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ABSTRACT

Research exploring the behavioral economic dimensions that drive travel has shown that social and psychological forces often play a role equal to price and economic levers. Yet, more work is needed to evaluate how financial verses social market norms influence economic decisions with regard to transportation. For this study, roughly 500 participants were offered differing incentives in four identical trials. These randomly assigned incentives included various monetary amounts, a free gift, or a social nudge tapping into altruistic values (in this case, benefits to the environment). After tests for homogeneity, the results showed the social nudge had a high degree of effectiveness, when compared to both the financial incentives and gifts. Furthermore, the results indicated that mixing financial and social norms caused both to be less effective. These findings suggest that fiscal incentive programs used to influence travel decisions may be lacking. In fact, this research suggests a new focus on behavioral economics in travel programs, and more emphasis on social norms and values as tools to facilitate changes in travel behaviors and nudge individuals to more healthy and climate-sensitive forms of travel.

1. Introduction

In the classic Mark Twain tale *Tom Sawyer*, Tom convinces his friends to paint his fence for the sheer joy of it, illustrating a key principle of modern behavioral economic theory—that social forces and self-interest also play a role in market decisions. A significant body of work illustrates that traditional, market pricing economics often fail to represent the complexity of decisions. As a result, planners who study transportation have trying to understand this complexity (Batty, 2007; Batty and Torrens, 2001). Nevertheless, little work has focused on how these complex transportation decisions as they relate to social markets. This is particularly acute with regard to transportation demand management (TDM) programs, which work to encourage people to decide to walk, bike or take transit, and could conceivably tap into social norms to encourage this kind of travel.

The ability to nudge these "active" forms transportation behavior offers an opportunity to address societal issues of inflection, such as congestion and air quality, public health and obesity. In response, this study focuses on market or social nudges to influence transportation decisions and behavior. There is a significant gap in the literature on the interplay between financial and social factors in the economics of travel behavior. Some research suggests that social forces may play a role in travel decisions (Riggs and Kuo, 2014, 2015; Riggs, 2014, 2015), and that socio-cultural beliefs can even shape perception of financial pricing policy (Schade and Schlag, 2003). Other work suggests that route-related built environment issues may trump many of these factors (Cervero and Duncan, 2003; Ewing and Cervero, 2010, 2001; Forsyth et al., 2008).

Recent work attempts to take into account how some of these design elements such as quality of sidewalks, zoning, or aspects of the streetscape or parking shape travel behavior outside of traditional origin-destination framework (Appleyard, 2012, 2015; Ewing et al., 2015). Yet despite this research, more evaluation is needed to expand and validate both the understanding of pricing impacts and the potential environmental benefit of behavioral nudge programs, as they relate to documented correlations between the built environment, active travel behavior and health outcomes (Ewing, 2005; Frank et al., 2004, 2005; Saelens et al., 2003).

This research evaluates the success of various economic norms—specifically the impact of financial vs. social incentives on changes in active transportation habits (e.g. those taken via biking, walking and transit). The researcher evaluates the literature spanning the fields of transportation and behavioral economics, then lays out the methodological approach, with a particular inter-

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est in the relationship of social norms to economic trade-offs and financial market pricing decisions. This is followed by a discussion of results focusing on the behavioral psychology that drives choices when travelers are presented a certain type of randomly assigned incentive. Conclusions and broader implications focus on the theoretical and practical implications for transportation policy and travel behavior research.

2. Literature

Research has shown that the economic trade-offs of travel choices are tied to both financial and socio-cultural norms. This relates to active modes like walking and biking, as well as driving and parking a vehicle. Such behavior is personal and relates to attitudes and believes related to individual health, environmental sustainability and the social capital of communities. Studies have shown the health benefits of active transportation for residents of dense, urban and connected environments; connected meaning that they have many intersections to allow for the flow of travelers via active modes such as cycling and walking (Cervero and Duncan, 2003; Cervero and Kockelman, 1997; Ewing, 2005; Ewing et al., 2003; Frank et al., 2004, 2005; Glazier et al., 2014; Handy et al., 2005, 2006; Saelens et al., 2003; Sallis and Glanz, 2006; Sturm and Cohen, 2004). These connected environments can also create economically resilient communities (Gilderbloom et al., 2014; Glaeser, 2008). However, this type of environment is not found in many communities across the US, particularly in locations that are rural or poor (Sallis et al., 2004).

Given the fact communities differ in how they support active mods like walking and biking (McCann, 2008; Riggs and McDade, 2016), many have suggested 'complete streets', policies as a means to reshape urban streetscapes, which include designs to accommodate and prioritize pedestrians and cyclists (de Zeeuw and Flusche, 2011). Yet, this trend is not pervasive. Larger cities, like San Francisco and New York, have implemented policies that promote active transportation, in contrast to smaller, poorer communities without similar policies (Lillis, 2013; Peters, 2012; Seskin and McCann, 2012). California, for example, recently passed California's Complete Streets Act (2008); however, its implementation is limited to new projects and plans. It does not require a baseline Level of Service (LOS) for bicycles and pedestrians in plans and designs, and does not control land use decisions necessary for success.

Integrating facilities for bicycling and walking is not easy or straightforward in smaller and poorer communities, where there is less funding and fewer projects. In some of these locations, installing sidewalks near a local school would do little to promote walking since there is no housing within the proximity due to land use and zoning. Schools and businesses are often isolated from residential areas, presenting a structural constraint to environmental and behavioral health interventions. Studies have shown that environmental design alone is not the 'silver bullet' in influencing healthy behaviors (Forsyth et al., 2008).

Limited work has studied financial market vs. social market norms as well as completive economic interactions related to personal travel. Stanford University piloted a social nudge program that uses prizes, to encourage off-peak travel and reduce congestion (Green, 2007; Mandayam and Prabhakar, 2014; Merugu et al., 2009). Preliminary results indicate substantial influence on congestion and parking supply dynamics (Hu et al., 2014); however it is unclear if any individuals changed to non-automotive or active transportation modes as a result of the program (Zhu et al., 2015).

This work is important, because while built environment factors play a role in active travel behavior policy, pricing and incentives play a key role in transportation decisions. Research has shown that transportation choice is tied to financial and social factors, as well as to public policies (Brock and Durlauf, 2003; Dugundji and Walker, 2005; Marchal and Nagel, 2005); yet, the interrelationship between these forces remains under-explored, along with other influencers like competition and gaming, especially in the face of new technology and mobile proliferation. Policies and incentives can encourage or deter driving behaviors and influence auto ownership (Guo, 2013; Shoup, 2005; Weinberger et al., 2008). Some communities use a 'carrot' approach, offering incentives such as free transit passes, cash back ('cash-out') programs and informational marketing to reward alternatives to driving (Carrel et al., 2012; Riggs and Kuo, 2015). Other communities prefer to use the 'stick' approach, charging high prices for parking, tolls, and roadway usage fees.

The appropriate balance between 'carrot' and 'stick' approaches is when the optimal consumption of the resource (e.g. roads, parking, etc.) makes the price equal to the marginal cost (P = MC). Some research suggests that the 'stick' approach is economically inefficient (McShane and Meyer, 1982; Peters and Gordon, 2009). Other work shows that mixing market norms— the 'stick' financial norms (like parking pricing) with social-cultural norms or values (like gifts or asking someone to do something out of courtesy for others), can cause confusion. In these cases economic messages become mixed. Individuals are likely to question whether the transaction is a financial transaction or a social one and to default to financial norms and their respective price anchors (Amir et al., 2005; Ariely, 2008; Heyman and Ariely, 2004). This theory that social economic norms become clouded by the entry of a highly-rational, monetary pricing construct, is underscored by work in behavioral psychology (Fiske's relational theory), which establishes four dimensions of social relationships: communal sharing or "we-ness" (CS); authority ranking (AR); equality matching (EM); and, market pricing (MP) (Aggarwal, 2004; Fiske, 1992).

Many residential and downtown areas, and university and corporate campuses, face exaggerated challenges as employment hubs because they cannot maintain adequate parking supply. Employers cannot meet access demands of their respective communities because they focus on car travel rather than non-automotive travel. The failure to encourage non-automotive or active transportation, while supporting auto-mobility works in opposition to public health efforts to increase activity through travel and generates high fiscal and environmental costs (Deakin, 2001; Deakin et al., 2004). Expanding urban campuses in particular, must balance the adequate provision of parking with land constraints and increased vehicle trips to campus (Tudela-Rivadeneyra et al., 2015). Major public institutions must find ways to balance parking supply with sustainability goals and rising budget constraints.

Travel behavior is complex. Knowledge and attitudes toward transit and driving, self-image and travel alternatives play a role in transportation behavior. Prior experience and habit also affect transportation mode choice decisions, and shape the responses to travel alternatives (Akerlof, 1997; Claisse and Rowe, 1993; Helbing and Molnár, 1995; Schlich and Axhausen, 2003). For many travelers, the trip to work is not a straightforward home-work-home round trip, but linked to other activities—running errands, dropping off or picking up household members and shopping.

The complexity of transportation behaviors often makes simple mode choice models misleading. For example, a choice that looks feasible—the home to work trip—may be impractical when one considers the overall pattern of behavior. A trans-Theoretical Model of behavior recognizes that individual behavior is in a state of change (DiClemente and Prochaska, 1998). In addition, recent work has suggested that financial and social incentives, such as those via mobile frameworks, may have greater effects on some individuals. (Carrel et al., 2012; Dugundji and Walker, 2005). One

might hypothesize that social incentives providing a 'carrot,' rather than a 'stick,' might be more effective in encouraging driving alternatives.

The global proliferation of mobile technology has added a tool for influencing behavior.[1] This mobile framework allows for companies and researchers to use location based information about trips, stemming from applications on individual-user iPhone or Android smartphones. The ability to know and disseminate location-based information, including trips, travel time, money spent, activities conducted, etc., has created the idea of the "quantified self" (Carrel et al., 2012). Information collected from mobile technology is now used to influence behavior in other fields,[2] and has begun to be used in transportation behavioral research.

Using social norms and cues to nudge users is more than a marketing trend. It has been an effective tool for behavior change and social impact. For example, Shape Up, a social exercise game, claims to have helped 700,000 people lose 1 million pounds. PayOff, a debt-management game, claims to have helped players pay off $41 million of debt. OPower, a social energy conservation game, claims to have reduced energy consumption by 1.6 billion kilowatt hours. There are over 34 computer and video games designed to improve health and physical education, each found to have positively influenced young peoples' knowledge, skills, attitudes, and behaviors in relation to health and physical exercise (Papastergiou, 2009).

3. Methodology

This research operates as a preliminary pilot study of travel behavior, comparing financial and social norms. As a part of an incentive pilot, offered as a part of an annual campus transportation survey at Cal Poly, San Luis Obispo (Cal Poly), a series of incentives were offered to test the key research question testing the efficacy of financial verses social incentives to reduce driving and parking. Consistent with experimentation research by Heyman and Ariely (2004), a cohort-based treatment group trial was devised with the hypothesis that, all things being equal, social norms have an equal or greater pull on behavior than financial norms, and social incentives better influence individuals to travel via 'painful' non-automotive, active travel modes such as walking and biking.

The approach of using a campus travel survey to test pricing and travel habits is well founded in the literature, as many campus environments, especially in the Western United States, have worked with academics in an experimental setting to design programs that influence travel habits, including UCLA, Berkeley, Stanford and University of Washington (Deakin et al., 2004; Riggs et al., 2011; Riggs, 2014; Shoup, 2005; Williams and Petrait, 1993; Zhou and Schweitzer, 2011).

The Cal Poly campus, with a population of roughly 23,000, is the largest employer in its county and occupies a large share of the City of San Luis Obispo (2010 population of 45,218). The campus has ample surface parking that has, until recently, limited the need for more aggressive alternative transportation programs. The current monthly permit system requires payment up-front for 'all-you-can eat' monthly parking that is priced below market rates. Based on this, prices are low, demand is high, and the daily decision on commute alternatives is embedded into a single sweeping parking permit decision. Yet, there is a growing recognition that transportation plays a large role in the campus' functionality in terms of trips generated and accessibility. At the same time, transportation poses land use, sustainability, and cost challenges. The Cal Poly campus is an urban environment with constraints on space and budget. It currently does not have a robust, clearly established TDM program.

There is a significant gap in the literature on the interplay between financial and social factors in travel behavior – let alone the effect of new technological tools on transportation, and increasing efforts to 'gamify' commuting. As illustrated in Fig. 1, research suggests that social forces may be as important in travel decision-making as price-based levers (Riggs and Kuo, 2014, 2015; Riggs, 2014, 2015) and can even shape perception of price-based strategies (Schade and Schlag, 2003). More research is needed to expand and validate both the understanding of pricing impacts and the potential environmental benefit of behavioral nudge and social programs, especially related to documented correlations between the built environment, active travel behavior and health outcomes (Ewing, 2005; Frank et al., 2004, 2005; Saelens et al., 2003).

In this context, this experiment tests various incentives to reduce driving behavior on roughly 500 randomly selected campus survey respondents, who had indicated that driving was their primary mode of travel. To evaluate how financial vs. social nudges influence transportation decisions, respondents were offered incentives in four identical trials as a part of a campus travel survey. The survey is outlined in the proceeding section, followed by a description of the trial. The trial was consistent with theory suggesting: that market-based relationships responses are connected to the relationship between level of effort, exertion, and compensation (Fehr and Falk, 2002); that a social market is shaped by altruism irrespective of effort (Cialdini et al., 1997); that including both financial and social market norms cause individuals to default to the financial ones (Gneezy and Rustichini, 2000). Consequently, the following hypotheses are assumed:

- Hypothesis 1 (H_1): The relationship between financial and social incentives will be different.
- Hypothesis 2 (H_2): All things being equal, social norms will have the potential to create an equal or greater pull on willingness to change behavior.
- Hypothesis 3 (H_3): Including both monetary and social signals will lessen the effect of social/altruistic exchange and cause the incentive to be perceived as a financial one.

4. Campus travel survey

The campus travel survey was a stated-preference survey designed to assess how various campus constituencies (students, faculty, staff) traveled to the campus, including their origin/destination information, how many miles traveled and attributes about travel behavior (permit, primary parking lot, etc.). The study used standard survey software during the spring of 2015. The total number of responses were 3961, roughly 17% of the entire campus population of roughly 23,000, significant at the 99% Confidence Interval with a margin of error of ±1.68%. As indicated in Fig. 2, approximately 38% of those coming to campus drive alone. On average, survey respondents, who reported driving alone or in carpool, traveled 17 vehicle miles (VMT). The distances were averaged.

The Cal Poly Committee for the Protection of Human Subjects reviewed and approved the survey, finding the project in compliance with Public Health Service guidelines for the use of human subjects in research, and exempt from further review. Participants provided written consent to participate in the survey, which was issued by Information and Technology Services. The confidentiality of participants was protected; the research team had no access to

[1] In May 2013 the Pew Research Center reported that 91% of American adults had access to a cell phone and 56% had a smartphone.

[2] Examples of this type of self-tracking of data to influence behavior are found in companies like Mint (personal finance), Nike+(run calculator & tracker), Zeo (sleep patterns), Calorie Counter (caloric intake) and RescueTime (time use).

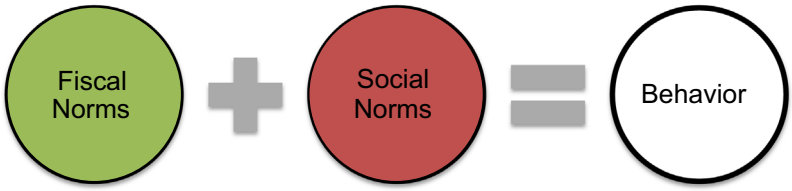

Fig. 1. Balancing financial and social market norms.

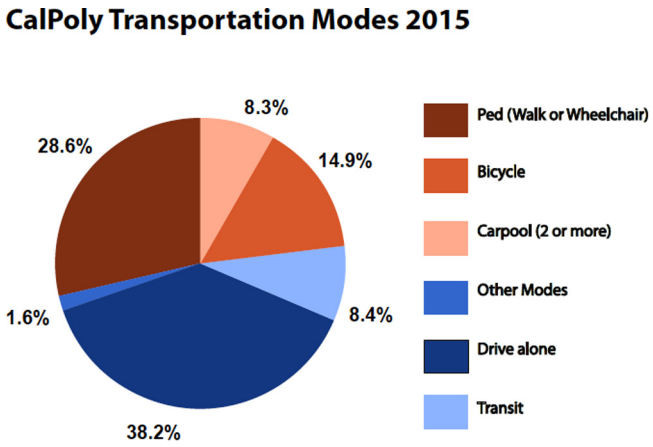

Fig. 2. Modal split for entire campus.

individual contact information in the survey process. Individual respondent data, including location-based information, could not be traced back to the individual unless the respondent elected to provide this information. Consistent with best practice, all data was reviewed on password-protected and encrypted devices.

5. Experimental design

Roughly 500 respondents were randomly chosen to participate in a parallel investigation, and were offered various incentives to change their travel. Respondents could decline the offer and decline participation. Individual trial participants were given the option to forfeit their right to a parking pass for one week, in exchange for the following randomly assigned incentives: (A) a $5 monetary incentive; (B) a free cup of coffee or juice; (C) a free cup of coffee or juice, with a specified value of $2; (D) a social request to give up their pass for altruistic reasons; in this case benefit to the environment. Treatment A represented a financial norm while treatment B and C represented two variations of social norms. Treatment C represented the mixing of financial and social norms, a factor that Heyman and Ariely suggest can cause both to fail. Treatment D represented a plea to serve a greater social good. This structure is similar to behavioral economic work by Heyman and Ariely (2004) and summarized in Table 1 which includes the connection to the related hypothesis.

6. Analysis

This experiment utilizes independent identical trials using Marascuilo procedure to compare differences between outcomes and their significance. As a procedure Marascuilo procedure assumes that a sample has been randomly chosen and reflects a normal distribution for the population being evaluated. To validate this, tests for both significance and homogeneity were used to evaluate the appropriateness of the model—particularly to ensure appropriate distribution between different types of respondents (in our case students vs faculty/staff, who may have very different travel motivations. Given that the sample was consistent with these preconditions, alternatives were analyzed using a series of planned contrasts. This allowed the researcher to calculate differences in conditional proportions, the critical ranges for each trial and their relative significance level.

7. Results

7.1. Hypothesis 1

The researcher reviewed the number and proportion of responses of treatment groups. From a sample size of 462, 136 individuals accepted some form of incentive, and 326 declined. As shown in Fig. 3 and 30% of participants were responsive to the financial incentive of $5, which was 13% fewer than those who chose a social or altruistic incentive (Treatment D). A nominal gift of coffee fared slightly better than the financial incentive, at roughly 35%. The mixed market option had the least amount of participants (N = 99) and fared less well, with only 13% electing it as an option.

In testing the homogeneity under Hypothesis 1 (H_1), we assume there is variance between the options and at least one trial differs. Under H_0, all four treatment options would be subscribed to equally ($P_A = P_B = P_C = P_D$). For each hypothesis, the null hypothesis is assumed to be H_0. This yields a χ^2 of 15.022 and a p-value of 0.002 (where n = 462; $\alpha = 0.05$; df = 3; K = 4). With a p-value of 0.002 lying below our significance threshold of $\alpha = 0.05$, there is cause to reject the H_0 and conclude that H_1 can be reasonably assumed and that the rate of success in at least one treatment group differs significantly at a significance threshold of $\alpha = 0.05$.

7.2. Hypothesis 2 and 3

Similarly, with H_2 and H_3, the significance threshold and data characteristics are determined using a Marascuilo Procedure ($\alpha = 0.05$; df = 3; n = 462; K = 4). Conditional proportions are calculated to determine if social norms have an equal or greater pull on willingness to change behavior (H_2) and if monetary signals will lessen the effect of a social/altruistic exchange (H_3). These proportions are indicated as follows, consistent with Fig. 4: $P_A = 34/113 = 0.3008$; $P_B = 39/126 = 0.3095$; $P_C = 15/99 = 0.1515$; $P_D = 48/124 = 0.3870$.

As shown in Table 2, at significance level $\alpha = 0.05$ and with a critical range of ($\chi^2_{\alpha,df} = 7.81473$, the proportion of people receiving Treatment B was significantly different than the proportion receiving Treatment C. This meant that there was a significant difference between those who agreed give up their parking pass when offered a free juice or coffee as opposed to those who would do so for the same free gift when it was "valued at $2"—the option that mixed fiscal and social market norms. This would seem to confirm H_3, or the notion that mixing the norms of behavioral economics causes both to become less effective, and that people default to the monetary norm—in this case $2.

Table 1
Conceptual experimental design.

	Group A (N = 100)	Group B (N = 100)	Group C (N = 100)	Group D (N = 100)
Drivers Asked to Give up Parking for:	$5	Gift	$2 Gift (Mixing Social/Financial Signals)	Social/Altruistic Reasons
Hypothesis	H1, H2	H1, H2	H3	H1, H2

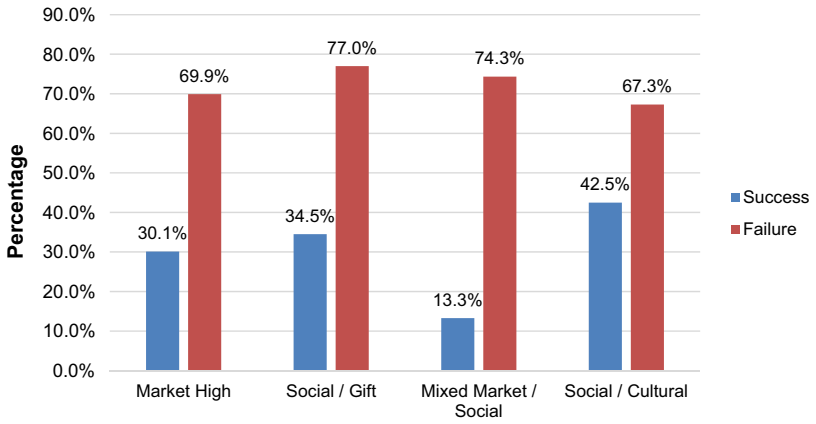

Fig. 3. Percentage of responses to varying incentives.

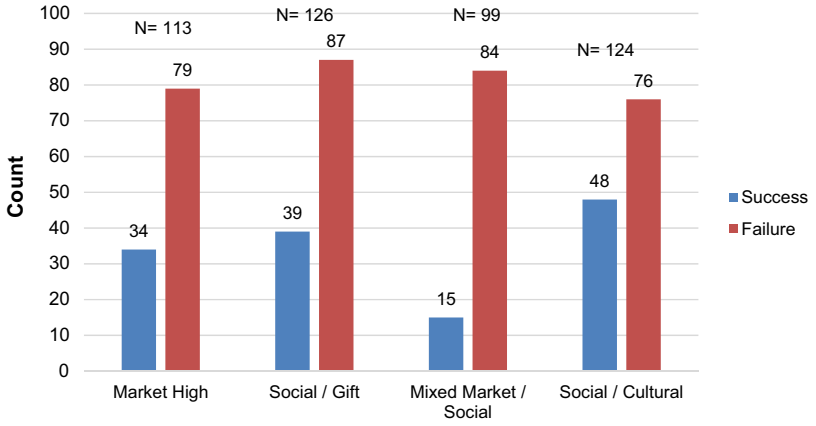

Fig. 4. Number of responses by TDM treatment group (N = 462).

Table 2
Critical ranges and significance ($\alpha = 0.05$).

Contrast	Value	Critical range	Significant
$\rho_A - \rho_B$	0.008639	0.166741036	No
$\rho_A - \rho_C$	0.14937	0.157147511	No
$\rho_A - \rho_D$	0.086212	0.17175427	No
$\rho_B - \rho_C$	0.158009	0.15298092	Yes
$\rho_B - \rho_D$	0.077573	0.167950443	No
$\rho_C - \rho_D$	0.235582	0.158430168	Yes

As Table 2 also illustrates, at significance level $\alpha = 0.05$, the proportion of people who agreed to Treatment C (giving up their parking passes, when offered a free juice or coffee, valued at $2) is also significantly different than the proportion of people who agreed to Treatment D—to give up their parking passes, when encouraged to do so for social reasons (benefit to the environment). Thus, while differences between social norms and a larger financial incentive of $5 (Treatment A) may not be significant, we can accept H_2, given the finding from H_3—that there may be merit to using small and non-monetary incentives in the economics of travel. There is a significant likelihood that someone would respond to a small gift as long as it does not have a monetary value associated. There is also a significant likelihood that more individuals would respond to a social norm than a small gift norm around $2. This points to the importance of social incentives in the behavioral psychology of travel decision frameworks, and provides a platform for further work in this area.

8. Discussion

As alluded in the introduction, the classic American story *Tom Sawyer* has been cited by many as a key illustration of the power of social norms to overcome perceived exertion without tapping into financial market principles. In the story, Tom chides his friends to paint a fence exclaiming how fun it is to do this work, and before long everyone joins in and does Tom's work for him, for no compensation other that the altruistic sense of painting a fence together, or 'we-ness' as Fiske (year) would describe. While Tom acted in his own mischievous self-interest, a tenant of traditional rational economic theory, he operated in a young boys world where social rather than financial norms aided transactions. While

these value-based or social economies have been explored as a part of many social awareness and global welfare programs, there has been little work that applies these principles of behavioral psychology (and perhaps manipulation in the case of Tom) to travel economics and behavior. The results of this study show that social factors do play a part in nudging travel decisions.

Social norms have a significant impact. Treatment D, our social norm to do something good for the environment, was successful 43% of the time in trials. Furthermore, in this case, after tests for homogeneity, in this experience social norms were more effective that other options—including a nominal gift of a cup of copy (Treatment B) and a gift valued at $2 that mixed financial and social messages (Treatment C). This finding that social economic norms and values can have equal (if not more) impact than fiscal norms, is particularly important in underscoring Fiske's relational theory. This theory has become the theoretical backbone for much of the work that explores how rational economic theory, in the vein of Smith, collides with Marxist theory when we make complicated life decisions such as travel choice.

This theory of colliding rational and irrational forces is further underscored by the finding of Treatment C, the mixed financial and social incentive. In this case when asked if they might consider a $2 gift of a cup of coffee or juice, respondents were far less likely to take up that offer as opposed to any other alternative—including the same gift without mention of the monetary value. This mixing is to emphasize, since the results of this study clearly indicate that mixing financial and social norms causes both to be less effective. Though this study cannot say with confidence that social norms are more effective than higher financial incentives, such as the Treatment A value of $5, it does suggest, that the behavioral psychology behind many travel or TDM programs might warrant rethinking.

The prevailing practice in TDM and travel incentives has been to focus on fiscal markets and incentives. This includes pricing and programs that provide nominal refunds to commuters when they choose not to travel via auto. Some might argue that this practice has become so common that financial incentives and pricing initiatives have lost their value, or become price inelastic. However, this claim is inconsistent with traditional rationale economic theory in the vein of Smith. While price may be near-elastic to some populations, the results of this study confirm that financial norms are effective in nudging travel behavior, but also that social norms are powerful. This is important because they are underrepresented in the incentive portfolios of many travel behavior programs. If one were to rethink them, s/he might want to refocus on social and cultural values that relate to individual travelers.

Likewise, a key finding from this study also indicates that when presented with a mixed message, an incentive or gift that postures as a social norm but has a price anchor, both are ineffective. This is consistent with the theoretical economic grounding provided by Fiske, Heyman and Ariely and an important lesson in the TDM arena. Many times travel incentives are presented with both a financial and social norm, for example "win a $500 bike" or "receive a $300 iPad". While this may seem rational to combine these messages, they turn social contracts into financial contracts, and undermine the success of both. As practices are akin to showing up a relatives' house for a dinner with a bottle of wine, and politely saying, "Thank you for dinner; here is a $7 bottle of wine for your trouble." In practice a non-coercive, social contract has been turned into a coercive financial contract.

These examples relate back to the importance of balancing and not conflating coercive and non-coercive policies. Gärling and Schuitema (2007) offer a conceptual framework for evaluating the effectiveness of travel behavior change measures, suggesting that non-coercive measures, such as public information campaigns, should be combined with coercive TDM measures—and the results of this study are consistent. As Litman (2010) argues TDM programs are most effective when implemented with other strategies, however the social dimension may current be underemphasized. As has been hypothesized in the outcome of other work, soft approaches to TDM and programs that support self-regulation and education can be highly effective (Bamberg et al., 2011; Riggs, 2015; Riggs and Kuo, 2015), and new technological innovations offer opportunities to apply predictive analytics and machine learning methods to travel behavior processes and feedback (Schweitzer, 2014).

Ultimately, as society comes to terms with "the internet of things" application program interfaces (API)s could be developed to both push and pull personalized information from travelers, and socially inform travel decisions. Information could be used to quantify travel through the built environment, while offering feedback and incentives that can be optimized by behavioral preferences. Perhaps could also be used to temper the palatability of pricing efforts as suggested by Schade and Schlag. The same APIs could help better quantify and reduce the embedded carbon in automotive travel and built environment resources (land, roads, parking) from travel, and in turn be used influence and justify the design and funding of built environment improvements that help shape active travel (i.e. improved sidewalks, bike lanes, and bus services). This promise of the future of information and incentives, is however underscored by a caveat. More information can also cause confusion, particularly when there are conflicting messages. These are important lessons as we continue to involve how with think about the economics of transport and behavior.

9. Conclusions

Research has shown that travel behavior is tied to economic and social factors. Policies can use a 'carrot' approach, taking advantage of incentives such as free transit passes, cash back ('cash-out') programs on parking, or social media nudge tools (Carrel et al., 2012) to incentivize alternatives to drive. Others use the 'stick' approach, where high prices for parking, tolls or roadway usage fees are common tools used to balance parking resources; however, research suggests that this approach is economically inefficient (McShane and Meyer, 1982; Peters and Gordon, 2009).

This research is novel because it examines the effect of social factors. This project evaluates different methods of shifting individuals to non-automotive transportation by using incentives. The study posits that rewards and social 'nudges' can encourage walking behavior. The results of this study suggest that the predominant focus on financial incentives may not be the most effective way to approach TDM and transportation market economics. Further research should expand and validate the understanding of pricing impacts, and the potential benefits (social, environmental, other) of behavioral nudge programs related to active travel behavior outcomes.

The broader impact of this work is aligned with thematic areas of public health, environmental sustainability and economic competitiveness. In public health, this project focuses on active forms of transportation like walking and biking—important areas related to societal issues of obesity and mental/physical wellness. Related to environmental sustainability, this study contributes to the understanding of active travel—about how people make choices to walk, bike or take transit; and that these choices are very complex but relate to broader issues of traffic congestion, air quality and greenhouse gas emissions. The complexity of these choices are wrapped up in both financial and social economic norms. This study helps improve the understanding how planners and policy makers can tap into these economic norms and improve the livability and accessibility of our travel patterns—attracting people to the fence so they can help "paint" a brighter future for us all.

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