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Published online: 26 Jun 2017.

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Gender in Shared Navigation: Men to Mars, Women to Venus?

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ABSTRACT

This study examined gender differences in perceptions and adoption of a shared digital navigation system, Waze. The study was exploratory within the qualitative methodology paradigm and employed semi-structured interviews. The 37 Israeli drivers, 20 women and 17 men aged 22–63 who used, Waze, for at least six months, were interviewed on their driving experiences and perceptions. Findings suggest that the motives can be divided into three categories: (1) Functionality: easy navigation to destinations and receiving real-time updates. This category was the most prevalently mentioned, with no evident differences between men and women. (2) Secondary advantages: this group includes motives related to the drivers' wellbeing and financial benefits. The findings indicated that women are motivated to a greater extent than men by these advantages. (3) Innovation: this motive was mentioned by the fewest number of participants, and findings indicated that men were motivated by innovation to a greater extent than women.

Introduction

Research and development in the field of digital applications and mobile devices have led to a technological revolution that has enabled us to acquire and ubiquitously use information in all locations and at all hours. The spread of smartphones has gradually led most of the western world to become a mobile information society [23]. This technological change was also manifested in the field of driving and navigation. Owing to technologies such as digital navigation systems and smartphones, cars are no longer function merely as a means of transportation from one place to another [19]. Rather cars have become complex interactive environments in which the driver is a multimedia consumer, communicating with others through the phone, consuming and providing information while driving.

Shared digital navigation systems are Global Positioning Systems (GPS) that are part of the interactive space, in which drivers consume, create and supply information through digital devices while driving. In recent years, there is a continuous growth of using shared navigation systems that enable drivers to receive real-time information relevant to the car's current location, optimal driving routes, and traffic reports. A new generation of "social" digital navigation systems, such as Waze application (waze.com) investigated in this study or Google Maps, is based on collecting background driving data and drivers' reports shared via such systems.

This study is grounded on two conceptual frameworks. The first of them, the "wisdom of crowds" framework [29] refers to a process in information communities, in which content is generated and shared by a large number of community members. According to this concept, an average

answer based on responses provided by numerous individuals is usually more accurate than one expert's answer. In the case of shared digital navigation systems, based on the wisdom of crowds concept one can argue that multiple reports of drivers in real-time will provide more accurate information about optimal travel routes than ordinary GPS maps prepared by experts. The second framework of this study is "*Produsage*" [11]—a concept that underlies participation in digital environments, in which people not only consume information but also are inclined to produce it and share with other users. In the case of shared digital navigation, drivers not only used information of others but also actively report in real time about traffic conditions, police patrols, etc.

Regarding gender differences in the willingness of producing and sharing information in systems based on the wisdom of crowds, Collier and Bear [13] claim that only 15% of individuals who contribute knowledge on Wikipedia are women. Furthermore, they indicate that women contribute less content to Wikipedia because they avoid confrontations—contributing and especially editing content of other contributors in Wikipedia might contain confrontation. Thus, although computer-mediated written environment such as Wikipedia can be gender-anonymous, women tend to avoid engaging in this activity. Another explanation provided by Collier and Bear [13] is that compared to men, women tend to have lower confidence in their knowledge, competence, and professional experience as a foundation for contributing content and hence, feel uncomfortable editing content that someone else contributed. Given the similar preliminary findings in relation to women's use of digital navigation systems based on the wisdom of crowds [21], it is important to examine whether fear of

confrontation and low confidence concerning spatial abilities and knowledge lead women to be less active users of digital navigation systems than men.

The goal of this study was to examine what are men and women's motives for using a digital navigation system which is based on the wisdom of crowds and produsage concepts? The following literature review will discuss the wisdom of crowds phenomenon and the produsage concept, which have been examined in relation to content or information sharing in digital environments.

Theoretical background

The concept of the wisdom of crowds was first examined in an experiment by Francis Galton published in Nature magazine, referred to as Vox Populi [15]. In 2004, Surowiecki coined the term "the wisdom of crowds" [29], discussing three manifestations of the phenomenon: (1) cognitive aspects of ideas and data processing by the masses, (2) harmoniously coordinated work, and (3) trust-based cooperation that is independent from control by hierarchical structures typical to organization. The wisdom of crowds phenomenon is the basis of information production in various technological platforms, such as collaborative writing and editing in Wikipedia, or Linux operating system and other open source software (OSS) [14]. The technological platforms which enable the development of the wisdom of crowds concept are crowdsourcing systems (CS). A system is defined as a CS if it recruits directly or indirectly a large number of people for the collaborative development of a product or a solution to a problem defined by the system managers [14]. As such, shared navigation systems are CS, in which the system users operate directly as active and/or passive reporters, and all users benefit from the various members' contributions.

The issue of the active and passive contribution of system users raises the question of what is people's motivation to share their knowledge within online communities. Previous research on participation in online social projects indicates a very low percentage of content contributors in comparison with content consumers, as well as a "long tail" distribution of active participation, with the majority of content being produced by a minority of participants [2]. For example, a study that explored content production by Israeli children and youth in cooperative programming platform [33] also revealed a long tail distribution of active participation. Regarding the scope of active contributions, a study conducted on a platform for finding vacant parking based on the wisdom of crowds revealed that the percentage of active contributors is more important than the volume of information that each participant contributes [12]. Namely, the study found that the critical mass of contributing participants needed to ensure the stable contribution of knowledge, regardless of the scope of knowledge which each participant contributes individually. Thus, to obtain reliable and stable information from a system based on the wisdom of crowds, it is important to have a critical mass—enough active contributors [2]. In addition, there are non-human factors that also play a role in the development of knowledge and must also be incorporated in the complex depiction of the structure of mass information communities. For example, some of the content editings in Wikipedia is conducted through bots—software robots [22]. Similarly, the optimal driving suggestions by a shared navigation platform are partially based on the data automatically collected from cars of the system's consumers.

Individuals' motivation to share their knowledge in online communities is influenced by the variety of motives: personal financial or non-financial interests, a sense of moral obligation, or community-based motives such as social norms [5 and 30]. When information is perceived as being individual or organizational property, the motive for contributing content is usually financial (i.e., the contributor expects to receive some sort of incentive for the information s/he is sharing) and for the user's own benefit. In the context in which information is perceived as public property, the motive is usually altruistic, characterized by a concern for the community, by the desire making the world a better place, and without the expectation of compensation [6 and 7]. Wasko and Faraj [30] concluded that people participate in online communities because they feel the sense of belonging to the group and want to be involved in the interchange of ideas and solutions.

As information consumers became information producers through digital technologies, the term "produsage" was coined by Bruns [11]. According to Bruns [11], the "produsage" process has four characteristics:

(1) *Community-based*: The process of producing information which is based on cooperative involvement in a community of participants working on a joint project. This is in contrast to work on traditional projects by small groups of experts. Shared navigation has a community-based quality, as opposed to information in traditional GPS systems, which is defined and updated by groups of experts. A community-based nature of shared navigation is reflected in findings [21] that 13% of Waze users, in addition to the functional reports about traffic conditions, comment on emotional aspects of other drivers' reports. Moreover, navigation systems tend to emphasize the characteristics of social networking. For example, starting from the 3.5 version of Waze, users can enter the system through Facebook, see when their friends are navigating to the same destination, send requests for a free ride, enable friends to follow their travel route, and send them private messages. In the current version of Waze, one of the social features is the "Carpool community helpers—a feature that helps fellow commuter heading in the same direction by matching riders with drivers through Waze.

(2) *Fluid roles*: Participants' roles in the community are not based on a clear hierarchy and often changes during work on a project. Furthermore, passive participation—"lurking"—can also have an important contribution to the community [8,17]. For example, merely entering a shared navigation app enables the collection of background data on driving speed, which is useful to other drivers in the area.

(3) *Unfinished artifacts*: In contrast to digital content in closed environments (e.g., a traditional GPS, an off-line version of a navigation app which is not updated in real time), in the produsage process, the content continues to be accessible for the users' contribution and updates. In other words, the information and artifacts are in a state of ongoing modification. For example, in the Waze app a driver can report a traffic jam in the navigation system in a given place, and later, other drivers can report faster traffic flow and the traffic jam notice will be removed.

(4) *Common property, individual merit*: The process of cooperative creation of dynamic knowledge cannot exist within the traditional framework of copyrights. Instead, the producers allow the public to use and change the information they shared. For example, the maps used in the Waze system are defined by voluntary users who have given other users the right to edit and improve them. Nonetheless, the individuals who develop the original information or those who made significant contributions to its improvement receive an acknowledgement within the community. For example, the Waze app has a user rating scheme with a defined point system in which users accumulate virtual points for reporting relevant events. The user's rating, which is based on the number of points accumulated, determines the level of authorization that the user receives to edit maps, assist teams developing the product, and be a "team player." In addition, users who reach the status of "Waze champs" achieve the right to be invited to the company's meetings which are held around the world [32]. The personal value is not limited to rewards such as the accumulation of virtual points, but rather it is primarily manifested in a sense of belonging to the community [2]. Moreover, drivers using shared navigation have reported feeling calmer and happier compared to drivers who do not belong to this community [21].

An examination of **gender differences** in the use of digital navigation programs based on the wisdom of the crowds involves factors that are beyond spatial and navigating abilities (e.g., willingness to adopt advanced technologies and to be active participants in online communities). Regarding gender differences in the early adoption of Waze digital navigation system, Waze blog [31] indicated extreme male dominance in the system use, (98% versus 2%, respectively). This data is inconsistent with research on gender differences in the adoption of new technologies, which have shown that the difference between men and women has diminished and even vanished over the first decade of the 21st century [27]. In fact, studies in the adoption of educational technologies have reported a reversed pattern [3,4]. Namely, mothers adopted an online and mobile school system faster and more extensively than fathers in order to receive information on their child's school functioning, and matched more efficiently than fathers their level of using the school app to the teacher's level of use. Regarding gender differences in social networking [20],

findings indicated a similar level of use by men and women, but a significant difference in the type of usage. Women were primarily motivated using networks to nurture relationships, whereas men's use of the networks was goal-oriented, for example, to find new romantic relationships. These findings indicate that technology preserves, rather than changes, gender differences (or lack of them) that exist offline.

Research goal and question

The research goal of this study was to reach an in-depth understanding of the participants' subjective experiences when using a shared digital navigation system while distinguishing between men and women's attitudes and motives. We examined gender differences in "produsage," manifested in the use of a digital navigation system based on the wisdom of crowds.

The study explored the following research question: Are there gender differences in men and women's perspectives on and motives for using a shared navigation system based on the wisdom of crowds principle?

Method

The study was conducted in the framework of the qualitative research paradigm, which is suitable for a study aiming to understand the personal experiences and perceptions of the participants [16,28]. Consistent with this paradigm, we examined the drivers' attitudes in relation to the use of a shared digital navigation system, as a product of their experiences and behavior. This research methodology enables to reach an in-depth understanding of the experience of information sharing by drivers during digital navigation using Waze and to explore of gender differences in these processes.

Context

GPS-based navigation apps for smartphones are an enhanced version of single purpose GPS systems (for finding travel routes). They are based on content that was created cooperatively by the users themselves through driving reports and automatic data collection and provide information beyond driving routes. This study explored shared navigation through Waze—a system that was developed in Israel and has been distributed internationally. Waze is a system based on the wisdom of crowds since a large number of people cooperate together to develop an ongoing product [14]. This system provides drivers with real-time guidelines about optimal driving routes, based on two types of information: (1) signals automatically collected when the application is opened and (2) active reports of users. Consequently, the more drivers use the system at each time point, the more comprehensive and reliable the information is, and thus, the greater is its benefits for drivers.

Participants

The study participants were 37 experienced drivers aged 22–63, 20 women and 17 men. The participants live in different areas of Israel, frequently navigate through Waze and have

at least 6-month experience of using this application. Each gender included passive users of the application and drivers who actively report road events.

Instruments

This study employed semi-structured interviews, since this research instrument enables a complex understanding of attitudes and motives related to people's behavior in a particular social context [1]. Consistent with the participants' preferences, 20 of the 37 interviews were conducted face-to-face and 17 through the *Zoom* videoconferencing platform.

Participants were recruited through a call for participation on social networks and applying a snowball method through personal acquaintance with the researchers. The interviews lasted 30–60 minutes and were audio recorded.

Procedure

After being transcribed, the interviews were read repetitively in order to identify ideas, patterns, characteristics, themes, contradictions, and any other relevant feature for data coding. The interviews were analyzed according to thematic analysis and focused on participants' statements through analysis of the text segments. The analysis included breaking the text down into small segments that are not necessarily related to the research question during the early stages of analysis, and then categorizing these segments into meaningful themes during advanced stages of the analysis to address the research question [28,24].

At the first stage of analysis, the data were coded according to "line-by-line analysis," which is used to create a detailed preliminary coding system [28] based on the terminology used by the participants. The process of developing a coding system is an iterative procedure [1]. Therefore, at the second stage of analysis, data mapping of the categories is conducted. Namely, the quotes in each category are meticulously examined and a new system of categories is developed, as described in the coding scheme (Figure 1).

The analysis revealed five categories: *Receiving information and real-time updates* code describes cases in which the participants choose to use the shared navigation app because it enables them to receive updated reports on road conditions in real time; *Navigating to a destination* code describes cases in which the participants choose to use Waze for the basic goal of navigating to a familiar or unfamiliar destination; *Drivers' wellbeing* code refers to cases in which the participants choose using the system because it contributes to their well-being in different ways—driving safety and stress reduction; *Travel*

(cost) efficiency: This code describes cases in which the participants choose to use the system because of effective time management and a financial value of saving costs, such as the cost of petrol; and *The Innovation effect* refers to cases in which the interviewees choose to adopt the shared navigation app because they perceived it as novel which aroused their curiosity.

Findings

Table 1 summarizes the distribution of participants who related to each of the motives for using shared navigation application.

An examination of the motives for using the system indicated that the two main motives were goal-oriented motives - practical use related to the primary advantage category: (1) receiving real-time updates and (2) assistance in navigating the way to a destination. Thirty-six of the 37 participants spoke about receiving real-time updates as a motive for using the system. For example, *"I heard about its amazing potential to provide updated information, …"*. This finding is not surprising given that this is the added value of the shared navigation system based on the wisdom of crowds beyond the basic function of GPS devices. Regarding the gender, men and women tended to relate similarly to the topic of real-time updates—19 women versus 17 men spoke about receiving real-time updates as a motive for using the system.

The second motive for using Waze was receiving assistance in navigating the way to a destination, with 30 out of 37 participants relating to this motive. For example, *"Because I've always been bad at navigating on the road, I've always gotten lost and always umm… called people and described where I am to ask what I should do."* The fact that navigation to destinations was not the primary motive for using the system is not surprising since standard GPS devices already address the navigation function. Contrary to gender stereotypes, men and women similarly addressed this topic—out of 30 participants who discussed navigation to destinations as a motive for using the system, 17 were women.

Table 1. Summary of the study participants' motives for using the system ($n = 37$).

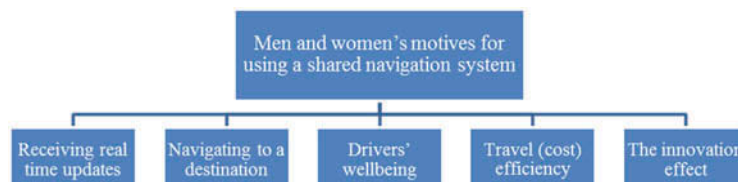| Gender	Primary advantages: Practical functioning		Secondary advantages		The innovation effect
	Real-time updates	Navigation to destinations	Drivers' wellbeing	Financial benefits	
Women	19	17	12	4	4
Men	17	13	6	1	7
Total	36	30	18	5	11

Figure 1. The coding scheme.

Apart from the functional features of the system, real-time updates and navigation, two additional motives were found relating to the secondary advantage category of using the shared navigation app. One of such motives was the drivers' wellbeing. The wellbeing aspect was manifested in participants relating to the psychological benefits that they derive from using the application, such as calmness, reduced stress, a sense of security, and actually avoiding stressful situations on the road. For example, *"… It's therapy. Waze is therapeutic. Therapeutic to someone like me who has not well-developed navigation skills. So, this is a therapy, several hours of a dialogue with Waze everyday … I can ask the system for help and the system answers me…".* Some drivers associated between the primary benefits, e.g., receiving updated information, and the secondary added value. For example, such association was expressed by A., who spoke of the connection between real-time information which he received and the stressful situation he managed to avoid as a result: *"I'm saying that at the resources level, it can save petrol and pollution, from all perspectives…even getting people back home because it's not worth waiting in traffic…. I saved petrol and time, and reduced stress that leads to aggressive driving and accidents."* Regarding the gender, men and women seemed to differ in their tendency to relate to the drivers' wellbeing as a motive for using shared navigation app. Namely, out of 18 participants who related to this topic, 12 were women and only 6 were men.

Another secondary advantage for using Waze which was addressed in the interviews was the financial benefit. This advantage was expressed directly in relation to the financial cutbacks (i.e., saving time and saving money). For example, S. interpreted the possibility of finding vacant parking spaces as a way of saving money she would have had to spend on parking: *"… and then unexpectedly it helped me find parking because you find side streets that people hardly know of, … You don't have to pay lots of money [for parking]."* Four out of five participants who addressed financial benefits as a motive for using the system were women.

An additional motive for using the shared navigation app is related to the system being perceived as innovative and different from traditional GPS. In relation to this motive, 11 participants, 7 out of them men, addressed shared navigation as technological innovation, as well as expressed their curiosity of trying something new. For example, *"First of all, because it's cool, in the beginning, I mean to try new things…".*

Discussion

This study examined gender differences related to the use of a shared navigation system. The discussion of the study findings is presented in relation to the research question on gender differences in the motives for using the shared navigation system based on the wisdom of crowds principle. The findings indicate that the motives can be divided into three main categories: (1) *Primary benefits* related to the functionality of the system – navigation to destinations and receiving real-time updates. This category was the most prevalently mentioned motivation for using Waze, with no evident differences between men and women. (2) *Secondary benefits* of using the system – psychological and financial advantages that were mentioned by the participants as byproducts of using the shared navigation system. This group includes motives related to the drivers' wellbeing and financial benefits of saving time and costs. The findings indicated that although these motives are less prevalent, women are motivated to a greater extent than men by an understanding of the secondary advantages of using the shared navigation system. (3) *Innovation* was mentioned by the fewest number of participants, and findings indicated that men were motivated by innovation to a greater extent than women.

These findings are in accordance with all four characteristics of produsage according to Bruns [11]. (1) Shared navigation is *community-based*: the process of producing information is based on cooperative involvement in a community of drivers using the system and actively reporting to a joint database. (2) *Fluid roles*: participants' roles in the community are not based on a clear hierarchy and often changes from passive to active and vice versa. Since merely entering a shared navigation app enables the collection of background data on driving speed and sharing this data with other drivers in the area, passive participation in the form of "lurking" has an important contribution to the shared navigation community. (3) *Unfinished artifacts*: the database continues to be accessible for the users' contribution and the information in it is in a state of ongoing modification. A traffic jam reported by the navigation system user will be later removed when background data or/and traffic reports of other drivers will reflect faster traffic flow. (4) *Common property, individual merit*: the producers of content allow the public to use and change the information they shared, for example, to edit maps used in the Waze system in order to keep them updated and increase their accuracy. Nonetheless, active users receive an acknowledgement within the community, such as a user rating scheme with a defined point system for reporting relevant events. The user's rating, which is based on the number of points accumulated, determines the level of authorization that active producers receive.

Thus, it is not surprising that the central motive for using shared navigation was receiving real-time updates since the driving information is constantly changing and updating, which makes it very useful for system users. Moreover, the motives related to the drivers' well-being and the financial benefits of using shared navigation are in line with the "common property, individual merit" characteristic of the produsage process—users receive personally benefit from the cooperatively created database. Although Bruns [11] does not address gender differences in the produsage process, our findings indicate that while men and women relate similarly to primary motives associated with the perpetually changing nature of the information, women show greater awareness to the secondary benefits of using the system (i.e., the drivers' wellbeing and financial advantages). Similarly to the calmness and happiness reported by drivers who belong to the community of shared navigation users in the New Cities Foundation study [21], the participants of our study also related to their psychological wellbeing motives. However, [21] did not address gender differences related to drivers' wellbeing, while our results revealed that calmness, reduced stress levels, and a sense of security were reported as a motive

for using the digital navigation system by women to a greater degree than by men. The innovation effect of the shared navigation system, which motivated men to a greater extent than women, also can be perceived as a type of individual merit. Men tendency towards using the shared navigation app because its novelty is consistent with traditional gender roles found in previous studies in online communities [3] or in ubiquitous mobile in communities [4].

However, neither secondary benefits, such as drivers' well-being and financial advantages nor the satisfaction of using a novel system is designed as integral merits of Waze application. These motives of drivers in using shared navigation system can be explained as mechanisms of user gratification in terms of Uses and Gratification theory, according to which the use of media fulfills different psychological needs of the individual [9]. The theory assumes that technology users consciously choose the medium that could fulfill their needs and that they are able to recognize their reasons for making media choices [18]. Rubin's [25] more recent version of uses and gratification approach suggested five generic motivation clusters of needs that media could fulfill: cognitive, affective, personal integrative, social integrative, and diversion needs. Analyzing motives of the shared navigation users based on Rubin's approach, we can argue that drivers with salient cognitive needs may be motivated by the novelty of the system; users reported motives of wellbeing may have salient affective needs, while drivers who mentioned financial advantages may be motivated by personal integrative needs of saving time and costs.

Conclusions, limitations, and recommendations

This paper aimed to explore gender differences in the use of the shared navigation system, Waze. This study is based on the "wisdom of the crowds" and "produsage" conceptual frameworks, the concepts that highlight both content consuming and producing by the community members. From the interviews, five themes were identified as motives for use of the shared navigation system. The two themes related to the primary benefits—functional use of the system showed no evident differences between the genders. However, women tended to prefer the secondary advantages—psychological and financial benefits of the system more than men, while men reported more motivation of using the system because of its innovative aspects. Our findings in the community of shared navigation characterized by ad hoc participation were only partially consistent with the characteristics of communities based on the wisdom of crowds [29] and with the concept of produsage [11], and we suggested explaining some of the results in terms of uses and gratification approach [25]. In summary, the theoretical framework for this study was based on an integration of concepts from different fields, which have not been studied in relation to each other sufficiently in previous research. For example, a large amount of research has been conducted on online communities in relation to active participation, however, such research has not been integrated with research on unique communities, such as the community of Waze users, which shares some characteristics with online communities and is unique in other

mechanisms (e.g., members' participation characterized by ad hoc activity). We suggest broadening the theoretical framework in order to better understand processes of these emerging digital platforms.

In terms of practical implications, this study indicates the existence of gender differences in the use of shared digital navigation apps based on the wisdom of crowds. Women showed more awareness to psychological and financial benefits of shared navigation. Men, on the other hand, reported innovation as a motive for using the system to a greater degree than women. In relation to the field of digital app design, these findings emphasize the importance of addressing gender differences in the design, development, and marketing of these apps [10,26]. For example, it can be useful to promote using shared navigation apps by highlighting its novelty and innovative features to male users and by focusing on its well-being and financial benefits when targeting female audience. In addition, the later types of advantages can be incorporated in the verbal feedback of the system to drivers who use female-targeted language settings.

This study has a number of limitations. Although the research is a bottom-up exploration and the sample is large for a qualitative study, with 37 participants, the participants' statements were divided into a large number of codes, and the sample size made it impossible to test gender differences quantitatively, through analysis of variance. Future studies should aim to obtain a larger number of statements for each topic through larger sample size. Furthermore, this studied focused on the Waze system, and additional studies are needed to examine the research questions among users of other shared navigation systems. Nonetheless, despite the limitations, this study lays a good foundation for future work. Larger, quantitative studies can be built on these findings, which may further explain the gender differences in the use of shared navigation systems. Reaching a greater understanding of these issues has the potential to characterize users of shared navigation systems and distinguish them from other online and/or mobile communities, as well as to the deeper understanding of gender differences and their implication on adopting technological innovations.

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