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Gamification design to foster stakeholder engagement and behavior change: An application to urban freight transport

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ABSTRACT

A recent trend to engage and promote sustainable behaviors in transport foresees gamification, i.e. the use of game design elements in nongame contexts. To foster the expected behavior change, one should appropriately conceive, deploy and manage gamification. The paper addresses the problem of gamification design by proposing an advanced user-centered approach accounting for players' heterogeneous preferences. This is performed using stated preference methods and is applied to a reverse logistics case study. By comparing the results obtained with the proposed approach to those derived from the traditionally adopted ones, the paper shows that the former would provide considerable new insights with respect to players' heterogeneous preferences, thus, possibly, increasing the chance of achieving satisfactory results. The paper suggests that, whenever designing gamification to foster engagement and behavior change in transport, one should adopt a user-centered approach based on stated choice experiments to maximize its probability of success.

1. Introduction

Transport systems are complex sociotechnical structures characterized by multiple agents taking single decisions (Cascetta et al., 2015). The overall system is determined by the aggregation of individual behaviors, which are not easy to predict (Ettema, 2015). In this context, effective policy-making constitutes a daunting task. In fact, it has to tackle transport problems, account for stakeholders' preferences and promote sustainable behaviors (Banister, 2008). Policy-makers need *ex-ante* evaluations to assess the most likely impact solutions will have (Ortúzar and Willumsen, 2011). This is relevant also because different stakeholders will respond to policy interventions from a different perspective, according to their perceived utility, and with alternative goals in mind (Le Pira et al., 2017a, 2017b). Behavioral analysis is fundamental to elicit stakeholders' preferences for alternative transport policies and investigate their utility functions (Holguín-Veras and Wang, 2013; Marcucci and Danielis, 2008; Gatta and Marcucci, 2014; 2015; Marcucci et al., 2012, 2013, 2015, 2017a). One should also directly engage stakeholders in the decision-making process to promote well-accepted solutions (Cascetta et al., 2015, Le Pira et al., 2016). This, in turn, will facilitate policy deployment, and stimulate stakeholder behavior change. In this respect, influencing behaviors is crucial to guarantee the success of sustainable transport policies (Gatta et al., 2017).

The concept of behavior change has a multifaceted lineage, surpasses traditional divisions in the political arena (Jones et al., 2011), and is intermingled with "nudging". The latter represents a form of "libertarian paternalism" (Thaler and Sunstein, 2008) and

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is a "liberty-preserving" approach to guide people while leaving them free to choose (Sunstein, 2014). Voluntary travel behavior change initiatives have been proposed to influence travel mode choices through awareness raising, marketing and education, challenging the assumption that modal shift is only possible through "hard" system-based measures, or through regulation. However, it is evident that getting people to change their travel behavior on a large scale and at a reasonable cost is undoubtedly a challenge (Brög et al., 2009).

One can use game dynamics to stimulate sustainable behaviors. This approach is often referred to as "gamification", i.e. the use of "game design elements in nongame contexts" (Deterding et al., 2011). The rationale is to leverage on game mechanics' power for a non-entertainment purpose (Nelson, 2012). This approach is quite new in transport policy. It is mostly adopted in passenger (e.g. Meloni and Sanjust, 2015; Corcoba Magaña and Muñoz-Organero, 2015; Hoh et al., 2012; Kazhamiakin et al., 2015; Jylhä et al., 2013), while less frequently in freight transport (e.g. Klemke et al., 2014; Hense et al., 2014).

Gamification is a promising tool that can positively influence the adoption of transport solutions (see, e.g. "CIVITAS Training: Influencing behavior through gamification"[1]). However, it is not capable *per se* to induce behavior change. One should rather appropriately conceive, deploy and manage it to maximize users' involvement. In fact, it can produce different results depending on the correlation existing between: structure adopted, context, player-types and their preferences. More in detail: (1) game structure refers to the rules and mechanics of gameplay that clarify how different parts interact and how the overall flow of the game happens; (2) context relates to the environment within which players operate that, in turns, determine the aim of gamification (see e.g. "Volvo driver challenge"[2]); (3) player-types represent various sets of players grouped according to their specific interest in the game (e.g. achieving awards, interacting with other players, etc.); (4) preferences in general describe the ordering of alternatives based on their relative utility. Taste factors are at the base of individual preferences.

Analyzing gamification conception and deployment in transport, one discovers that, in general, the focus is on assessing the impact of gamification on users' behavior. Less attention in the literature is paid to the design phase, i.e. how to effectively address players' preferences to tailor-design gamification mechanics. In particular, three main issues have not been appropriately addressed so far. In the first place, there is no *ex-ante* classification of potentially different player-types. As an example, Corcoba Magaña and Muñoz-Organero (2015) cluster users according to their driving behavior, but they do not take into account players' interests in the game. Secondly, researchers do not explicitly account for preference heterogeneity among players with respect to game structure. For example, some gamification approaches reward users via "a badge system" (e.g. Meloni and Sanjust, 2015), without considering that, probably, some of them would be more willing to participate if rewarded with other types of prizes (e.g. discounts). Finally, there is a lack of theoretically rooted and econometrically robust analysis linking players' preferences to game structure. The few cases explicitly considering the correlation between user-type composition and game structure make use of anecdotal knowledge and employ experience-based evidence. For instance, Kracheel et al. (2014) perform a "mobility behavior study", where they analyze people's habits and activities without actually investigating their preferences as players. This constitutes a shortcoming when attempting to estimate and compare, *ex-ante*, the potential of alternative gamification processes.

Given the context defined above, the research question this paper answers to is the following: *how can one improve the design of a gamification structure via a theoretically robust quantitative approach accounting for players'-type and their heterogeneous preferences so to successfully foster engagement and behavior change toward sustainable transport?*

This paper contributes to the literature in the field of gamification in transport by illustrating, through a specific example in reverse logistics, a procedure to appropriately design gamification via stated choice experiments (SCEs). We propose a user-centered design approach, based on SCEs, and inspired by the human-centered scheme. The fundamental tenets of human-centered schemes, according to ISO standards, are: (i) build the design upon a clear understanding of users; (ii) involve them throughout the process; (iii) fine-tune the design analyzing users' perceptions (ISO 9241-210).

The proposed procedure allows to align game characteristics with players' preferences/expectations and increase stakeholders' engagement while stimulating behavior change. Fig. 1 schematically describes the rationale supporting the use of SCEs for user-centered gamification designs. Given the gamification objective, the SCE, accounting for player-types and game elements/mechanics, helps tailoring the gamification process based on the preferences the stakeholders expressed. In the implementation phase, players' behavior responds to game dynamics. Game monitoring will allow checking the correspondence between envisaged player-types and actual ones, and, possibly, adjusting game elements/mechanics. It is worthy of notice that this paper specifically aims at exploring gamification design issues, leaving the implementation phase to a second step of the research that is already underway.

We believe an adequate gamification process can contribute to the promotion of behavior change, while minimizing the undesired effects of commonly used instruments, such as taxes (distortion), subsidies (financial burden), and restrictions (surveillance). This is even more important in urban freight transport (UFT), due to the low efficiency of the sector (e.g. low load factors), negative externalities generated (e.g. noxious emissions), and stakeholder heterogeneity (Comi et al., 2008; Gatta et al., 2017).

The remainder of the paper is organized as follows. Section 2 introduces the main concepts of gamification and its structural components. Section 3 describes the methodological framework proposed and discusses its suitability to develop a user-centered gamification approach. Section 4 illustrates a case study in a reverse logistics context, showing the main steps needed to acquire data, and the results obtained to inform a tailored/context-specific gamification process. Section 5 critically discusses the benefits of the procedure adopted with respect to traditional approaches. Section 6 concludes indicating future research endeavors.

[1] http://www.civitas.eu/content/civitas-training-influencing-behaviour-through-gamification.
[2] https://www.volvotrucks.com/en-en/services/driver-challenge.html.