism. Below, we link each empirical finding to a specific component of our theoretical model.

First, the observed negative relationship between physical stress—such as air pollution, heat, and high electricity prices—and the take-up of green delivery aligns with the *cognitive scarcity* channel ($\partial m/\partial S < 0$). The framework posits that such stressors deplete cognitive resources, inducing a narrowing of attention toward immediate needs and away from future-oriented considerations (Mullainathan and Shafir 2013). The data confirm that as these pressures mount, households are more likely to prioritize immediate convenience over environmental benefits, consistent with a decrease in the attentional weight m assigned to the future.

Second, the significant rise in green delivery participation during sustainability campaigns supports the operation of the *salience shock* channel ($\partial m/\partial E > 0$). As proposed by the model, these events function by increasing the perceptual prominence of the environmental attribute (Bordalo et al. 2013). The results indicate that such interventions effectively shift attentional focus by reminding households of sustainability benefits, thereby increasing the salience of future benefits and temporarily raising m (Gabaix 2014, 2019). This suggests that pro-environmental preferences can be activated when the relevant attributes are made more accessible at the point of decision, although the effect is inherently temporary as the salience shock fades over time.

Third, the documented interaction, whereby the positive effect of green events is weaker under conditions of high physical stress, is explained by the mechanism of *attenuated salience effect under scarcity* ($\partial^2 m/\partial E \partial S < 0$). This finding indicates that cognitive scarcity not only reduces baseline attention to environmental goals but also constrains the processing of new, pro-social cues (Mani et al. 2013; Shah et al. 2012). When cognitive load is high, the capacity for attentional reallocation is diminished, limiting the effectiveness of external prompts.

Finally, our framework also accounts for the ancillary effects of order characteristics through the *immediate cost* channel, $u_0(a)$. The negative impacts of higher order value, size, and weight are explained by an increase in the perceived inconvenience of forgoing scheduling flexibility, which lowers $u_0(G)$. Conversely, greater green slot availability reduces this immediate cost by offering more convenient sustainable options, effectively increasing $u_0(G)$. These systematic patterns demonstrate that the model's core trade-off between immediate and future utility effectively captures a wider set of determinants beyond attention alone.

In summary, the framework provides a unified account of the evidence, positioning the allocation of attentional resources as a central determinant of pro-environmental choice. The results demonstrate that household contributions to the green transition are not solely a function of stable preferences, but are shaped in predictable ways by contextual factors that influence cognitive scarcity and salience.

5 Discussion

Our findings have direct implications for policymakers and firms aiming to encourage sustainable consumption, moving beyond conventional price-based or informational instruments. The central lesson is that the effectiveness of interventions depends critically on the cognitive context of the decision-maker. Policies must therefore be cognitively aware, aiming not only to provide incentives but also to manage the allocation of scarce attentional resources.

First, the finding that cognitive scarcity (e.g., from heat stress or pollution) significantly reduces green choices suggests that policymakers and firms should adopt a timing-sensitive approach to sustainability nudges. Deploying complex information or requests for pro-environmental effort during periods of high ambient stress is likely to be ineffective, as individuals' mental bandwidth is already depleted. Instead, green prompts and awareness campaigns should be strategically scheduled for periods when cognitive scarcity is lower, such as during milder weather conditions, to ensure the message can be received and processed.

Second, the demonstrated power of salience shocks highlights the value of well-designed public awareness campaigns. However, our framework adds a crucial caveat: the positive impact of these shocks is attenuated under high cognitive load. This implies that simply increasing the volume or frequency of messaging during crises will yield diminishing returns. Instead, the design of these interventions must be adapted. Under conditions of widespread stress (e.g., a heatwave), communications should be exceptionally simple, visual, and easy to process, minimizing cognitive effort. For online platforms, embedding immediate and salient feedback on environmental impact directly into the interface can serve as a persistent, low-cost reminder that functions as a continuous salience shock, helping to keep long-term goals top-of-mind even under stress.

More fundamentally, the interaction between scarcity and salience points to the superior strategy of building cognitive resilience directly into the choice architecture. Rather than relying solely on efforts to capture fluctuating attention, the goal should be to make the sustainable choice the path of least resistance. This can be achieved by setting 'cognitively-light' defaults, such as automatically opting customers into green delivery slots, while preserving the right to opt-out for convenience. Such a system would require minimal active attention and decision-making from the user, thereby making the green choice more robust to fluctuations in cognitive scarcity.

Thus, promoting sustainable consumption in an era of increasing climate-related stress could require a shift from a model of providing information to one of strategically managing attention. By timing interventions wisely, designing them for cognitive ease, and embedding sustainability into choice defaults, policymakers and firms can create systems that support pro-environmental behavior even when individual cognitive resources are stretched thin.

5.1 Robustness

To further validate our interpretation, we conduct a series of robustness checks to rule out alternative explanations.

5.1.1 Air Pollution

Table **??** examines whether air pollution affects green delivery choice through similar attention mechanisms as thermal stress. We measure air quality using Singapore's Pollutant Standards Index (PSI), which aggregates concentrations of major air pollutants into a single indicator of environmental quality. Like heat and humidity, poor air quality generates physiological discomfort and has been documented to impair cognitive function, suggesting it may similarly crowd out environmental considerations.

As mentioned earlier, the PSI is the official composite indicator of ambient air quality, incorporating multiple pollutants into a single measure published daily by the National Environment Agency. We use district-day variation in PSI as a plausibly exogenous proxy for exposure to air pollution and the associated cognitive and physiological strain it imposes on households. Formally, we test the impact of air pollution using the following specification:

$$\begin{aligned} Green_{i,t} = \alpha &+ \beta_1\, PSI_{d,t} + \beta_2\, Proportion_{i,t} + \beta_3\, OrderChar_{i,t} \\ &+ \gamma_i + \delta_d + \theta_t + \eta_t + \varepsilon_{i,t}. \end{aligned} \tag{17}$$

Here, the dependent variable $\text{Green}_{i,t}$ equals one if order i on date t was delivered via the green option. The key regressor $\text{PSI}_{d,t}$ denotes the Pollutant Standards Index in district d on date t. $\text{Proportion}_{i,t}$ is the share of green slots in the delivery menu. The specification controls for $\text{OrderChar}_{i,t}$, which includes $\text{Expensive}_{i,t}$, $\text{Qty}_{i,t}$, and $\text{Orderweight}_{i,t}$ (total order weight).

To control for unobserved heterogeneity, the model includes individual fixed effects (γ_i), postal sector fixed effects (δ_d), year-month fixed effects (θ_t), and day-of-week fixed effects (η_t). Standard errors are clustered at the individual level.

*[Insert Table **??**]*

Columns 1 and 2 present baseline results without considering environmental salience.

The coefficient on *Ln_psi* is negative and significant: a 10% increase in PSI reduces green delivery choice by approximately 0.12 percentage points (Column 2). Singapore's PSI typically ranges from 25 (clean air) to occasionally exceeding 100 during regional haze episodes from Indonesian forest fires. Moving from clean conditions (PSI of 25) to moderately polluted conditions (PSI of 80), roughly a 220% increase, would reduce green choice by approximately 2.7 percentage points based on this specification. The negative pollution effect is consistent with cognitive scarcity theories. Poor air quality creates physical discomfort and has been documented to impair cognitive function (Chen et al. 2024), reduce workplace productivity, and increase irritability.

However, columns 3 and 4 reveal a crucial interaction with environmental salience that transforms our interpretation. When we include *HasEvent* (indicating days with prominent environmental events) and its interaction with pollution, the main effect of *Ln_psi* becomes positive or statistically insignificant, while the interaction term is strongly negative. The coefficient on *HasEvent* of 0.7910 (Column 3) indicates that environmental events substantially boost green choice during clean air conditions. But the interaction coefficient of -0.1910 shows that each 10% increase in PSI reduces this event boost by approximately 1.9 percentage points.

This pattern suggests that pollution itself does not uniformly reduce green choice in the same manner as thermal stress. Instead, pollution operates through a different channel: it specifically undermines the effectiveness of environmental salience. When air quality is poor and environmental awareness is high (such as during haze episodes that receive media attention), individuals may experience cognitive dissonance or decision fatigue. They are reminded of environmental problems through both direct physical experience (breathing polluted air) and increased media coverage, yet the discomfort and cognitive impairment from pollution simultaneously make it harder to act on environmental concerns. The interaction effect captures this tension: heightened environmental attention increases green choice when conditions are comfortable, but pollution negates this boost by creating physiological barriers to acting on environmental values.

This finding complements our temperature results while revealing a distinct mechanism. Thermal stress appears to directly crowd out environmental considerations by narrowing attention to immediate comfort needs, producing consistent negative effects regardless of environmental salience. In contrast, air pollution primarily interferes with the translation of environmental awareness into behavior, evidenced by its strong negative interaction with environmental events. Both mechanisms ultimately reduce sustainable behavior under environmental stress, but through different cognitive pathways: temperature constrains attention allocation, while pollution disrupts the connection between values and action. Together, these results demonstrate that multiple dimensions of environmental degradation create barriers to pro-environmental behavior, each operating through specific attention and cognition channels that compound the challenge of maintaining sustainable practices as climate conditions deteriorate.

5.1.2 Rainfall

Table **??** examines the effect of rainfall on green delivery choice, providing an important falsification test for our attention scarcity mechanism. Unlike temperature, rainfall presents an ambiguous theoretical prediction that allows us to distinguish between competing explanations for our heat results.

[Insert Table **??***]*

From a purely mechanical perspective, rainfall should increase green delivery adoption through our platform's slot consolidation mechanism. Rain makes outdoor activities less convenient, likely increasing overall grocery delivery demand. Higher order volume creates more opportunities for slot consolidation: a delivery slot becomes 'green' only after an initial customer has already selected it, meaning more orders mechanically generate more green slots available to subsequent customers. If this mechanical channel dominated, we would expect rainfall to positively predict green choice simply because rain increases the supply of consolidatable slots.

The results in Table **??** confirm this mechanical prediction. Columns 1 through 4 examine different rainfall measures without delivery controls, while columns 5 through 8 add these controls. Daily total rainfall shows a positive and significant effect: each millimeter of daily rainfall increases green delivery choice by 0.03 percentage points (Column 1), an effect that persists with delivery controls (Column 5, 0.02 percentage points). Columns 2 through 4 examine rainfall intensity using maximum precipitation over 30-minute, 60-minute, and 120-minute windows. The 120-minute maximum rainfall exhibits the strongest effect (0.04 percentage points in Column 4), suggesting that sustained heavy rainfall particularly boosts green adoption, likely because prolonged rain most strongly shifts demand toward delivery services.

These positive rainfall effects stand in sharp contrast to our negative temperature effects, despite the fact that rainfall and temperature are typically highly correlated in tropical climates like Singapore. Rain often accompanies lower temperatures and provides relief from heat, yet the two weather conditions produce opposite effects on sustainable behavior. This divergence is difficult to reconcile with alternative explanations for our temperature findings. If heat reduced green choice simply by increasing overall delivery demand (which might strain consolidation), rainfall should produce similar negative effects since it also increases demand. If heat operated through general weather-related discomfort that crowds out all non-essential considerations, rainfall (which creates its own form of discomfort and inconvenience) should likewise reduce green choice.

Instead, the positive rainfall coefficient supports our attention scarcity framework. Rainfall increases green adoption because it operates primarily through the mechanical channel of expanding slot availability, without imposing the same physiological stress that heat creates. Unlike heat and humidity, which generate direct thermal discomfort that forces attention toward immediate cooling needs, rainfall does not create comparable cognitive burden or redirect attention away from environmental considerations. In fact, the comfort of staying indoors during rain may even free cognitive resources for considering delivery options more carefully. This asymmetry between rainfall and temperature effects validates our theoretical mechanism: thermal stress specifically crowds out environmental considerations by narrowing attention to immediate physiological comfort, a channel that rainfall does not activate despite similarly affecting delivery patterns. The falsification test thus strengthens confidence that our temperature results reflect genuine attention-based behavioral responses rather than spurious correlations with weather-driven demand fluctuations.

5.1.3 Google Searches

To further validate our attention-based framework, Table **??** examines whether heightened environmental salience increases green delivery choice by testing the role of public attention to sustainability. We construct a measure of environmental awareness using Google Trends data for sustainability-related search terms in Singapore, capturing fluctuations in public attention to environmental issues.

[Insert Table **??***]*

Our analysis employs a two-stage approach. Columns 1 and 2 establish that major environmental events substantially increase public attention to sustainability. The variable *HasEvent* indicates days with prominent environmental events (such as Earth Day, climate summits, or major environmental news). The coefficient of 1.5675 (Column 1) indicates that environmental events increase the Google Trends sustainability index by approximately 157%, an effect that strengthens to 165% when controlling for delivery characteristics (Column 2). This first stage confirms that our measure captures meaningful variation in environmental salience driven by exogenous events.

Columns 3 and 4 examine whether this heightened environmental attention translates into sustainable behavior. The coefficient on *sustainability* is positive and significant: a one-unit increase in the sustainability index increases green delivery choice by 0.03 percentage points without controls (Column 3) and 0.06 percentage points with controls

(Column 4). Given that environmental events produce roughly a 150-unit increase in the sustainability index, these estimates imply that major environmental events boost green delivery adoption by approximately 4.5 to 9 percentage points through increased public attention alone.

This finding provides critical support for our attention scarcity mechanism. If cognitive attention toward environmental considerations increases sustainable behavior, then factors that expand this attention (environmental events and media coverage) should enhance green choice, while factors that crowd out attention (thermal stress) should reduce it. The positive effect of sustainability salience mirrors and validates our negative temperature effects: both demonstrate that the allocation of cognitive attention directly shapes environmental decision making. When public discourse and media coverage make environmental issues more salient, individuals have greater cognitive capacity devoted to sustainability considerations, making them more likely to choose green options even when doing so requires minimal effort or sacrifice. Conversely, when physiological stress from heat and humidity captures attention and redirects it toward immediate comfort needs, the same environmental considerations recede from decision making.

The magnitude of the salience effect also offers perspective on the policy importance of our temperature findings. While major environmental events can temporarily boost green choice by several percentage points, our earlier results show that moving from comfortable to stressful thermal conditions reduces green choice by similar or larger magnitudes. This suggests that rising temperatures under climate change could systematically erode sustainable behavior on a scale comparable to the benefits achieved through periodic increases in environmental awareness, creating a persistent rather than temporary barrier to pro-environmental action. The symmetry between attention-expanding events and attention-constraining thermal stress thus reinforces our core theoretical claim: scarcity of cognitive attention represents a fundamental constraint on sustainable behavior that environmental conditions can either alleviate or exacerbate.

5.1.4 Alternative Temperature Specifications

To verify that our main findings are not artifacts of the logarithmic transformation, Table **??** re-estimates the effects of thermal stress using temperature measures in levels rather than logs. This alternative specification provides a complementary perspective: coefficients now represent the absolute percentage-point change in green choice probability for each one-degree Celsius increase in temperature.

[Insert Table **??***]*

Panel A examines mean temperature in levels. The coefficient of -0.0042 (Column 1) indicates that each degree Celsius increase in mean temperature reduces green delivery adoption by 0.42 percentage points. This effect remains significant when controlling for delivery characteristics (Column 2, −0.0032). Given that Singapore's mean temperatures range from approximately 25°C to 29°C in our sample, a 4°C increase from cooler to hotter conditions would reduce green choice by roughly 1.28 to 1.68 percentage points, consistent with the magnitude implied by our log specification in Table **??**.

Panel B presents results for maximum temperature in levels. The coefficient of −0.0026 implies that each degree Celsius increase in peak daily temperature reduces green choice by 0.26 percentage points. Singapore's maximum temperatures range from approximately 28°C to 34°C, meaning that moving from moderate to extreme heat (a 6°C increase) would reduce sustainable behavior by approximately 1.56 percentage points. While the per-degree effect is smaller than for mean temperature, maximum temperature captures the acute stress of peak heat exposure when discomfort is most pronounced.

Panel C examines wet-bulb temperature in levels, providing our most direct measure of physiological heat stress. The coefficient of −0.0121 is substantially larger than those for mean or maximum temperature: each degree Celsius increase in wet-bulb temperature reduces green delivery choice by 1.21 percentage points. This stronger effect reflects the fact that wet-bulb temperature directly captures the body's thermoregulatory capacity. Singapore's wet-bulb temperatures span from roughly 22°C to 27.5°C in our sample. A 5.5°C increase from comfortable to physiologically stressful conditions would reduce green choice by approximately 6.66 percentage points in the baseline specification, representing a massive behavioral response. This finding reinforces our interpretation from Table **??**: combined heat and humidity stress, not heat alone, most powerfully crowds out environmental considerations by forcing attention toward immediate thermal comfort.

The consistency of negative and highly significant effects across all three panels confirms that our main results are robust to functional form. Whether we model temperature effects logarithmically or linearly, thermal stress systematically undermines sustainable behavior. The larger coefficients for wet-bulb temperature in both specifications underscore that humidity-adjusted heat provides the most policy-relevant measure of environmental conditions that compete with pro-environmental decision making. These robustness checks strengthen confidence that rising temperatures under climate change will create a behavioral feedback loop, where the environmental conditions that make sustainable action most urgent simultaneously make such action psychologically more difficult.

6 Conclusion

This paper demonstrates that attention scarcity fundamentally constrains household contributions to climate mitigation. Using transaction-level evidence from Singapore's largest online grocery platform, we show that thermal stress systematically reduces green delivery adoption, while environmental campaigns temporarily boost sustainable behavior by redirecting attention toward environmental goals. Critically, thermal stress undermines the effectiveness of these campaigns, revealing that climate change itself erodes the cognitive mechanisms needed to sustain pro-environmental action.

Three main contributions emerge. First, we provide causal evidence on how attention allocation shapes sustainable consumption in real time. Environmental campaigns increase green delivery choice by 5 to 7 percentage points on event days, representing a 17 to 23% increase relative to baseline. Event study analysis confirms that these effects operate through short-lived attention shifts rather than persistent preference changes, with no pre-trends and rapid dissipation after events end. This demonstrates that salience-based interventions can meaningfully influence everyday environmental decisions when cognitive bandwidth is available.

Second, we establish that thermal stress crowds out sustainable behavior through attention mechanisms. All four temperature measures examined (abnormal temperature, mean temperature, maximum temperature, and wet-bulb temperature) show negative and highly significant effects. A 10% increase in wet-bulb temperature reduces green choice by approximately 2.3 to 3.0 percentage points, with moving from comfortable to physiologically stressful conditions (23°C to 27°C wet-bulb) reducing adoption by roughly 5 percentage points. These effects remain robust across alternative specifications and are distinct from mechanical channels: rainfall increases green adoption through expanded slot availability, while temperature operates by narrowing attention to immediate comfort concerns.

Third, and most critically, we document that thermal stress specifically undermines environmental messaging. Interaction analysis reveals that a 10% increase in wet-bulb temperature reduces the campaign boost by approximately 8 to 11 percentage points. Under comfortable conditions, environmental events can increase green choice by 27 to 35 percentage points. However, as temperatures rise to stressful levels, this boost shrinks dramatically or reverses entirely. This pattern demonstrates that thermal discomfort and environmental salience compete for the same scarce cognitive resource, creating a behavioral feedback loop where climate conditions undermine the interventions designed to address climate change.

Our findings extend the cognitive scarcity literature by showing that attentional constraints systematically reduce pro-social contributions to collective environmental goods, not merely private economic outcomes. They also reveal an overlooked cost of environmental degradation: heat and humidity weaken the behavioral foundations needed for climate mitigation precisely when such action becomes most urgent. As global temperatures rise, the periods when environmental campaigns and sustainability messaging are most needed coincide with conditions that make individuals least receptive to such interventions.

From a policy perspective, these results highlight both opportunities and constraints. Simple salience interventions like environmental campaigns can generate meaningful behavioral responses at low cost, demonstrating the potential of attention-based policy tools. However, the effectiveness of such interventions depends critically on ambient conditions. As climate stress intensifies, policymakers may need to shift from purely informational approaches toward interventions that reduce cognitive burden or operate independently of conscious attention allocation, such as smart defaults, automated sustainable choices, or infrastructure changes that make green options the path of least resistance rather than requiring active consideration.

The interaction between choice architecture and order characteristics provides additional guidance. Menu prominence substantially increases green adoption (a 10 percentage point increase in green slot availability raises uptake by 4.8 percentage points), but this sensitivity diminishes when financial stakes, basket complexity, or logistical concerns increase cognitive load. This suggests that sustainable choice architecture is most effective for simple, low-stakes transactions where cognitive resources remain available for processing environmental information. For complex or high-value decisions, stronger interventions may be necessary to overcome the natural tendency for immediate concerns to dominate attention.

Looking forward, our framework suggests several directions for research and policy. First, interventions should be designed with explicit consideration of cognitive constraints, particularly during periods of environmental stress. Second, the behavioral feedback loop we document implies that climate adaptation and mitigation are not independent challenges: rising temperatures may systematically erode the behavioral mechanisms needed to limit further warming. Third, understanding heterogeneity in attention capacity and how it varies with environmental conditions could help target interventions more effectively. Finally, our setting focuses on low-cost sustainable actions; the attention mechanisms we identify may play even larger roles in higher-stakes environmental decisions where cognitive demands are greater.

In sum, this paper establishes attention allocation as a fundamental determinant of household contributions to climate mitigation and reveals how environmental stress creates a vicious cycle that undermines sustainable behavior. Addressing climate change will require not only technological solutions and economic incentives, but also careful design of interventions that account for the cognitive constraints individuals face, particularly as those constraints intensify under the very conditions that make environmental action most critical.

7 Additional Tables and Figures

Table 1: Listing of Events

Start Date	**End Date**	**Year**	**Month**	**Day**	**EventName**	**Category**	**Description**	**Duration Days**
2023/5/13	2023/5/13	2023	5	13	SG Clean Day - Islandwide Clean Up	Environment	Record-breaking community clean-up under Public Hygiene Council	1
2023/9/14	2023/9/14	2023	9	14	Recycle Right Campaign Update 2023	Environment	NEA update encouraging correct recycling; household recycling survey release	1
2023/9/16	2023/9/16	2023	9	16	World Cleanup Day SG 2023	Environment	Global cleanup day observed across Singapore	1
2023/10/14	2023/10/14	2023	10	14	International E-waste Day activation (NEA)	Environment	NEA e-waste awareness activation at Toa Payoh HDB Hub	1
2023/11/4	2023/11/4	2023	11	4	Clean & Green Singapore Day 2023	Environment	National CGS Day with community activities and tree-planting	1
2023/12/15	2023/12/15	2023	12	15	GreenGov.SG Report (Inaugural)	Environment	Public sector sustainability performance report released	1
2024/3/4	2024/3/4	2024	2	10	Green Plan 2030 - COS Update 2024	Environment	Committee of Supply speech / Green Plan progress highlights	1
2024/6/12	2024/7/14	2024	6	12	Go Green SG 2024	Environment	Nationwide sustainability movement; many public events	33
2024/6/14	2024/7/22	2024	6	14	Singapore Oil Spill Response	Weather/ Environment	Collision-led fuel oil spill; response and phased beach reopening	39
2024/6/24	2024/6/24	2024	6	24	NEA Update: Bulk Oil Removal Near Completion	Weather/ Environment	NEA update on oil removal progress; shift to specialised cleanup	1

Continued on next page

Table 1: Listing of Events (continued)

Start Date	**End Date**	**Year**	**Month**	**Day**	**EventName**	**Category**	**Description**	**Duration Days**
2024/7/13	2024/7/30	2024	7	13	Dry Spell (18 days)	Weather	18 consecutive days with <1.0 mm rainfall; respite end July	18
2024/9/20	2024/9/20	2024	9	20	World Cleanup Day SG 2024	Environment	Global cleanup day	1
2024/11/3	2024/11/3	2024	11	3	Clean & Green Singapore Day 2024	Environment	Environmental stewardship day; community and hygiene focus	1
2024/11/18	2024/11/18	2024	11	18	GreenGov.SG Report FY2023	Environment	Annual public sector sustainability performance report release	1
2025/1/10	2025/1/13	2025	1	10	Northeast Monsoon Surge Advisory Window	Weather	NEA advisory: monsoon surge bringing cool rainy conditions	4

Notes. This hand-collected table summarizes the green events which took place during our sample period.

Table 2: Robustness: Air Pollution (Absolute Value)

	Dependent variable: green							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	green	green	green	green	green	green	green	green
PSI_mean	-0.0003**	-0.0003**						
	(0.0001)	(0.0001)						
PSI_max			-0.0001	-0.0001				
			(0.0001)	(0.0001)				
PM25_mean					-0.0001	-0.0001		
					(0.0002)	(0.0002)		
PM25_max							-0.0001	-0.0001
							(0.0001)	(0.0001)
Control	No	Yes	No	Yes	No	Yes	No	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	244,177	244,060	244,177	244,060	244,177	244,060	244,177	244,060
R-squared	0.3544	0.3583	0.3543	0.3582	0.3543	0.3582	0.3543	0.3582
Adj. R-squared	0.1351	0.1403	0.1351	0.1403	0.1351	0.1403	0.1351	0.1403

Note. This table presents the impact of air pollution on consumer green choice. The Pollutant Standards Index (PSI) is a type of air quality index used in Singapore, which is a number used to indicate the level of pollutants in the air. Robustness using absolute value as the pollution measure. The regressions control for internal delivery variables *Proportion, Expensive, Qty, Order weight.* All columns include individual, slot timing, district, day-of-week, and year-month fixed effects. Standard errors in parentheses are clustered at the individual level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 3: The effect of environmental factors on other consumption choices

	Independent variable: PSI		
	(1)	(2)	(3)
	Expensive	qty	order weight
Panel A: PSI			
Ln_PSI	-0.00377	-0.115	0.0000298
	(0.00388)	(0.113)	(0.000158)
Adj. R-squared	0.4192	0.5854	0.5694
Observations	244177	244177	244060
Panel B: Abnormal temperature			
Abn temp	-0.00240**	-0.00753	0.0000973**
	(0.000952)	(0.0270)	(0.0000386)
Adj. R-squared	0.4191	0.5855	0.5694
Observations	243912	243912	243795
Panel C: Wet-bulb temperature			
Ln_Twb	-0.0865*	0.320	0.00528***
	(0.0453)	(1.320)	(0.00184)
Adj. R-squared	0.4192	0.5854	0.5694
Observations	244177	244177	244060
Panel D: Mean temperature			
Ln_mean temp	-0.113***	-1.410*	0.00197*
	(0.0276)	(0.784)	(0.00113)
Adj. R-squared	0.4192	0.5854	0.5694
Observations	244177	244177	244060
Panel E: Max temperature			
Ln_max temp	-0.0629***	-0.584	0.000561
	(0.0204)	(0.589)	(0.000842)
Adj. R-squared	0.4192	0.5854	0.5694
Observations	244177	244177	244060
Panel F: Event			
HasEvent	-0.00721	-0.114	-0.000355
	(0.00516)	(0.150)	(0.000220)
Adj. R-squared	0.4192	0.5854	0.5694
Observations	244177	244177	244060
Panel G: Rainfall			
Daily_rainfall	0.000204***	0.00325*	-0.00000387
	(0.0000572)	(0.00169)	(0.00000248)
Adj. R-squared	0.4192	0.5854	0.5694
Observations	244177	244177	244060
Control	Yes	Yes	Yes
FE	Yes	Yes	Yes

Note. The table presents the effect of air pollution, temperature, event and rainfall on other consumption choices. All the columns include individual fixed effects, slot timing fixed effects, district fixed effects, day-of-week fixed effects and year-month fixed effects. Standard errors in parentheses are clustered at the individual level. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

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