How to track behaviours' changes toward more sustainable mobility habits: the serious game of TrafficO$_2$

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Abstract

Social science and new communication technologies are influencing deeply the transportation domain and new models of urban sustainable development are constantly emerging as new possible solutions. One of the principal reasons is the capability to reach the motivations that foster us to choose one or other urban transportation systems. It's already feasible to develop solutions to aim the implementation and the rooting of more efficient and sustainable habits in urban transportation.

The present exploratory paper presents the activities conducted by innovation lab PUSH, with the Italian Ministry of Innovation and Research, for the development and the application of the social innovation project "trafficO$_2$" in the city of Palermo Italy. The project is a technology driven (a mobile app) serious game for sustainable urban mobility that tries to foster citizens, through information and tailor made incentives, to choose low emission means instead of using cars.

In a very controversial context given by the urban mobility of the city of Palermo, aim of the game is to build a strong and values driven self-organized community, able to change the actual urban condition without any command and control policies or any structural transformation.
The system was already tested twice with the community of students of the Palermo University; the paper shows the first results in terms of CO$_2$ reduction and testers engagement.

The technology driven bottom-up attempts to improve the Palermo urban mobility

All over the world designers are dealing with studies that aim to define new tools to face urban traffic issues in the old and consolidated cities (Gal-Tzur et al., 2014). Many believe that we need to change citizens' views towards mobility systems, simply focusing on and improving "human transit".
The social sciences have already crossed into the urbanism field, but today new information technologies are making this communication faster and more productive. American private enterprises such as Nuride (http://nuride.com), Zimride (http://www.zimride.com/) and Urban Engine (https://www.urbanengines.com/), and European enterprises like moovel (https://www.moovel.com/en/US/), Mo-bility (http://www.mo-bility.com/mo/home.html) and Covivo (http://www.covivoturage-dynamiq.eu/) are quickly moving the debate on changing cities by switching their attention from the necessary modifications of the urban structure (the hardware) to the changes that can be induced by working on citizen behavior and the urban communities' habits (the software).

All of these initiatives try to stimulate the community to change its bad habits, fostering more responsible behavior through the use of smartphone apps. Essentially, the idea is to trigger a social and cultural change with the "dialog" tools provided by social media technology and, possibly, create a new service and, therefore, a new market. In fact, the majority of the above-mentioned projects were all developed by start-ups. This area of computer science is called "Social Computing" (Kwai Fun & Wagner, 2008). The idea behind it is: deep impact on global economy and on social organization can be obtained by fast connections (with low cost devices), modular contents and shared computing resources. In Palermo the most relevant on going initiatives in this direction are probably the three innovative projects on Palermo funded with almost 4 millions euros by the Italian Ministry of University and

Research in the framework of the competition "Smart Cities and Communities and Social Innovation". The projects aim to stimulate local communities to change their habits fostering more responsible mobility behaviours with the help of smartphone applications. The three groups that won the fellowship are young multidisciplinary teams with a "social entrepreneurs" approach to the theme. They are working on different softwares – Muovity, CityFree and TrafficO_2 – that will provide services of carpooling logistic (mostly focused on short distance commuters) and inter modality logistic to foster sustainable mobility values.

"TrafficO_2" a serious game for sustainable urban mobility

Among these social innovation projects we'll report the activities of trafficO_2, the project ideated, co-financed and developed by PUSH research lab.

TrafficO_2 is an action-research study that tries to pursue the objective to improve traffic conditions without using any top-down policies but, through a social network, fostering directly the citizens toward more green behavior in a one-to-one dialogue.

The goal of trafficO_2 is to reduce traffic and pollution caused by the use of private cars by facilitating the interaction between pre-defined categories of users, companies, and potential sponsors in order to arrive to an agreement that is fair to all of them: an agreement providing for a reward in exchange for sustainable modes of circulation.

TrafficO_2 aims at orienting citizens' mobility effectively, by showing them that sustainable mobility is possible also in complex urban environments (the first test takes place in Palermo), and that it can be also a fun and rewarding game (Figure 1).

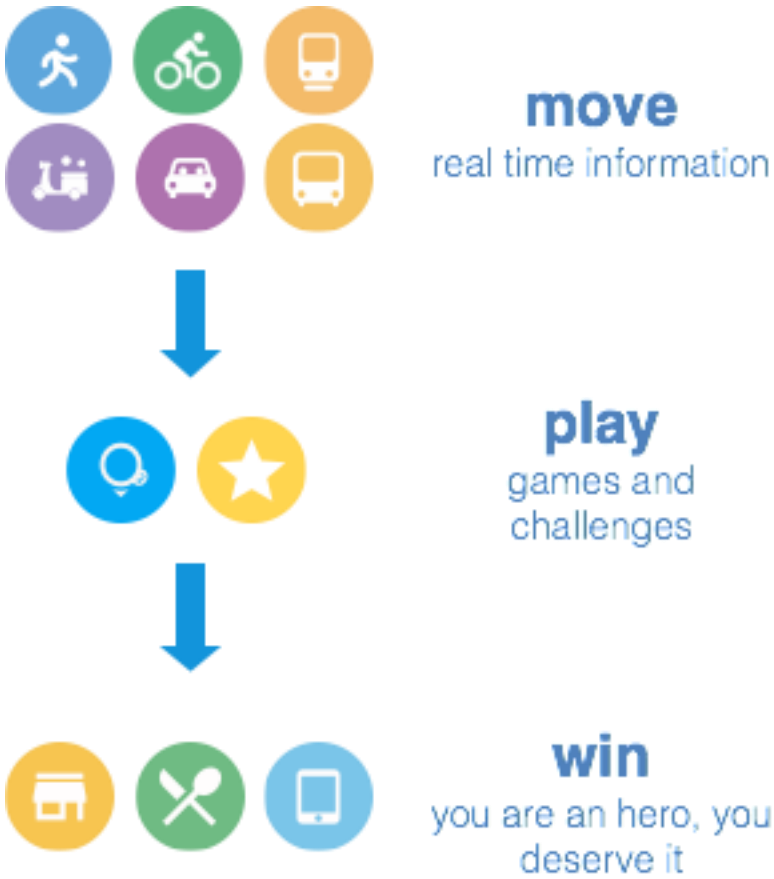

Figure 1. The user experience flow of trafficO_2: Move, Play Win.

Therefore, trafficO_2 mobile app connects together info-mobility, entertainment, and engagement with local companies, so that urban commuters are informed of the array of possibilities that allow them to circulate in a sustainable way (on foot, by bike, with public transportation, with vehicle pooling, car sharing) and to be rewarded when they opt for the most sustainable choice. This means that the

commuter will immediately be able to see the total improvement towards a more sustainable mobility, and therefore can be more motivated to change (Vinci & Di Dio, 2014).

For each route and for any single mode of circulation the app describes the travel time, the cost in Euros, the environmental cost expressed in CO_2 and the calories burnt.
Furthermore, each choice will be worth a certain amount of so called O_2 points (a virtual currency), which the users will earn and use towards prizes, transforming trafficO_2 from DSS sustainable and environmentally friendly trips into a game citizens play. The possibility to earn O_2 points is also influenced by a weather factor. This option is created with the attempt to promote more sustainable systems (walking, biking and moving by the public transport network) on the cloudy and rainy days.
Obviously more sustainable trips will award more points and also users will be able to increase their O_2 points by challenging, through the website or via mobile app, their friends and playing with the engagement contents made available by the sponsors.
With the O_2, moreover, it's possible to join the challenges ("thematic" challenges as "Move your feet" for those that will earn more O_2 points just by walking have many prizes by several local business sponsors or "branded" challenges with few prizes by just one sponsor) and play to get the prizes gift by the sponsor community.
Fundamentally, trafficO_2 is a platform based on value exchange: for each responsible choice there is an existing tangible market value, and each choice will advertise and communicate information regarding the sponsors (Di Dio et al, 2015).
TrafficO_2 aims to provide commercial motivations and an emotional input to push people towards change, by combining information on mobility, advertising and a game (Figure 2).
The game motto is "Move in a sustainable way, collect points, win prizes. Save the World!"

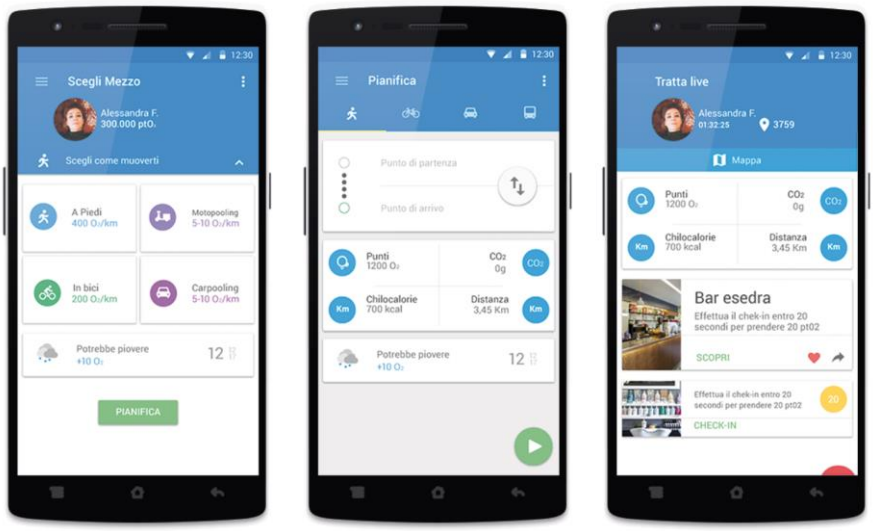

Figure 2. TrafficO_2 mobile app.

The smartphone technology, besides the software interface, provides motion recognition for the trips (Dernbach, 2012), differentiated with a high level of accuracy if the user is walking, biking or travelling by car. This is possible due to the sensors within the devices and the microprocessors that, through a specific algorithm, overlap the GPS position information and accelerometer, and detects the motion system (Manzoni et al, 2011). The recognition of the transport system and validation is the most interesting innovation, and represents for the users and sponsors a fundamental guarantee for the rules of the game.

In order to build a model able to measure the results of the application, at first sample (about 100 people) of the Palermo University student community was selected through a workshop (involving students from computer science, business school and marketing and communication), and a survey was provided to

inquiry into the mobility habits formed before the experiment (Scenario 0). Starting from this information an analysis model was designed taking in account two main indicators: the first connected to the distance home/school (dividing the sample in subsamples from the nearest A to farthest E geographical classes), and the second to the user's improvement potential (according to the Scenario 0 emissions and the behavior change due to new motivations).
In order to define this second indicator, simulations were made to lead to two possible improved scenarios of the Scenario 0 Palermo University students' modal split (Figure 3):
"Do Your Right Mix" is the easiest. In this Scenario is simulated that in choosing a system of sustainable mobility, a user within a given geographical class, in relation to his or her own preferences, acts according to the behavior of the mean of the sample taken in the same class;
"Do Your Best Mix" represents the hardest. The simulation leads to more drastic, and hence challenging, modifications in a user's behavior (again considering his or her geographical location and trying to meet at best his or her own preferences).

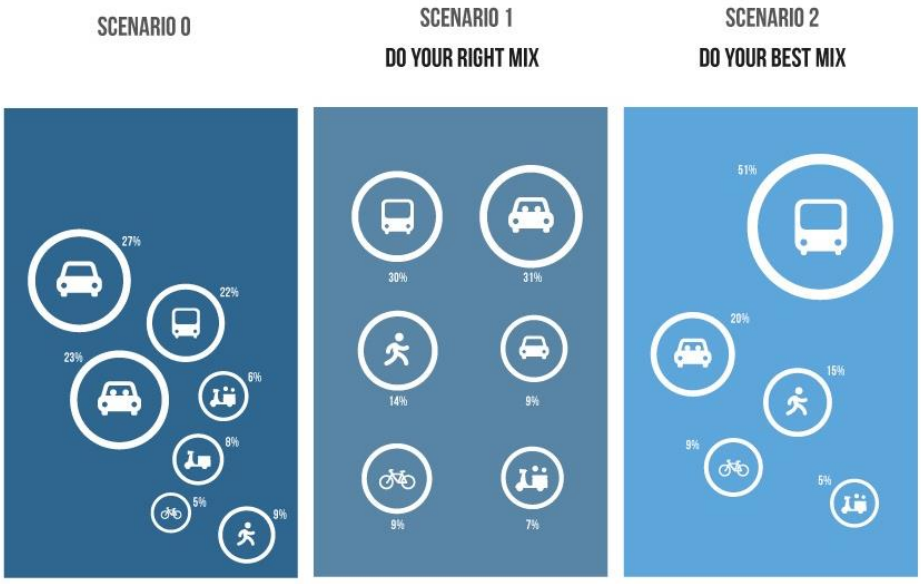

Figure 3. University community's modal split improvement simulations

Results
In order to test the assumptions trafficO_2 application was tested twice in the city of Palermo with the participation of the students from the University in what was called "S.U.V. Challenges", where the acronym stands for Sustainable Urban Values. The selected sample, although it is not representative if related to the total number of students of the University residing in the urban area (about 25,000), still displays some interesting features allowing us to detect specific habits and behaviors connected to urban mobility.

Figure 4. S.U.V. Challenge badge for the students' community testers

The first test, from May to June 2014, was conducted mainly for the definition and validation of the analysis model, the second one, from November to December 2014, for the implementation of new features in response to the first testers' feedback.
A third test is now running while we are writing this exploratory paper (from April to May 2015).

Although the first version of the test provided only two systems of mobility (on foot and by bike), thanks to game dynamics and to the fact that real prizes could be won, the first test yielded encouraging results. As shown in Table 1, about 77 testers were active users of the app and almost a third of the system use was related to the home-to-university trips. As it is possible to see from Figure 5 students living in 10 km radius from the university departments mainly made the sample.

Table 1. Results of first test of the system (from May to June 2013)

Sample	77
Tracks	306
Total km	760
Tracks Home to Work and vice versa	99

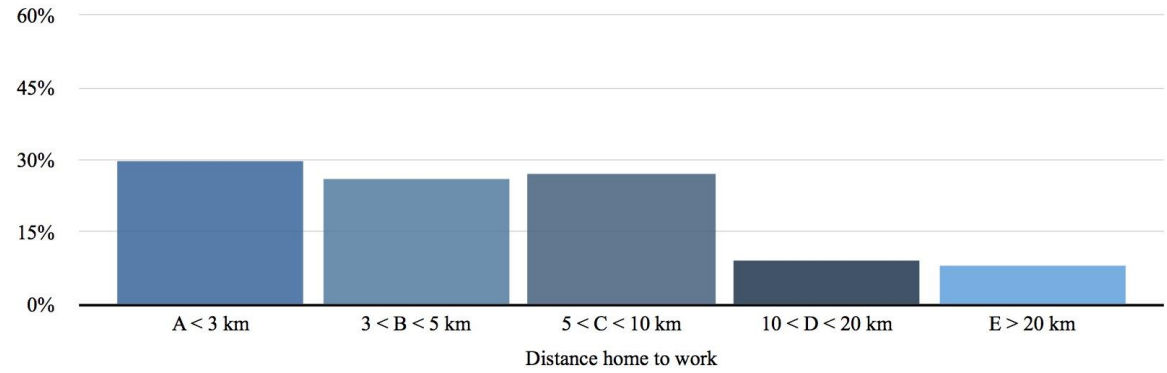

Figure 5. First test sample's distribution

In terms of CO_2 emissions, the game active users' performances reached the level indicated under Scenario 1, "Do Your Right Mix" (Figure 6).
The desirable change seems indeed to be possible.

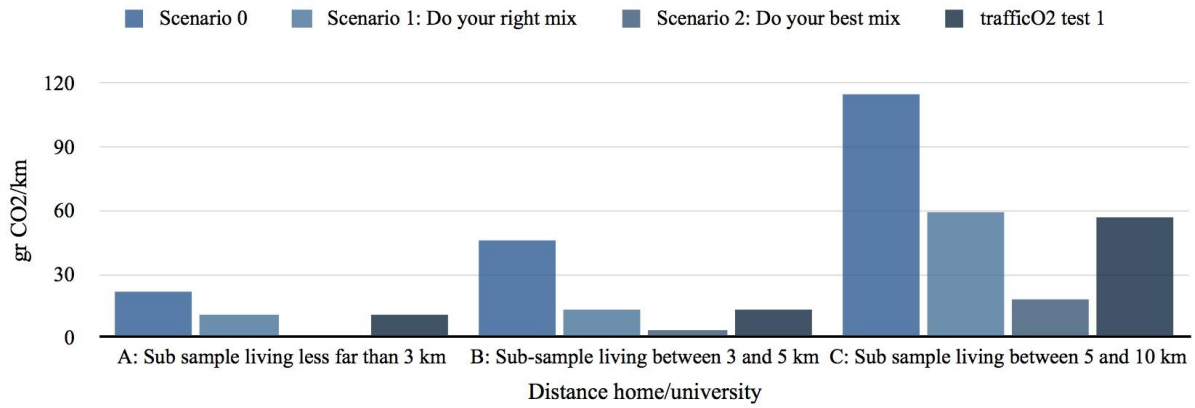

Figure 6. University community's CO_2 reduction during the first trafficO_2 test

The second round of tests was performed on a larger number of testers, 245 active users with more than 400 trips home-to-work (Table 2), and vehicle pulling was introduced as additional system of mobility. Also, data shows that the app is especially used in the user's spare time, in so highlighting that the users' appreciation for this new experience, for the gaming dynamics, and for the engagement with the companies. As shown in figure 7 the large part of the sample still lived in the urban area very closed to the university departments.

Table 2. Second test of the system (from November to December 2014)

Sample	245
Tracks	4.603
Total km	27.680
Tracks Home to Work and vice versa	444

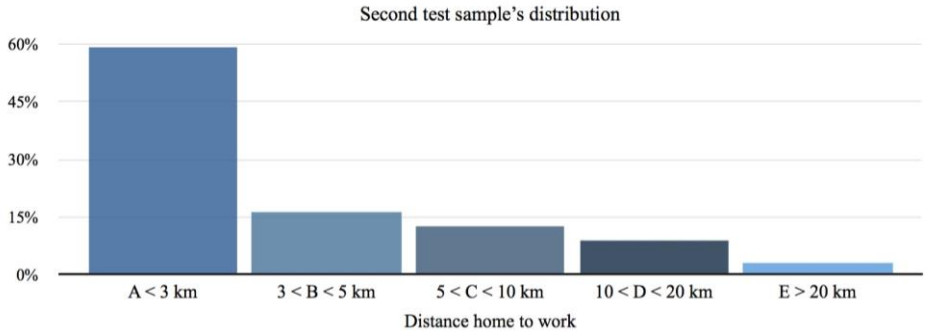

Figure 7. University community's CO_2 reduction during the second trafficO_2 test

The data collected were elaborated in digital maps (as Figure 8) in order to draw a completely new scenario with regard to Palermo's sustainable mobility and therefore reveal to be quite important (see www.traffico2.com/data). For instance, thanks to the valiant bikers engaged in trafficO_2, today we can find which is the safest route for a biker to move around the city and to get to the various university facilities.

Figure 8. University community's tracks visualized

The performance results of the sample taken for this test are in line with the previous results obtained as it's shown in Figure 9. With reference to the route home-to-university the data analyzed shows that the sustainable mobility performance of the active users' sample has improved of the 30% (as the previous experimentation the result accords to the Scenario 1: Do your right mix), reducing CO_2 emissions in the atmosphere of about 30 kg.

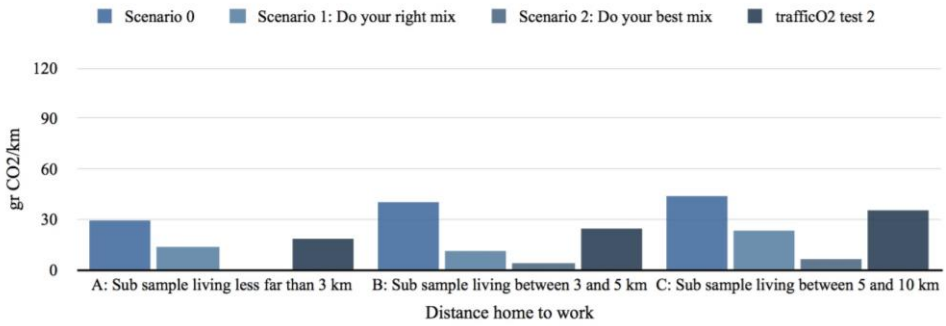

Figure 9. University community's CO_2 reduction during the second trafficO_2 test

Conclusions

In these times of almost "zero resources", it seems possible to improve the city's livability without implementing actions on the current infrastructures but, through information technologies, by simply inducing people to change their current bad behaviors (Ceder et al, 2013). This kind of approach to urban policies on mobility, furthermore, does not foresee the classic top-down dynamics such as road pricing or the optimization of the public transportation network, neither the creation of limited traffic zones.

The design and the analysis models of trafficO_2, in fact, takes into account only the already available resources without modifying any aspects of them, but trying to highlight the real value they could provide to the citizens.

Aim of the game is to build a strong and values driven self-organized community, improving the environmental conditions without any command and control policies.

Without realizing any structural or infrastructural intervention on the urban landscape, but only recurring to a game combining technology, information, and incentives, trafficO_2 demonstrates that in order to bring about innovation in a city, it is sufficient (sometimes) to innovate its citizens' behaviors.

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