badvertising

Advertising and demand for Sports Utility Vehicles

Demand for SUVs among UK residents is positively related to their exposure to SUV adverts but unrelated to their exposure to pro-ecological transport messages

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This paper was first published in December 2021

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Contents

Executive Summary

Demand for Sports Utility Vehicles (SUVs) plays an increasing and outsize role in CO_2 emissions. Some recent evidence suggests that advertising is partially responsible for SUV demand, but, to our knowledge, no primary research has examined this relationship directly with the use of sophisticated statistical tools. In order to fill this gap, we designed a survey and then obtained data from UK residents who either owned an SUV, owned a standard car but not a large motor vehicle, or owned no motor vehicle. Respondents reported on-line about their exposure to SUV adverts and to pro-ecological transport messages (e.g., encouraging the use of public transport). After statistically controlling for 10 demographic variables and 3 general advertising exposure variables, results showed that exposure to SUV adverts was significantly positively associated with current ownership of an SUV. For example, compared to a person who reports that s/he is "rarely" exposed to SUV advertisements, a person who reports that s/he is “sometimes" exposed to SUV advertisements is 71% more likely to own an SUV than a standard car and is 250% more likely to own an SUV than to own no motor vehicle. Exposure to SUV adverts was also positively associated with desire to purchase an SUV. For example, a person who reports being exposed to SUV advertising "sometimes" would score almost a half point higher on the 5-point rating scale of desire to purchase an SUV than would someone who reports being exposed to SUV advertising "rarely." In contrast to these results for exposure to SUV adverts, exposure to pro-ecological transport messages was unrelated to any measure of demand for an SUV. That is, such positive environmental messages appear to be irrelevant to SUV demand and are, in effect, drowned out by SUV adverts. These findings suggest that governmental and campaigning groups that are trying to reduce CO_2 emissions from SUVs may do well to focus at least as much on ending the practice of SUV advertising as on sending pro-ecological transport messages to the general public.

Background

The transport sector accounts for about 25% of CO_2 emissions in Europe and 34% in the UK.[1,2] According to a recent report by the International Energy Agency,[3] demand for Sports Utility Vehicles (SUVs) plays an outsize and increasing role in these climate-damaging emissions; Table 1 provides a summary of some of the evidence for this.

Table 1: Key data on Sports Utility Vehicles from the International Energy Agency.

In general...	In 2020...
"On average, SUVs consume about a quarter more energy than medium-size cars."	**"The share of SUVs in total car sales has increased to 42%..., around 3 percentage points higher than in 2019"** **"...close to 97% of SUVs sold ... had fossil fuel-powered engines."** **"The world's overall energy-related emissions fell by an estimated 7% ... but emissions from SUVs ... are estimated to have seen a slight increase of 0.5%."** **"we estimate that the increase in the overall SUV fleet ... cancelled out the declines in oil consumption by SUVs that resulted from Covid-related lockdown measures" and that "the reduction in oil demand from the increased share of electric vehicles in the overall car market ... was completely cancelled out by the growth in SUV sales..."**
Over the past decade...	
"Emissions from SUVs have nearly tripled," outpacing "the growth of other segments of the auto market. Today, SUV emissions are comparable to those of the entire maritime industry, including international shipping." **"SUVs were the only area of energy-related emissions growth in advanced economies, adding 300 million tonnes of CO_2 (Mt CO_2). Across all other sectors of the economy ... and other forms of transport, carbon emissions remained flat or declined."**	

[1] Transport & Environment, April 2018, *CO2 Emissions from cars: the facts* https://www.transportenvironment.org/sites/te/files/publications/2018_04_CO2_emissions_cars_The_facts_report_final_0_0.pdf

[2] Department for Business, Energy & Industrial Strategy, March 26, 2020, *2019 UK greenhouse gas emissions, provisional figures* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/875485/2019_UK_greenhouse_gas_emissions_provisional_figures_statistical_release.pdf

[3] https://www.iea.org/commentaries/carbon-emissions-fell-across-all-sectors-in-2020-except-for-one-suvs

People's demand for any product, including an SUV, is likely influenced by many factors, including their interactions with friends and family who own (or do not own) the product and the extent to which the physical infrastructure where they live makes it easy to buy and use one product but difficult to buy and use an alternative product. Exposure to advertisements is another factor known to influence demand for products, including such ecologically- damaging products as leisure air travel,[4] as well as tobacco and beef.[5]

Some recent reports have suggested that SUV advertisements might be partly responsible for people's increasing demand for SUVs. For example, marketing researchers recently calculated that an award-winning advertising campaign from 2015-2017 by auto-maker Audi resulted in the sale of almost 133,000 additional autos, many of them SUVs; these extra sales contributed to an additional 5 million tons of emitted CO_2.[6] Media Monitors found that Ford motor company began shifting its mix of advertising expenditures on cars vs. SUVs and trucks from a 50/50 ratio in 2016 to a 15/85 ratio in 2018,[7] a shift that coincides with increasing demand for SUVs. Further, a recent report from the New Weather Institute (the sponsor of the current study) shows the sophisticated ways that SUVs have been marketed to make them seem more appealing than standard cars, even to individuals who will rarely take them "off-road".[8] Another report from the New Weather Institute finds that the global sports industry currently has almost 200 sponsorship deals with automakers, thereby encouraging sports fans to consume ecologically- damaging products like SUVs.[9]

These pieces of anecdotal and historical evidence are certainly consistent with the claim that increasing demand for SUVs has occurred concurrently with their active marketing by auto-makers. However, to our knowledge, no studies have yet collected primary data and conducted sophisticated statistical analyses to empirically test whether

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[4] Frick, V., Matthies, E., Thogersen, J., & Santarius, T. (2021). Do online environments promote sufficiency or overconsumption? Online advertisement and social media effects on clothing, digital devices, and air travel consumption. *Journal of Consumer Behavior, 20 (2),* 288-308.

[5] https://www.badverts.org/s/Advertisings-role-in-climate-and-ecological-degradation.pdf

[6] Davison, C., & Essen, B. (2020). Eco-effectiveness: The missing measure in a climate crisis. Presentation available at https://ipa.co.uk/effworks/effworksglobal-2020/ecoeffectiveness-the-missing-measure-in-the-climate-crisis/

[7] http://www.insideradio.com/free/ford-ad-spend-predicted-company-s-shift-away-from-cars/article_69c0c832-e65a-11e8-a609-5b56473df19e.html

[8] https://www.badverts.org/s/Mindgames-on-wheels-FINAL.pdf

[9] https://www.badverts.org/s/Sweat-Not-Oil-why-Sports-should-drop-advertising-from-high-carbon-polluters-March-2021v3.pdf

a significant, reliable, and robust relationship occurs between exposure to SUV advertising and demand for SUVs. The first purpose of the current project was to conduct such a study and determine whether such a relationship indeed exists.

A second purpose of the current project was to examine another type of message regarding transport to which people are often (but less frequently) exposed. Specifically, messages from governmental and campaign groups often promote alternative, eco-friendly ways of transporting one's self around, such as cycling, using public transport, or buying electric or small vehicles. We assume that such organizations hope that well-communicated, "green" messages might be able to outcompete the advertisements, social norms, and physical infrastructures that promote ecologically-damaging choices, because people might "do the right thing" if they are exposed to such messages.

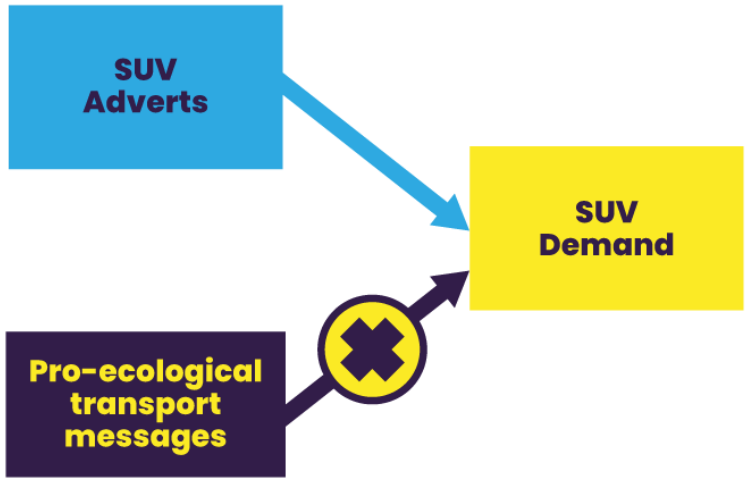
Unfortunately, we are unaware of any data showing that such pro-ecological transport messages are actually effective in reducing demand for SUVs. In fact, one recent study[10] casts doubt on the efficacy of such messages, as Germans' consumption of electronics, fashion, and leisure airline flights was essentially unrelated to on-line exposure to eco-friendly messages but was positively predicted by on-line exposure to advertisements and other pro-consumption messages for these products and services. In the current project, we sought to examine whether similar findings occur in the case of demand for SUVs.

[10] Frick et al., 2021

Overview of Project

We tested two hypotheses in this project. First, we hypothesized that people's exposure to SUV advertisements would be positively associated with their current ownership of and desire to purchase an SUV. Second, we hypothesized that people's self-reported exposure to pro-ecological transport messages would be unrelated to (or at best, weakly negatively related to) their current ownership of and desire to purchase an SUV. Figure 1 graphically represents these hypotheses.

Figure 1: Visual Representation of the Current Study's Two Hypotheses.



We tested these hypotheses by undertaking a two-stage survey with UK residents. As described below and in Appendices A and B, we collected information from three samples of people: those who owned an SUV, those who owned a standard car (e.g., a four-door car or mini-car) but not an SUV or other large motor vehicle, and those who owned no motor vehicle at all. We asked these individuals about their desire to purchase an SUV in the future as well as their exposure to advertisements for SUVs and to pro-ecological transport messages. We also collected data to control for a large number of demographic factors and the respondents' general advertising exposure. Finally, we used advanced statistical techniques to test our hypotheses.

Sample

Our sample was recruited via the website Prolific (see **www.prolific.co** for further information on this service). Appendix A explains the process by which we obtained our ultimate sample of 472 adult residents of the United Kingdom; as explained in the Glossary of Statistical and Methodological Terms, this sample size provided sufficient statistical power to allow us to detect small to medium size effects.

151 of these individuals reported owning a gasoline-powered or hybrid Sports Utility Vehicle (SUV); owners of fully electric SUVs were excluded. Thirty-four of the individuals in the SUV group had purchased their vehicle less than one year ago, 34 between one and two years ago, 38 between two and three years ago, 22 between three and four years ago, and 23 more than four years ago.

For comparison, we also collected data from 163 individuals who reported owning a standard car (SC; e.g., mini-car) and not owning an SUV, truck, lorry, or van. In addition, we collected data from 158 individuals who reported that they do not own any type of motor vehicle (NMV).

As reported in Table 2 the three groups (henceforth SUV, SC, and NMV) had similar distributions on most demographic variables, including gender, age, ethnicity, nationality, and area of the UK in which they resided. The SUV and SC groups also had similar distributions on income, employment status, and number of children under age 16 in the home, but the SC group was composed of somewhat more students and single people than was the SUV group. Compared to the SUV group, the NMV group tended to be poorer, less likely to be employed full time, less likely to be married, and less likely to have children under age 16 in the home. These demographic differences between groups were statistically controlled for in relevant analyses (see Glossary and below).

Table 2: Demographics of the groups owning a Sports Utility Vehicle (SUV), a Standard Car (SC), and No Motor Vehicle (NMV).

Age	**Sports Utility Vehicle**	**Standard Car**	**No Motor Vehicle**
18-29 years	8.61%	12.88%	12.66%
30-39 years	33.77%	31.90%	34.18%
40-49 years	25.17%	25.15%	22.78%
50-59 years	19.87%	19.63%	18.99%
60-69 years	11.92%	9.82%	10.13%
70 or more years	0.66%	0.61%	1.27%
Gender	**Sports Utility Vehicle**	**Standard Car**	**No Motor Vehicle**
Male	41.06%	42.94%	44.30%
Female	58.94%	57.06%	55.70%
Yearly Household Income	**Sports Utility Vehicle**	**Standard Car**	**No Motor Vehicle**
<20,000 GBP	13.25%	10.43%	45.57%
20,001-40,000 GBP	27.15%	42.33%	32.28%
40,001-60,000 GBP	35.10%	20.86%	9.49%
60,001-80,000 GBP	13.25%	13.50%	6.96%
>80,000 GBP	11.26%	12.88%	5.70%
UK Area of Residence	**Sports Utility Vehicle**	**Standard Car**	**No Motor Vehicle**
England	75.50%	79.14%	77.22%
North Ireland	4.64%	3.68%	4.43%
Scotland	15.23%	12.88%	13.92%
Wales	4.64%	4.29%	4.43%
Number of children under 16 years old in household	**Sports Utility Vehicle**	**Standard Car**	**No Motor Vehicle**
0	53.64%	63.19%	84.18%
1	19.87%	17.79%	10.13%
2	17.22%	19.02%	3.80%
3	7.95%	0.00%	1.27%
4	1.32%	0.00%	0.00%
5 or more	0.00%	0.00%	0.63%

Nationality	Sports Utility Vehicle	Standard Car	No Motor Vehicle
UK	88.67%	91.41%	87.34%
Other	11.33%	8.59%	12.66%
Employment Status	**Sports Utility Vehicle**	**Standard Car**	**No Motor Vehicle**
Full-time	56.67%	53.37%	33.55%
Not in paid work	22.67%	17.18%	22.58%
Part-time	15.33%	19.63%	21.94%
Unemployed (seeking job)	3.33%	4.91%	13.55%
Starting new job soon	0.00%	0.61%	2.58%
Other	2.00%	4.29%	5.81%
Student Status	**Sports Utility Vehicle**	**Standard Car**	**No Motor Vehicle**
Yes	3.97%	11.66%	11.46%
No	96.03%	88.34%	88.54%
Marital Status	**Sports Utility Vehicle**	**Standard Car**	**No Motor Vehicle**
Single	15.89%	33.13%	55.70%
Married or de facto	76.16%	58.90%	32.91%
Separated or divorced	6.62%	6.75%	7.59%
Widowed	0.00%	1.23%	2.53%
Unclear status	1.32%	0.00%	1.27%
Ethnicity	**Sports Utility Vehicle**	**Standard Car**	**No Motor Vehicle**
Asian	5.30%	8.59%	6.96%
Black	6.62%	4.29%	4.43%
Mixed	1.99%	2.45%	1.27%
Other	0.66%	0.61%	1.27%
White	85.43%	84.05%	86.08%

Measures

Appendix B provides detailed information regarding the questions that we asked respondents and how the resulting data were coded and/or used in calculation procedures. In brief, we collected data on three sets of variables.

The first set of variables included three outcome variables, i.e., the variables measuring SUV demand that we were trying to understand and explain. The first variable was the

respondents' *current ownership of a standard car vs. an SUV*. The second variable was the respondents' *current ownership of no motor vehicle vs. an SUV*. The third variable was the respondents' desire to purchase an SUV in the coming two years.

The second set of variables included two predictor variables, i.e., the variables that we were using to understand and explain the outcome variables. One of these variables was respondents' reported *exposure to SUV advertisements* and the other was their reported *exposure to pro-ecological transport messages.*

The third set of variables included thirteen control variables (see Glossary). Ten of these variables were demographic: *age, gender, yearly household income, UK area of residence, number of children under 16 years old in the household, nationality, employment status, student status, marital status, and ethnicity.* The other three control variables concerned the respondents' *general advertising exposure on electronic media, in traditional media,* and *in public locations.* By including these 13 control variables in our statistical analyses, we can be confident that any relationship that might be found between exposure to SUV advertisements on the one hand and ownership of and/or desire to purchase an SUV on the other hand is **not** due to the 13 variables we statistically controlled for. For example, by having controlled for gender in the analyses, it would be inappropriate to claim that the reason that exposure to SUV advertisements relates to SUV ownership is because of issues related to gender; the use of these control variables in the statistical procedures rules out such an alternative interpretation.

Results

Recall that we had two primary hypotheses. First, we expected that respondents' current ownership of and desire to purchase an SUV would be positively related to their exposure to SUV advertisements. Second, we expected that ownership of and desire to purchase an SUV would be unrelated (or, at best, weakly negatively related) to exposure to pro-ecological transport messages.

We first examined our hypotheses by comparing individuals who own a standard car (SC) to those who own a Sports Utility Vehicle (SUV) and by comparing individuals who do not own a motor vehicle (NMV) to those who own a Sports Utility Vehicle (SUV). We did so via a statistical tool known as logistic regression, which is implemented when multiple variables are simultaneously used to predict a binary outcome such as group membership (see Glossary for further information). One logistic regression was conducted for the SC vs. SUV comparison and another for the NMV vs. SUV comparison; the results of these analyses are presented in Tables 3 & 4, respectively.

Table 3 – B-weights, Odds Ratios (and Standard Errors) from Logistic Regressions Predicting Owning a Standard Car (SC) vs. a Sports Utility Vehicle (SUV).

Demographic Variables	**Model 1 B-weights**	**Model 2 B-weights**	**Model 2 Odds Ratios**
Age	.01 (.01)	.01 (.01)	1.01 (.01)
Gender	.05 (.25)	.08 (.26)	1.08 (.28)
Yearly Household Income	-.13 (.12)	-.20 (.12)+	0.82 (.10)
UK Area of Residence	-.24 (.29)	-.18 (.30)	0.83 (.25)
Number of Children	.24 (.14)+	.23 (.15)	1.26 (.17)*
Nationality	-.58 (.43)	-.52 (.44)	0.59 (.25)
Employment Status	.20 (.27)	.23 (.28)	1.25 (.35)
Student Status	-1.00 (.54)+	-1.14 (.57)*	3.13 (.17)
Marital Status	.72 (.30)*	.70 (.31)*	2.02 (.63)
Ethnicity	.24 (.35)	.34 (.36)	1.41 (.50)
General Advertising Exposure			
On Electronic Media	.09 (.07)	.11 (.08)	1.12 (.08)
In Traditional Media	-.11 (.08)	-.14 (.08)+	0.87 (.07)
In Public Locations	.11 (.13)	.02 (.14)	1.02 (.13)
Exposure to			
SUV advertisements		.54 (.17)**	1.71 (.28)**
Pro-ecological Transport Messages		.05 (.22)	1.05 (.23)

Note: + = p < .10, * = p < .05, ** = p < .01. Motor vehicle ownership: 0 = ownership of a standard car (SC), 1 = ownership of a Sports Utility Vehicle (SUV); Gender: 0 = male, 1 = female; UK area of residence: 0 = resides in Scotland, Wales, or Northern Ireland, 1 = resides in England; Number of Children = Number of children under 16 years old in the household; Nationality: 0 = non UK, 1 = UK; Employment Status: 0 = any non-full time employment status, 1 = full time employment status; Student Status: 0 = non-student; 1 = student; Marital Status: 0 = any non-married or non de facto status, 1 = married or de facto; Ethnicity: 0 = any non-White ethnicity, 1 = White. All models were also estimated using a probit model to check the robustness of the results. The coefficients and significance of the estimators did not differ notably between specifications. Hence, we decided to maintain the Logit specification.

Table 4 – B-weights, Odds Ratios (and Standard Errors) from Logistic Regressions Predicting Owning No Motor Vehicle (NMV) vs. Owning an SUV.

Demographic Variables	Model 3 B-weights	Model 4 B-weights	Model 4 Odds Ratios
Age	.02 (.01)+	.03 (.01)*	1.03 (.01)
Gender	.37 (.28)	.42 (.31)	1.47 (.45)
Yearly Household Income	.27 (.13)*	.15 (.15)	1.18 (.17)
UK Area of Residence	-.31 (.33)	-.33 (.37)	0.76 (.26)
Number of Children	.58 (.19)**	.56 (.19)**	1.78 (.36)**
Nationality	-.17 (.43)	-.54 (.49)	0.59 (.29)
Employment Status	.93 (.32)**	.85 (.35)*	2.46 (.80)**
Student Status	.14 (.62)	-.51 (.64)	0.97 (.02)*
Marital Status	1.26 (.30)**	1.36 (.34)**	3.89 (1.29)**
Ethnicity	-.08 (.41)	-.06 (.47)	1.00 (.48)
General Advertising Exposure			
On Electronic Media	.01 (.08)	.02 (.09)	1.02 (.09)
In Traditional Media	.05 (.09)	-.06 (.10)	0.96 (.10)
In Public Locations	-.09 (.13)	-.29 (.15)+	0.77 (.11)
Exposure to			
SUV advertisements		1.27 (.22)**	3.50 (.74)**
Pro-ecological Transport Messages		-.16 (.25)	0.85 (.23)

Note: + = $p < .10$, * = $p < .05$, ** = $p < .01$. Motor vehicle ownership: 0 = ownership of no motor vehicle (NMV), 1 = ownership of a Sports Utility Vehicle (SUV); Gender: 0 = male, 1 = female; UK area of residence: 0 = resides in Scotland, Wales, or Northern Ireland, 1 = resides in England; Number of Children = Number of children under 16 years old in the household; Nationality: 0 = non UK, 1 = UK; Employment Status: 0 = any non-full time employment status, 1 = full time employment status; Student Status: 0 = non-student; 1 = student; Marital Status: 0 = any non-married or non de facto status, 1 = married or de facto; Ethnicity: 0 = any non-White ethnicity, 1 = White. All models were also estimated using a probit model to check the robustness of the results. The coefficients and significance of the estimators did not differ notably between specifications. Hence, we decided to maintain the Logit specification.

Model 1 (in Table 3) reports the relations of the 13 control variables to membership in the SC group or the SUV group. The only statistically significant result was that people in the SUV group are significantly more likely to be married than are people in the SC group. In Model 2 (in Table 3), we also entered the two variables of primary interest: exposure to SUV advertisements and exposure to pro-ecological transport messages. Results now showed that people in the SUV group are significantly more likely to be married and to be non-students than are people in the SC group. More importantly, respondents' exposure to SUV advertisements is significantly positively related to owning an SUV instead of a SC. In contrast, respondents' exposure to pro-ecological transport messages was unrelated to whether they owned an SUV or a SC. These results support both of our hypotheses.

In Model 3 (in Table 4) we examined the contrast between not owning a motor vehicle (NMV) vs. owning an SUV; as in Model 1, in Model 3 we entered only the 13 control variables. Results showed that, compared to people in the NMV group, people in the SUV group have significantly higher yearly household incomes and more children under 16 years old in the household, and are significantly more likely to be employed full-time and married. In Model 4 (in Table 4) we also entered the two exposure variables. As in Model 3, number of children under 16 years old in the household, employment status, and marital status were significant predictors of group membership; however, yearly household income was no longer significantly related to group membership whereas age was a significant predictor, such that the SUV group is older than the NMV group. More importantly, respondents' exposure to SUV advertisements is significantly positively related to owning an SUV instead of no motor vehicle. In contrast, respondents' exposure to pro-ecological transport messages is unrelated to whether they own an SUV or own no motor vehicle. These results again support both of our hypotheses.

The columns reporting odds ratios in Tables 3 & 4 allow for a way of concretizing the magnitude of these relationships. For example, controlling for all the other variables in Models 2 & 4, compared to a person who reports that s/he is "rarely" exposed to SUV advertisements, a person who reports that s/he is "sometimes" exposed to SUV advertisements is 71%

more likely to own an SUV than a standard car and is 250% more likely to own an SUV than to own no motor vehicle.[11]

Next, we turned from the respondents' ownership of an SUV (or not) to their desire to purchase an SUV. We conducted this analysis via a statistical tool called multiple linear regression, which is implemented when multiple variables are simultaneously used to predict a continuous outcome such as desire to purchase an SUV (see Glossary for further information). Table 5 reports the results of these analyses.

As in Models 1 and 3, only the control variables are included in Model 5. The results show that the desire to purchase an SUV is significantly positively associated with yearly household income, with the number of children under 16 years in the household, and with being married. In Model 6, when the two exposure variables were also entered, number of children under 16 years in the household and marital status remain significant predictors of the desire to purchase an SUV, but yearly household income is no longer significant. More importantly, and parallel to the results for ownership, respondents' exposure to SUV advertisements is significantly positively related to their desire to purchase an SUV. In contrast, respondents' exposure to pro-ecological transport messages is unrelated to their desire to purchase an SUV. Once again, these results support both of our hypotheses.

Again, to make these results more concrete, holding constant all the other variables in Model 6, a one unit increase in exposure to SUV advertisements is associated with a .45 unit increase in desire to purchase an SUV. For example, a person who reports being exposed to SUV advertising "sometimes" would score almost a half point higher on the 5-point rating scale of desire to purchase an SUV than would someone who reports being exposed to SUV advertising "rarely."[12]

[11] To be clear, additional increases in exposure to SUV advertising would be associated with additional increases in the likelihood of owning an SUV.
[12] As with owning an SUV, additional increases in exposure to SUV advertising would be associated with additional increases in the desire to purchase an SUV.

Table 5: B-weights (and Standard Errors) from Multiple Linear Regressions Predicting Desire to Purchase an SUV.

Demographic Variables	**Model 5**	**Model 6**
Age	.00 (.01)	.00 (.01)
Gender	.03 (.13)	.06 (.13)
Yearly Household Income	.16 (.07)*	.09 (.06)
UK Area of Residence	-.04 (.16)	.02 (.15)
Number of Children	.21 (.08)**	.17 (.07)*
Nationality	-.09 (.22)	-.11 (.20)
Employment Status	.12 (.15)	.09 (.15)
Student Status	.30 (.25)	.15 (.22)
Marital Status	.44 (.16)**	.39 (.16)*
Ethnicity	-.12 (.18)	-.04 (.18)
General Advertising Exposure		
On Electronic Media	-.02 (.04)	-.01 (.04)
In Traditional Media	.08 (.04)+	.04 (.04)
In Public Locations	.11 (.06)+	.03 (.07)
Exposure to		
SUV advertisements		.45 (.08)**
Pro-ecological Transport Messages		.01 (.12)

Note: + = p < .10, * = p < .05, ** = p < .01. In both models, Gender: 0 = male, 1 = female; UK area of residence: 0 = resides in Scotland, Wales, or Northern Ireland, 1 = resides in England; Number of Children = Number of children under 16 years old in the household; Nationality: 0 = non UK, 1 = UK; Employment Status: 0 = any non-full time employment status, 1 = full time employment status; Student Status: 0 = non-student; 1 = student; Marital Status: 0 = any non-married or non de facto status, 1 = married or de facto; Ethnicity: 0 = any non-White ethnicity, 1 = White.

Discussion & Implications

The results of all statistical tests provided strong support for our two hypotheses.

First, we found that demand for an SUV was significantly and positively related to UK residents' self-reported exposure to SUV advertisements. Said differently, SUV demand was higher to the extent that UK residents reported being exposed to SUV advertisements. This finding was robust across three different ways of measuring SUV demand: ownership of an SUV vs. a standard car, ownership of an SUV vs. no motor vehicle, and desire to purchase an SUV in the coming two years. The current results are consistent with past empirical research which has found that advertising exposure is positively related to demand for other ecologically-damaging services (i.e., leisure airline flights) and products (i.e., tobacco, beef) and with recent reports that have connected SUV advertising to the documented rise in SUV demand. Finally, the findings held after controlling for 10 demographic variables and 3 general exposure to advertisements variables. That is, for example, the fact that SUV owners and those who desire SUVs tend to be married cannot explain why exposure to SUV advertisements also predicts demand for SUVs; these effects are statistically independent of each other.

Second, as hypothesized, we found that demand for an SUV was unrelated to UK residents' self-reported exposure to pro-ecological transport messages. This result suggests that such positive environmental messaging is irrelevant and may be, in effect, "drowned out" by the influence of SUV advertising.[13] Again, this finding occurred for all three measures of SUV demand and after controlling for the 10 demographic factors and 3 general exposure to

[13] We note that preliminary analyses (not reported here) that did not include other variables suggested that the zero-order relationships between exposure to pro-ecological transport messages and all SUV demand variables tended to be non-significant and/or (rather unexpectedly) positive. As such, the non-significant relations between SUV demand and exposure to pro-ecological transport messages reported in Tables 3, 4, & 5 **did not occur because a statistically significant, negative, zero-order relationship between SUV demand and exposure to pro-ecological transport messages was statistically erased** when the 13 control variables and the exposure to SUV advertising variable were also in the regression equation(s). Instead, any "drowning out" of pro-ecological transport messages which occurs is likely cultural and experiential rather than statistical and mathematical.

advertisements variables. Such a result is also consistent with past research showing that, compared to pro-consumption messages, exposure to pro-ecological messages is unrelated to consumption of electronics, fashion, and leisure airline flights. On the whole, this literature thus casts doubt on the power of pro-ecological transport messages to subdue people's demand for SUVs; apparently, in the face of SUV advertising, social norms, and SUV-supporting infrastructure, such messages are relatively ineffectual.

Although we believe that the current results represent a clear methodological advance over past studies on advertising and SUV demand, the questions raised here would certainly benefit from further research designed to overcome the current project's limitations. For one, the study used a correlational design (rather than an experimental design). As such, definitive conclusions about causation cannot be made. For example, owning or desiring an SUV may cause individuals to be highly attuned to SUV ads or to receive high levels of targeted advertising for SUVs; unfortunately, we are unaware of data that can tease apart causal explanations for these relationships. Another limitation is that all of our data were obtained via surveys in which respondents made their own self-reports; although such an approach is common in this type of research, it leaves open the possibility that our respondents' reports of their exposure to SUV ads or to pro-ecological transport messages are biased or inaccurate in some way(s). A third important limitation concerns our sample. Although we went to substantial effort to obtain samples of people that comprised the various motor vehicle ownership statuses that we were studying (see Appendix A), future studies will need to determine whether the current results replicate in other samples, especially those composed of people outside the UK.

Nonetheless, we believe that the current results have important implications for governmental and campaigning groups that are trying to change transport policy and infrastructure to be more environmentally sustainable. Fundamentally, the current results suggest that the popular approach of providing people with messages suggesting that they use public transport, ride a bicycle, or buy less ecologically-damaging motor vehicles may not be an effective means of suppressing demand for environmentally-damaging SUVs. Instead, it appears that a more promising approach would be to limit people's exposure to SUV advertisements, as those clearly are

positively related to people's ownership of and desire to purchase an SUV.

To this end, the New Weather Institute recently made three recommendations aimed at reducing SUV advertising:[14]

1) Pass laws that end advertising of the dirtiest third of the most polluting vehicles sold in the UK (i.e., cars with average emissions above 160g CO2/km), as well as any cars which are too large to fit in a standard parking space (i.e., an overall length above 4.8 metres);

2) Ask the UK Advertising Standards Authority (ASA) and Committee of Advertising Practice to renew its commitment to tackle climate change by implementing new codes of practice concerning SUV advertising; and

3) Obtain pledges from creative agencies and their media partners to reject advertising work for polluting SUV vehicles.

Additionally, a European-wide initiative to end a range of advertising for high carbon products, including SUVs, has recently been instigated.[15] This European Citizens' Initiative (ECI) requires generating a certain level of public support via petition before it can be considered officially.

The results of the current research study suggest that such efforts may be useful in reducing demand for SUVs and thereby CO_2 emissions.

[14] https://static1.squarespace.com/static/5ebd0080238e863d04911b51/t/606d9f68d91ce3661d5c7095/1617796977586/Mindgames+on+wheels+FINAL.pdf
[15] https://europa.eu/citizens-initiative/initiatives/details/2021/000004_en

Appendix A:
Creation of the Sample

We used the data collection service Prolific to obtain our sample; see **www.prolific.co** for further information on this service.

Step 1: Recruitment of initial sample and administration of Survey 1

On April 12 & 13, 2021, we posted an announcement about our initial screening survey (Survey 1) on the Prolific website, aiming it towards current residents of the United Kingdom. Potential participants were told that completing the survey would take about one minute and that their Prolific account would be credited .15 GBP in return for their participation. After completing a brief consent form, participants were asked a series of demographic questions and information about their motor vehicle ownership (see Appendix B for further information). All items were administered on-line. Respondents were told that, depending on their responses, we might contact them for a second, longer survey. 3351 people provided answers to Survey 1 before we closed access to the survey; 6 of these individuals had incomplete questionnaires, leaving 3345 valid responses.

Step 2: Creation of three groups differing on motor vehicle ownership status and matched on key demographic variables

We next identified those participants who reported that they currently owned a Sports Utility Vehicle (SUV) that was a "hybrid (i.e., runs on a battery and on gasoline, petrol, or diesel)" or that was "powered only by gasoline, petrol, or diesel"; we excluded the 8 SUV owners who reported on Survey 1 that their SUV was fully electric, as well as 2 SUV owners who reported a gender on Survey 1 that did not match the gender they had earlier reported to Prolific. 212 individuals who completed Survey 1 fit these criteria.

Next, we set out to create two additional samples of individuals: one group of 212 individuals who owned a "standard car" (SC) and another group of 212 individuals who did not own any motor vehicle (NMV). Our goal was to find individuals who met certain motor vehicle ownership criteria **and** who matched the SUV sample on three key

demographic variables: age, gender, and UK area of residence.

To create the SC group, we first identified all individuals who reported on Survey 1 that "I own a standard passenger car (e.g., a four-door standard car or mini-car; NOT an SUV)" and who did not report on Survey 1 that they did own an SUV, a van, or a lorry, open-backed van, or pick-up truck. From this group, we then sought to create a sample of 212 SC owners who matched the 212 SUV owners on age, gender, and UK area of residence. For example, if the SUV sample included a male from Scotland who is in his 30s, we searched all of the people in the SC group for males from Scotland who are in their 30s. Once we found individuals who matched on the three criteria, we randomly selected one and entered him into the SC sample and moved on to find a match for another SUV owner. On the whole, this process worked well, but there were a handful of SUV owners for whom we were unable to find an exact match from the SC group. In these few cases, we sought an individual from the SC group who matched the SUV owner on two of the three key demographic variables; we generally prioritized matches on UK area of residence when possible.

To create the NMV group, we first identified all individuals who reported on Survey 1 that "I do **not** own any type of motorized vehicle" and who did not check any other response option to the question about motor vehicle ownership. From this group, we used the same procedure specified above for the SC group to create a sample of 212 individuals who did not own any motor vehicle and who matched the 212 SUV owners on age, gender, and UK area of residence. As with the SC group, this process worked well, but there were a handful of SUV owners for whom we were unable to find an exact match from the NMV group; we followed the same procedure described for the SC group above to find the best possible match in the NMV group.

Importantly, *no other information than the data described above* was used to create the resulting sample of 636 individuals.

Step 3: Administration of Survey 2 and validity checks

We invited the 636 individuals identified via the process described in Step 2 to participate in a second survey, which was available from May 20, 2021 until May 24, 2021. They were told that this second survey would take about 10 minutes to complete and that we would credit their Prolific account 1.30

GBP for their participation. After completing consent procedures, participants completed the second survey. Survey 2 included measures that assessed exposure to SUV advertisements and to pro-ecological transport messages, as well as certain control variables (see Appendix B). In addition, we re-administered the same item regarding current ownership of motor vehicles that had been administered at Survey 1, so as to ensure the integrity of this variable (see below). Finally, we also collected some measures not relevant to the current report. All items were administered on-line.

Of the 636 individuals invited to participate, 573 completed Survey 2, yielding a very respectable response rate of 90%. Two individuals were dropped because the Prolific IDs that they entered for Survey 2 did not match any ID we had obtained in Survey 1.

We then conducted two validity checks to ensure that our data were of high quality. First, about two-thirds of the way through Survey 2, we had embedded an "attention check item" (see Glossary) that simply asked respondents to "Please answer "Agree" to this item". Two individuals provided an answer other than "Agree," and we therefore dropped them from the sample. Second, at the end of the survey, we re-administered the item from Survey 1 which asked respondents about their current ownership of motor vehicles. 97 individuals provided answers on Survey 2 which did not place them in the same motor vehicle ownership group in which we had placed them based on their Survey 1 responses. Although we cannot know with certainty the reason(s) for such discrepancies, we deemed it safest to drop these individuals from the sample that we used in our analyses.

At the conclusion of these three steps, we had 472 respondents: 151 in the SUV group, 163 in the SC group, and 158 in the NMV group. This sample of individuals was used in the analyses reported here.

Appendix B:
Measurement of Variables

Outcome Variables

Desire to purchase an SUV was assessed at Survey 2 with a single item:

> "**How much do you agree with this statement?** Forgetting for the moment the vehicle(s) that I already own, and imagining that money was not an issue, I would like to purchase an SUV sometime in the next two years."

Respondents were provided with five options: "Strongly Disagree"; "Disagree"; "Neutral"; "Agree"; & "Strongly Agree". High scores indicate more desire to purchase an SUV.

Current ownership of motor vehicles was assessed at both Surveys 1 & 2 with a single item. Participants were told to "Please check all of the following statements that are true for you" and presented with the following 7 options:

- "I own a standard passenger car (e.g., a four-door standard car or mini-car; NOT an SUV)"
- "I own a van"
- "I own a lorry, open-backed van, or pick-up truck"
- "I own a Sport Utility style Vehicle (i.e., an SUV)"
- "I own a motorized two-wheel vehicle (e.g., motorcycle, scooter)"
- "I do **not** own any type of motorized vehicle";
- "Other".

See Appendix A for further information on how this variable was used to create the samples used for group membership contrasts.

Predictor Variables

Exposure to pro-ecological transport messages was assessed at Survey 2 with nine items. Respondents were provided with three stems that asked them "In the last couple of years, how often have you seen advertisements/messages" that

- "encourage people to walk or cycle to meet their day-to-day travel needs"
- "encourage people to purchase energy-efficient cars (e.g., mini or electric cars)"
- "encourage people to use public transportation to meet their day-to-day travel needs"

For each of these three stems, participants were asked to consider how frequently they saw the relevant advertisements/messages in three types of media:

- "On electronic media (e.g., social media sites, pop-up ads)"
- "On traditional media (e.g., TV, radio, newspapers)"
- "In public locations (e.g., billboards)"

For each type of media, the respondents rated frequency of exposure on a 5-point scale: "Never"; "Rarely"; "Sometimes"; "Often"; & "Very Often". These nine ratings (i.e., 3 types of pro-ecological transport messages X 3 types of media) were averaged together to form a single variable, which showed acceptable levels of internal reliability (Cronbach's alpha = .87; see Glossary). High scores indicate greater exposure to pro-ecological transport messages.

Exposure to SUV Advertisements was assessed at Survey 2 in a very similar manner, also with nine items. Respondents were provided with three stems that asked them "In the last couple of years, how often have you seen advertisements..."

- "for SUVs"
- "which suggest that SUVs are safe and comfortable"
- "which suggest that SUVs are powerful and luxurious"

For each of these three stems, participants were asked to consider how frequently they saw the relevant advertisements in the same three types of media as for pro-ecological transport messages and to rate their frequency of exposure on the same 5-point scale. These nine

ratings (i.e., 3 types of SUV advertisements X 3 types of media) were averaged together to form a single variable, which showed acceptable levels of internal reliability (Cronbach's alpha = .94; see Glossary). High scores indicate greater exposure to SUV advertisements.

Control Variables

Age was assessed at Survey 1 with a single item: "What is your age?" Participants were provided with an open box into which they could type a number. Age responses were ultimately collapsed into the categories described in Table 2.

Gender was assessed at Survey 1 with a single item: "What is your gender?" Participants were provided with 3 options: "Female"; "Male"; & "Other".

UK area of residence was assessed when the respondent initially signed up to participate in studies sponsored through Prolific's website; respondents had the option to update their answer if it changed. Respondents were asked a single item: "What UK area do you currently live in?" and provided with eleven different options. Eight of these options were for areas of England (e.g., "North East England (Tees Valley, Durham, Northumberland and Tyne and Wear)") and one option each was for "Northern Ireland", "Wales", and "Scotland". We collapsed the eight England options into a single category, as seen in Table 2.

Yearly Household Income was assessed at Survey 2 with a single item: "What is your household's average yearly income?" Participants were provided with 5 options: "< 20,000 GBP"; "20,001-40,000 GBP"; "40,001-60,000 GBP"; "60,001-80,000 GBP", & ">80,000 GBP".

Number of Children under 16 years old in the household was assessed at Survey 1 with a single item: "How many children under age 16 live in your household?" Participants were provided with an open box into which they could type a number.

Nationality was assessed when the respondent initially signed up to participate in studies sponsored through Prolific's website; respondents had the option to update their answer if it changed. A single item was used "What is your nationality?". Respondents could type in one answer.

Employment Status was assessed when the respondent initially signed up to participate in studies sponsored through Prolific's website; respondents had the option to update their

answer if it changed. Respondents were asked a single item "What is your employment status?" and provided with six options: "Full time"; "Not in paid work"; "Part-time"; "Unemployed (seeking job)"; "Starting new job soon"; and "Other".

Student Status was assessed when the respondent initially signed up to participate in studies sponsored through Prolific's website; respondents had the option to update their answer if it changed. Respondents were asked a single item "Are you a student?" and answered "Yes" or "No".

Marital Status was assessed at Survey 2 with a single item: "What is your marital status?" Participants were provided with 5 options: "Single"; "Married or de facto (including civil partnership)"; "Separated or divorced (including from civil partnership)"; "Widowed"; & "Unclear status".

Ethnicity was assessed at Survey 2 with a single item: "What is your ethnicity?" Participants were provided with 5 options: "Asian or Asian British"; "Black, African, Caribbean, or Black British"; "Mixed ethnicity (e.g., White and Asian)"; "White"; & "Other".

General Advertising Exposure was assessed at Survey 2 with three items. After reading the stem "In the last couple of years, how many hours per day would you say that you spend" respondents were presented with three types of media:

- "On electronic media (e.g., website, social media sites)"
- "Using traditional media (e.g., TV, radio, newspapers)"
- "In public locations where you might see ads (e.g., billboards)"

Respondents rated each item using the following 8-point scale: "None"; "less than 1 hour"; "1-2 hours"; "2-3 hours"; "3-4 hours"; "4-5 hours"; "5-6 hours"; & "more than 6 hours". These three variables were entered separately into statistical analyses because internal reliability analyses suggested that they do not cohere into a single variable. High scores for each item indicate more general exposure to advertisements.

Additional SUV variables

During Survey 1, those respondents who reported owning an SUV were asked two additional questions.
Length of SUV ownership was assessed with a single item: "How long ago did you purchase your SUV? If you own more than one SUV, please answer regarding the SUV that you

most recently purchased." Five response options were provided: "less than one year ago"; "more than one but less than two years ago"; "more than two but less than three years ago"; "more than three but less than four years ago"; & "more than four years ago".

SUV power source was assessed with a single item: "How is your SUV powered? If you own more than one SUV, please answer regarding the SUV that you most recently purchased."

Three response options were provided: "The SUV I own is fully electric (i.e., runs on only a battery)"; "The SUV I own is a hybrid (i.e., runs on a battery and on gasoline, petrol, or diesel)"; & "The SUV I own is powered only by gasoline, petrol, or diesel". This item was collected to exclude from the SUV group those individuals who own a fully electric SUV.

Glossary of Statistical and Methodological Terms

Attention Check Item

Including an attention check item is standard procedure in much survey research. To do so, the researcher inserts into the survey an item (or more than one item) which is designed solely to determine if the respondent is paying attention to the survey. The researcher assumes that if a respondent fails to accurately respond to the simple instructions in the attention check item (such as "Please answer "Agree" to this item"), it is likely that the respondent is either a robot or is also responding with less than optimal validity to other items. Typically, an *a priori* rule is set for how many attention check items a respondent may fail before being removed from the sample; our *a priori* rule was to remove any respondent who failed the single attention check item that we administered.

Control Variable

A control variable is a variable that a researcher enters into statistical equations even though it is not one of the primary variables about which the researcher has hypotheses. Typically, control variables are additional variables that the researcher suspects may be associated with the primary variables under investigation, and so the researcher wants to test whether the primary variables relate to each other as hypothesized even after "controlling for" (or holding constant) the potential effects of the control variable(s). For example, a researcher might want to examine the association between households' work hours and energy use, but would do so after controlling for the number of people in the household, as, of course, households with more people are likely to use more energy and to have a larger total number of hours worked than would households that have fewer people.

Cronbach's alpha

This is a statistic used to describe the "internal reliability" of a set of items composing a scale used to measure a particular variable. Cronbach's alpha can vary between 0 and 1.00, with higher values reflecting higher internal reliability. Highly internally reliable scales are those in which respondents' answers to items on the scale are highly and positively

correlated with each other. A Cronbach's alpha of .60 or higher is considered acceptable by most researchers.

Logistic regression

This is a statistical tool used to examine how multiple variables might simultaneously predict a single categorical outcome variable, like membership in one or another group. It was the appropriate tool for the analyses presented in Tables 3 & 4 because we wanted to examine how 15 variables (the 10 demographic variables + the 3 general exposure to advertisements variables + the 2 exposure to SUV advertisements and to pro-ecological transport messages variables) related to being a member of either the SC group or the SUV group (in Models 1 & 2) and of either the NMV group or the SUV group (in Models 3 & 4). The statistics reported in Tables 3 & 4 are B-weights and the Standard Error of these B-weights. These statistics are not standardized, and so a reader cannot determine the relative magnitude of the relationships between the outcome variable and particular predictor variables by examining the size of the B-weight; the p-value test of statistical significance must be examined (reflected in Tables 3 & 4 by + = $p < .1$, * = $p < .05$, and ** = $p < .01$; see entry on Statistical Significance below). The direction of the relationship can be determined by examining whether the B-weight is positive or negative; in Tables 3 & 4, a positive B-weight indicates that as a predictor (or control) variable increases, a respondent is more likely to be in the SUV than the SC or NMV group, and a negative B-weight indicates that as a predictor (or control) variable increases, a respondent is more likely to be in the SC or NMV group than in the SUV group.

Multiple linear regression

This is a statistical tool used to examine how multiple variables might simultaneously predict a single continuous outcome variable (like height or intelligence). It was the appropriate tool for the analyses presented in Table 5 because we wanted to examine how 15 variables (the 10 demographic variables + the 3 general exposure to advertisements variables + the 2 exposure to SUV advertisements and to pro-ecological transport messages variables) related to desire to purchase an SUV. The statistics reported in Table 5 are B-weights and the Standard Error of these B-weights. As with logistic regression, these statistics are not standardized, and so a reader cannot determine the relative magnitude of the relationships between the outcome variable and particular predictor variables by examining the

size of the B-weight; the p-value test of statistical significance must be examined (reflected in Table 5 by + = p < .1, * = p < .05, and ** = p < .01; see entry on Statistical Significance below). The direction of the relationship can be determined by examining whether the B-weight is positive or negative; in Table 5, a positive B-weight indicates that as a predictor (or control) variable increases, a respondent is more likely to desire to purchase an SUV, and a negative B-weight indicates that as a predictor (or control) variable increases, a respondent is less likely to desire to purchase an SUV.

Odds Ratio

As the name implies, an odds ratio is the ratio of two odds. If the chances of event A occurring vs. not occurring are 50%, then the odds of event A occurring are 1.0 (i.e., .50/(1-.50)); if the chances of event B occurring vs. not occurring are 20%, then the odds are .25 (i.e., .20/(1-.20)). The odds ratio reflects how much more likely event A is to occur than event B is likely to occur. In this example, the odds ratio of A vs. B occurring is 4.0 (i.e., 1/.25). An odds ratio of 4.0 would mean that event A is 4 times more likely (or 300% more likely) to occur than event B; an odds ratio of 1 would mean that event A is just as likely to occur as is event B.

Statistical power

Statistical power concerns the chance of making a Type II error, which occurs when one concludes that a hypothesis is not supported when in fact the data actually do support the hypothesis. Statistical power is a joint effect of the p-value the researcher chooses (see Statistical Significance entry below), the magnitude of the effect, and the sample size. Statistical power varies from 0 to 1.00; a power of .80 is generally considered acceptable, and means that the researcher has a 20% chance of committing a Type II error. In the current study, two separate power calculations needed to be run, depending on the statistical tool we used. For the multiple regressions involving respondents' desire to purchase an SUV, we had an n = 472 (i.e., the entire sample) and set the p value at .05 (for a two-tailed test); statistical power tables indicted that our power was therefore >.85 for detecting a small effect (e.g., a Cohen's d = .20 or a Pearson's r = .10). Thus, the study is quite well-powered for the statistical tests that used desire to purchase an SUV as the outcome variable. For tests involving comparisons of the SUV group to the SC group or to the NMV group, power calculations are based on the number of respondents in

each group. Our smallest sample was for the SUV group (n = 151), and we again set the p value at .05 (for a two-tailed test); statistical power tables indicated that our power was >.70 to detect small to medium sized effects (e.g., Cohen's d = .30 or a Pearson's r = .15). Thus, the study is somewhat less well-powered to detect an effect for the statistical analyses involving current motor vehicle ownership as the outcome variable.

Statistical significance

When researchers compute inferential statistics, they check if the results are statistically significant by comparing their observed results to standardized tables. In most cases, for a researcher to conclude that the result is statistically significant, there must be less than a 5% chance of committing a Type I error, i.e., concluding that an observed result is meaningful when in actuality it is due to random fluctuations in the data. The "p-value" is the statistic reflecting significance. If the p-value is less than .05, the result is deemed significant, as there is less than a 5% chance of having committed a Type I error; if the p-value is less than .01, there is less than a 1% chance of having committed a Type I error.