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Capturing the Relationship between Motility, Mobility and Well-Being Using Smart Phones

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Understanding and modeling subjective well-being has been an expanding area of research among transportation researchers during the last decade. It has been well argued that mobility is the result of people's desire to conduct activities in order to satisfy several needs so as to maintain or enhance well-being. In recent years, several efforts have been made to quantify travelers' subjective well-being using self-reported state of happiness while participating in various activities or travel patterns. The limitations of these conventional survey methods to collect uninterrupted and comprehensive information have restricted the number of such studies. In this study, we adapted a smartphone-based sensing platform to collect mobility information and measure happiness.

We have developed a conceptual approach to the implementation of happiness evaluations within the Future Mobility Sensing (FMS) survey platform. FMS is a smartphone-based system that tracks users' activities and trips and can detect certain trip attributes such as the mode. Users can visualize their activities and trips as an activity diary on the FMS app (or alternatively on the FMS website) where they also have the option to verify their activity diary and provide further information. The FMS has initially been developed as part of the Future Urban Mobility project of the MIT-Singapore Alliance for Research and Technology (SMART) and is under continuous development as part of other projects as well including this UTC project.

Two types of happiness measures are obtained through FMS for a random sample of activities for each participant: a real-time happiness measure, while the individuals are performing their activities, and a retrospective happiness measure, provided by the individuals when verifying their activity diaries online.

- Real-Time Happiness: The individual is asked at a random time during the day about the activity that is being performed and his level of happiness (in a 7-level scale, going from "Very Unhappy" to "Very Happy").
- Retrospective Happiness: When verifying his activity diary, the individual is asked how happy he was (on the same 7-level scale) during the same activity for which he answered on real-time.

Two surveys have been conducted to measure happiness, both in real-time and retrospectively. The respondents came from several countries covering five continents, and considered both workers and students. The results of the first survey helped in improving the methodology for collecting well-being information using a smart-phone app.

We compare the real-time and retrospective happiness measures, and explain them as a function of activity attributes and socio-economic variables. Results show that:

- Compared to staying at home, performing work and education activities tends to result in lower levels of happiness.
- Compared to staying at home, performing other activities tends to result in higher levels of happiness.
- Performing education activities on weekends instead of weekdays leads to lower levels of happiness.
- Men tend to report higher levels of happiness on real-time, but women tend to report higher levels of happiness retrospectively.
- Activity duration has a more significant effect on real-time happiness than on retrospective happiness.
- Longer work and education activity duration has a negative impact on happiness
- Longer duration of other activities has a positive impact on happiness.

We compare and explain real-time and retrospective happiness measures. Results show that different cognitive biases affect the levels of happiness provided by the individuals. Compared to staying at home, performing work and education activities tends to result in lower levels of happiness, while performing other activities tends to result in higher levels of happiness. Activity duration has a significant effect on real-time happiness, but is less significant on retrospective happiness.

The framework that we have developed for measuring happiness is expected to have an impact on the state of the art in transportation planning surveys and modeling methodologies. The FMS platform provides an opportunity for researchers to collect relevant mobility information at a low cost. Previous studies on happiness measure overall activity pattern happiness, while our approach allows the collection of measures of happiness for different activities conducted along the day.

In a later stage of the study, we plan to incorporate these happiness measurements in transportation and mobility models, to enhance their capabilities. Another direct extension/application of the framework of this project and the data collected is to provide information to travelers about their travel and activity patterns (via the FMS app or its website) and how they compare to others may influence their travel behavior. The provision of feedback may help them when making decisions about travel patterns, and this feedback could be targeted for efficiency and/or sustainability purposes.

The framework developed in this research can be of use for researchers working in different fields of subjective well-being measurement (which covers a broad range of disciplines, such as Sociology or Economics). The results of the project have been disseminated in two conferences:

Raveau, S., Ghorpade, A., Nawarathne, K., Zhenquang, Q., Ko, W., Zhao, F., Abou-Zeid M., Zegras, C. and Ben-Akiva, M. (2015) Smartphone Based Travel Survey to Study the Relationship Between Happiness and Behavior. 5th Future Urban Mobility Symposium, July 6-7, Singapore.

Raveau, S., Ghorpade, A., Zhao, F., Abou-Zeid, M., Zegras, C. and Ben-Akiva, M. (2016). Smartphone-based survey for real-time and retrospective happiness related to travel and activities. 95th Annual Meeting of the Transportation Research Board. Washington D.C., USA, January

A scientific paper has been submitted for publication to Transportation Research Records. The draft of this paper is included as an annex to this report.

Raveau, S., Ghorpade, A., Zhao, F., Abou-Zeid, M., Zegras, C. and Ben-Akiva, M. Smartphone-based survey for real-time and retrospective happiness related to travel and activities. Transportation Research Record (submitted).