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# Crowdsourcing for Mode Shift: An Empirical Evidence of its Success among College Students

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## Abstract

In this paper, a crowdsourcing-based perception framework is developed to estimate any changes in mode-shift behavior of college students. An empirical experiment was conducted with a sample of 30 participants from California State University, Long Beach, spanning over two phases, Phase I followed by Phase II. Participants used one of the five modes transit bus, bicycling, walking, car and carpool to arrive at the university campus. During Phase I, a control was created by individually acquiring the mode choice of participants and their numeric value of perception of each specific mode with the identity of a participant being kept anonymous to other participants throughout this research. The participants in Phase II were asked to post their comments publicly anonymously on modes on a “Twitter” address used for this study each time they arrived at the campus, thus utilizing a crowdsourcing platform to observe mode choice of other participants without knowing their identity. Data compilation showed an overall shift of users from private car to other modes of transportation.

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## 1. Introduction and Background

Crowdsourcing has seen a recent surge in various transportation applications (Chandra et al., 2019). Crowdsourcing can be used to obtain real-time conditions of nearby public transit and rail lines, traffic delays, and parking conditions (Misra et al., 2014). This elicits human behavior on transportation choice decision making. Inherent complexities involved in capturing human behavior makes surveys and interviews the best approach for understanding mode choice and shifts. However, most of the survey-based research outcomes are limited to providing insight at the individual

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level, which may not be uniform across all potential transit users. Although the information obtained through surveys is very useful for understanding transportation problems that exist locally or within the area surveyed, the policy implications and impacts can only be empirically justified. Thus, a suitable choice modeling technique can be deployed to understand the determinants that govern complex human mode choice among a set of available options and variables. To simplify the analysis, most of the research in this field can be further subdivided into qualitative and quantitative studies. An in-depth understanding of both qualitative and quantitative aspects of people's perceptions, attitudes, and behaviors toward choosing between a private car over public transport helps make policy decisions justifiable. While qualitative methods directly allow assessment and explanations of an individual transport user's behavior and attitudes, quantitative methods draw implications and attitudes from a traveler's mode choice based on statistical data analyses (Clifton and Handy, 2001; Beirão and Cabral, 2007).

Individuals are provided with a platform where they are able to express their thought and concerns for a project while also contributing in a diverse group of people thereby introducing different ideas in hopes of solving one or more specific problems pertaining to the project (Rabinowitz, 2013). Fig. 1 shows the visual example of how basic crowdsourcing is theorized to work as well as some of the main steps that are typically involved in crowdsourcing (Misra et al., 2014). This method of looking for a solution allows for a larger range of possible solutions being observed while also increasing the participation the public has with a transportation project. This increase in participation aid in the concern of many urban planners that tend to have difficulty in obtaining public involvement (Brabham, 2009). Furthermore, through the use of crowdsourcing one can make use of the massive amount of information needed for planning decisions (Ferster et al., 2017).

This paper develops a framework for building a crowdsourcing approach to substantiate any mode-shift behavior of college students at California State University, Long Beach (CSULB). Crowdsourcing was carried out to gather data about mode choice and subsequent mode shift behavior of students in two phases (Phase I and II) spanning over a two-month period.

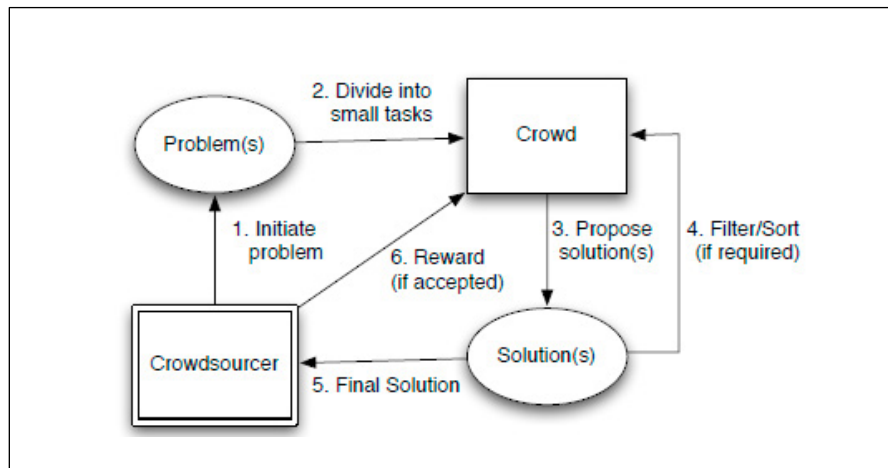


Fig. 1. Overview of Main Steps in Crowdsourcing (Ali et al., 2012)

## 2. Framework

In this paper, the popularity of a mode is modelled by gathering and evaluating opinions received from participants on a series of transportation modes. Opinions can be gathered through traditional surveys such as a blog or a social media platform (which could be a blog or a social media site such as Twitter, Facebook etc.) where each individual knows the opinions of others before pitching in his/her own views about a mode. This enables others to see the most popular and commonly used mode to reach to their destination. Thus, a participant can access comments/opinions

posted on the platform from all his/her previous participants acting as predecessors arranged in a chronological order. Opinions reflect one's preference from among the series of modes which might have been influenced by a participant's prior experience or perception on the use of the mode. The participant may choose to endorse opinions of other participants for or against the mode, thus exhibiting decision making skills of favouring or not favouring the use of a mode by crowdsourcing information from others.

### 3. Empirical Study and Findings

The theory presented on perception framework discussed above has been empirically validated using example of determining mode choice based on crowdsourcing. The goal of the application example is to understand at what instance can a mode potentially become popular among individuals who are averse to using the mode.

Real data were used to show applicability of theory on perception impacts of positive and negative comments of a mode in a crowdsourcing set-up. The exercise is carried out to assess any mode shifts among five transportation modes of personal car, transit bus, bicycling, walking and carpool for students from California State University, Long Beach (CSULB). These five modes are usually used by CSULB students to arrive at the campus. A total of 30 students participated in this exercise spanning over a two-month period divided into two phases of one month each - Phase I and Phase II. Only those participants were included in this study who could easily choose either of the five modes to arrive at the campus. Furthermore, participating students were required to be on campus at least once on a weekday, own or can use a smartphone, and be able to either use personal car, public transport, walk, or bike to arrive at the campus.

The weather throughout regular semesters of Spring and Fall in the city of Long Beach is always perfect for using all five modes of transport. Phase I was carried out for the month of October of year 2016 and Phase II was carried out during November and December of 2016. For both the phases, data collection was made only for the weekday travels of the participants to the CSULB campus. During Phase I mode choice of each participant was collected every Tuesday, Thursday, and Friday through emails and was not shared among the participants.

Pamphlets were posted around the college campus to select participants for the study. There was an overwhelming response from college students to participate mainly due to incentives given after the completion of the study. To ensure maximum random sample of participants that were selected, no two participants belonged to the same major/department at the same level of study (freshman, sophomore, junior or senior); in addition, it was ensured that the usual arrival times to campus of the participants belonging to the same major differed by at least two to three hours for a given weekday. There was an equal number of male and female students participating in this study. Incentives were given to participants at the completion of each phase.

During Phase II, each participant was provided with a short-encrypted name (with random four-letter first and also four-letter last name) to be used to post any tweets on a Twitter account created and managed specifically for this research. This was done to mask and protect the privacy of the participants from knowing each other while making any posts on the Twitter account. All unrelated, unwanted or differing tweets or posts other than the six mentioned above, were deleted from the Twitter page as soon as the researchers encountered them. A warning was also issued to the violator via email. The researchers served as the administrator and the owner of the Twitter account. The students were asked to post short phrases on the controlled Twitter account "Civil CSULB" for the mode used to reach campus on weekdays (Monday-Friday) along with a score rating the mode. The students were allowed to choose only from among the six phrases as mentioned below:

1. Heavy traffic to campus
2. Found parking
3. Took bus to campus
4. Biked to campus
5. Carpooled
6. Walked to campus

For the above six phrases, positive and negative interpretations are tabulated in Table 1. Each phrase had at least one positive interpretation.

Table 1. Interpretation of phrase posted on Twitter by participants

Phrase No.	Phrase	Transit Bus	Bicycling	Walking	Car	Carpool
1	Heavy traffic to campus	<i>P</i>	<i>P</i>	<i>P</i>	<i>N</i>	<i>N</i>
2	Found parking	<i>N</i>	<i>N</i>	<i>N</i>	<i>P</i>	<i>P</i>
3	Took bus to campus	<i>P</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>
4	Biked to campus	<i>N</i>	<i>P</i>	<i>N</i>	<i>N</i>	<i>N</i>
5	Carpooled	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>P</i>
6	Walked to campus	<i>N</i>	<i>N</i>	<i>P</i>	<i>N</i>	<i>N</i>

*P* = positive; *N* = negative

#### 4. Results

It is evident from Table 2 that female students had a higher percentage decrease in car usage while also not preferring to bike to school- either during Phase I or II. This might be due to poor infrastructure or safety-issues for females if at all they desired to bike. There was also a high percentage change (almost 16%) change in mode choice of walking for female students for Phase II. It is also to be noted in Table 2 that there was almost no change in bus usage from Phase I to II.

City planners and stakeholders can improve ridership and user frequencies of sustainable transportation modes (such as transit, bicycling etc.) by utilizing the crowdsourcing technique of soliciting public opinions, which are transparent, about specific infrastructure facilities. Further, using the crowd-based perception score developed in this research, the future popularity of the modes can be assessed.

Table 2. Resulting mode shift (Phase II minus Phase I) for overall and gender-specific mode frequencies

	Overall Mode Shift	Males Mode Shift	Females Mode Shift
Car	-13.05%	-11.63%	-14.13%
Bus	-0.20%	0.26%	-0.42%
Bike	0.40%	1.17%	0.00%
Walk	13.36%	10.20%	15.80%
Carpool	-0.51%	0.00%	-1.24%

### Concluding Remarks

Crowdsourcing is emerging as a powerful tool in transportation for travel management and routing decisions. For example, Cyclopath (which is a geo-wiki where bicycle users in Minnesota share note about bike lane and trail conditions on an editable map) is being used to crowdsource information about missing parts or trails on a lane to fellow bicyclists (Cyclopath, 2016). Other examples include smartphone-based applications, such as Google Maps, which provide dynamic routes to roadway users by crowdsourcing (Google Help, 2016).

This paper provides an application of a model with a crowd-based perception framework developed to study any potential mode-shift behaviour among college students soliciting comments and opinions on mode used to arrive at the CSULB campus. Based on the outcome of this study, albeit for a small sample size, it is shown that the crowd-based perception framework can potentially predict the future ridership to a certain extent.

The findings of this research can be further validated by increasing the participant pool in this crowdsourcing exercise. The results clearly will have some very wide-spread implications beyond the college settings in popularizing mode-shifts to transit and other active transportation modes if appropriate social media and information sharing mechanisms through crowdsourcing are provided to transport users.

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