Designing for Decision-Making: the Assessment of Road Safety Compliance Through Conversational Storytelling

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Abstract. Road safety culture among young people necessarily needs to be addressed with a multidisciplinary approach, since they are more reluctant than adults to engage and be openly evaluated in safety research. The present research, using a psychographic through psychometrics approach, combines concepts and methods from cognitive psychology and design to investigate behaviors, beliefs, and attitudes and to increase knowledge about the design and effects of adopting interactive technologies. In particular, we describe the processes, experiences, and results of the research and interaction design of a conversational storytelling mobile app for road safety, in which mobile computing was used to collect and give meaning to qualitative and quantitative data related to road safety decisions. The results of the analyses carried out on the data collected by the mobile app confirm the effectiveness of this interactional tool in capturing the complexity of the combination of contextual, personal, and behavioral factors related to compliance toward road safety.

Keywords: Conversational Storytelling, Decision-making, Interaction design, Moral Engagement.

1 Introduction

Urban mobility innovation is a key driver for sustainable cities and the emergence of newly created mobility models. The future of mobility is largely envisioning today's vehicles with integrated components in the internet of things, capable of collecting and managing information from drivers, occupants, goods, vehicles, and other sources. In this way, it is possible to provide citizens, companies, and transport operators with novel digital services. Human factors, as well as mobility behaviors and expectations, are challenging to catch among young people because they might be more reluctant than adults to be monitored through connected devices [1].

Nowadays the human driving experience is progressively aided by sophisticated assistive driving technologies, named Advanced Driver Assistance Systems (ADAS),

which help drivers to cover up for their driving errors, namely the first causes that provoke road accidents [2, 3].

At the same time, the current urban mobility scenario is radically and quickly evolving. Recent research investigating the relationship between urban mobility behavior, emerging digitalized shared mobility services, and road safety [4] demonstrates that young adults are keener on using micromobility modes such as bicycles, electric scooters, and kick scooters, than older users, and are expected to reduce their public transport trip frequency [5]. At the same time, a growing trend for crashes involving micromobility emerges [4] and novel safety and security challenges arise [6].

Existing systems on the market are thought to collect data about safety, mainly based on driving sensors directly tracking measurable behaviors into conventional mobility means, i.e. cars, motorbikes and buses, The specific problem arising from this domain relates to the fact that there are no technologies that can provide satisfactory explanations of the decision-making process, investigating, for example, the underlying motivations behind the choice of a particular vehicle, the decision to drive a certain way, the choice to comply or not to comply with existing recommendations, rules, or prescriptions.

Integrated research on behaviors, beliefs, and attitudes in road safety culture, requires to make sense of qualitative and quantitative data in road safety decision-making. In order to reach this goal, the research employs design, and field investigation through ICT innovation with a psychometric perspective requiring an interdisciplinary approach merging psychological and interaction design methods and theories to integrate a decision-making conceptual framework, an experiential and interactive methodological approach, and the consequential technology implementation.

This research proposes to reach the following objectives in a twofold perspective: on the one hand to gather information about decision-making on the other, to raise awareness about real-life safety-critical behaviors. The first objective refers to monitoring decision-making in young adults and thus capturing and understanding tacit and hidden assumptions as well as intrinsic motivations towards road safety rule-breaking and compliance with the related moral dilemmas. The latter refers to the design intervention that lends itself as a means to make young users reflect and analyze different road safety contexts and to develop a personal safe mobility culture and increased awareness of road risks.

These aims are grounded on the following research questions (RQs):

1. Can moral dilemmas in decision-making effectively explore road safety-related moral disengagement, and if so, how?
2. Do realistic scenarios support the investigation of rule-breaking and rule-compliance behaviours, and if yes, what's the role of fictional elements?
3. Is interactive conversational storytelling effective as a psychosocial research method?
4. Does mobile computing prove to be an effective and valuable psychometric tool?

This paper describes the process, the experience, and the results of the research and interaction design project Ninja Stories - Conversational Storytelling mobile app for Road Safety. The main goal of the project is to gather information about decision-

making and attitudes from young people in a structured (data) and partially implicit way through mobile computing.

The approach followed is psychographics through psychometrics, which means to get youngsters' road safety profile through decision-making assessment in the mobility context. Specifically, "psychographics" here means the analysis of consumer lifestyles to create a detailed customer profile: market researchers conduct psychographic research by asking consumers about their degree of agreement on activities, interests, and opinions. The results of this research are combined with cultural and demographic characteristics to develop a more realistic portrait of the target consumer segment. Psychometrics, on the other hand, measures and assesses individual differences in values, skills, attitudes, behaviors, and other personal attributes through psychological tests.

Since decision-making is always context-specific, we decided to create different urban mobility stories told by different characters ("Ninjas") in the conversation/chat of the Ninja Stories mobile app. These stories are told in the third person in a peer-to-peer style, which makes it easy for the user to reflect on the specific context without feeling judged or under observation.

All conversations with ninjas are based on real stories, that is, stories inspired by real-life episodes collected during the user research and content co-creation phase. Each conversation includes several questions, thus building a gamified survey for relevant decision-making data. The application invites the user to discover his or her "inner ninja," or that configuration of values, talents, and abilities to handle the challenges of urban mobility, thus providing feedback that complements personal reflection during the story.

2   State of the Art

The recent widespread diffusion of mobile apps and the subsequent scientific interest shed new light on the possibilities given by easy-to-use, mobile-based (hence portable), and carefully designed digital instruments aimed at collecting personal data concerning behaviors and attitudes of the subject. Recent works demonstrated the practicality of designing an interactive visualization-based mobile app for delivering crucial information on personal healthcare based on the patients' information processing heuristics [7].

The use of tools in the form of mobile applications (or web-enabled applications) peculiarly designed to collect emotional, cognitive, and behavioral data stands as excellent support to more traditional, self-report methods. Even more, these interactive instruments may also have the potential to overcome some of the threats to validity due to respondent characteristics (such as socially desirable responses, reactivity, or acquiescence biases) [8]. Moreover, the use of serious gaming applications has enabled the implementation of straightforward data collection strategies that would otherwise be extremely difficult, such as the live assessment of transitory cognitive conditions directly preceding failures in aging adults through a simple tablet-based "whack-a-mole" game. Significantly, this cognitive impairment would has been assessed too late in other data-collection respects [9]. Moreover, as highlighted by a recent systematic

review, carefully crafted gamified assessment tools proved themselves to be not only precise but also to be highly discriminative. In the instance considered, the examined application was generally effective in recognizing ADHD cases from controls and could discriminate successfully between attention-deficit disorder subtypes as well [10].

Predictably, this burgeoning creation and dissemination of interactive cognitive assessment tools bring along with great variability in terms of psychometric quality. Among the multitude of mobile applications, in fact, only a few have provided helpful indications regarding reliability, validity, sensitivity, and specificity for the detection of relevant cognitive features of the subjects involved [11]. Indeed, the depth of the theoretical support and the methodological clarity on which the functional architecture of the instrument is rooted is of paramount concern if the results are expected to be interpretable and applicable in real contexts. For instance, one of the main difficulties faced in HCI research is that of the experimental sample chosen by the researcher to understand human behavior. The use of traditional recruiting methods from university participant pools or, more recently, from the crowdsourcing platforms of experiments, despite many strengths, show methodological and ethical criticalities that are hard to overcome [12]. The use of gamified resources to collect psychologically relevant data, although still in its early stage, seems very promising because of the high degree of engagement involved and the ease of reaching a diverse and realistically distributed sample - particularly when the target is a subgroup within that of young adults.

In real-life contexts, apps based on ludic scenarios aimed at collecting information related to situated cognitive and emotional functioning have shown their effectiveness in very different occasions; an example that demonstrates the potential of personalization as a result of an appropriate design for a specific context is the application called "America's Army", a true multiplayer game designed and engineered to provide the U.S. Army with a preliminary psycho-attitudinal screening and assessment of the skills of possible candidates intending to pursue a military career [13].

Based on the same interactional principles within a realistic, albeit simulated, context, a recent literature review has helped to enlighten the potential of such tools to actively build a situated knowledge of the individual's decision-making processes, even tackling the complexity of moral judgment [14]. Taking it a step further than merely collecting data, through what is called moral games it is possible to not only collect information but also engage the user in a conversational meta-reflection that occurs during engagement with the tool itself [15]. For example, School Life is one of the few playable games that has been designed and used intentionally to understand a multidimensional and complex phenomenon such as school bullying.

Going beyond the simple detection of data, the potential for moral reflection provided by a realistic and engaging experience lies in the shift of importance from an indoctrination 'ab alto' of content deemed appropriate, to an active engagement of the player in an interactive process through role-playing and simulations [16, 17, 18]. To an even greater extent than with usual applications, for a moral game the design principles and key elements of the platform's conversational architecture are of utmost relevance for its success both from a data collection perspective and in terms of the engagement aspect of the user during their interactive experience. This, for example,

can make a difference in the applicability to the everyday context of the decision-making processes encountered in the virtual environment [18].

3 Interaction Design for Conversational Storytelling

3.1 Mobile App Scoping

Through the psychographic mobile application Ninja Stories, young people are asked to assess their skills as "ninjas" through concrete scenarios in which decision-making is influenced by personal and social contexts. Mobility stories are told by other ninja characters in a conversational and informal manner, and gamified surveys are included to engage the user in discovering what kind of urban mobility ninja he or she currently is (or can become).

   The conversational storytelling mobile app proposes real-life scenarios of situated knowledge, i.e., realistic situations that are easy for young people to read and recognize through the first-person narration of Ninja characters; contextually, psychometric data detection and collection occur interactively. Thus, wanting to summarize the overarching goal of the Ninja Stories mobile application, it can be said that the goal is the all-around promotion of road safety culture in young people and, at the same time, the collection of valuable and accurate information for safe mobility stakeholders, with the aim of going beyond mere "driving detection" apps. By stimulating awareness creation and encouraging personal reflection, NinjaStories gives meaning to attitudes and choices in different contexts, thus enabling both youth and mobility stakeholders to gain a deeper understanding of the reasons behind risky decisions.

   Ninja Stories' mission is strongly linked to road safety with a specific focus on young people, among the most vulnerable on the road. The mobile app produces the following outcomes for the stakeholders:
-   Statistics on most common decision-making profiles with respect to road safety;
-   Detailed statistics on specific profile dimensions (e.g. variables, justifications);
-   Analysis of story-specific dimensions which are embedded in the conversation;
-   User profiling based on other demographic dimensions (e.g. age, gender, location, nationality, etc.).

3.2 Interaction Model

Ninja Stories wants to collect real-life stories and experiences and to investigate attitudes, perceptions, and decision-making by leveraging upon user stories generated from participatory scenario-based design and implementing a research algorithm able to gather data and information in order to classify specific profiles, according to a psychological model mapping each answer and each interaction through defined elaboration patterns.

   Ninja Stories gamification has been designed as a digital tool for user engagement, and ultimately to tackle the challenges of recruiting and profiling participants in psycho-social research; first-person storytelling has been implemented to support

projection mechanisms, where the users are invited to think about how they would behave in the shoes of the Ninjas. Proposing creative storytelling and gamification mechanisms, Ninja Stories engages young people by investigating their attitudes, preferences, and moral choices regarding mobility, and displays the results on the reporting model by showing user profiles through the "user-personas" approach, matching the information provided to specific behaviors and the subset of values and visions belonging to each user. All stories have the same general structure, but what changes is the mobility context in which the story takes place. Some examples of context variables that can be fine-tuned are the means of transportation used by the protagonist, the reason for the trip, and fellow travelers.
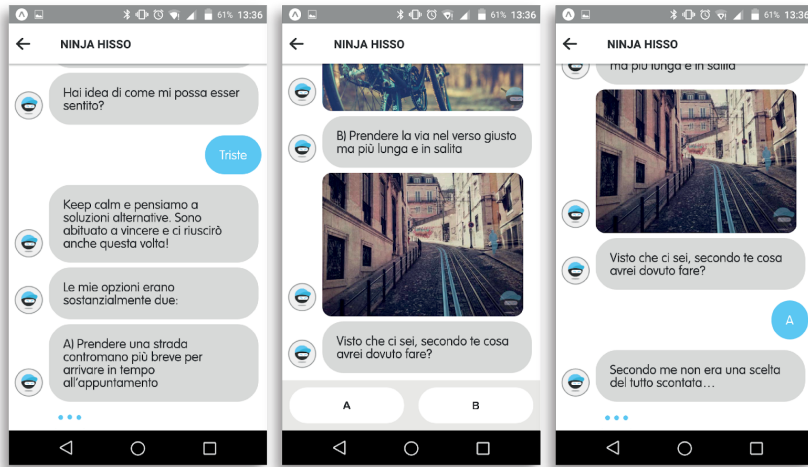

Fig. 1.. Ethical choices A (on the left) and B (in the middle) in the second Ninja conversational scenario.
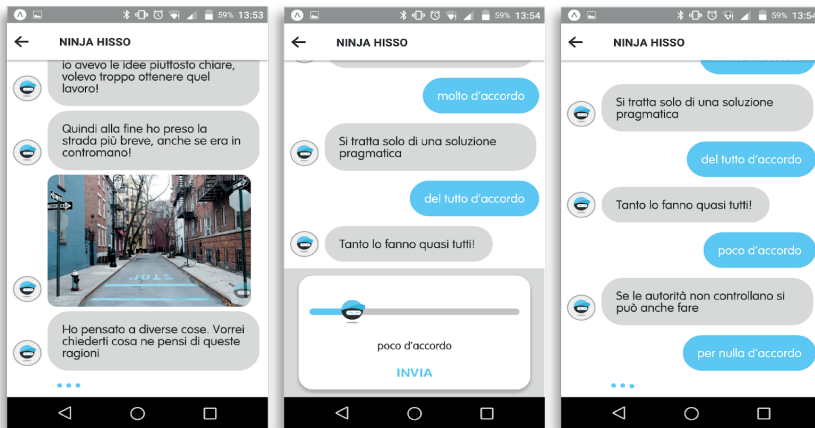

Fig. 2.. Moral disengagement explanations in the second Ninja conversational scenario.

The ninja narrator begins by telling the story, setting the mobility context of the story, and asking questions to get the user to identify with the specific situation.

At one point in the narration, the user is faced with a binary choice that always prompts the decision to break or abide by the rules, called the "moral dilemma" (see Figure 1). Then, the ninja with whom the user is interacting prompts reflection on the factors that influenced his or her decision, so that it is the user himself or herself who ponders the specific situation (see Figure 2).

The ninja with whom the user is interacting always makes the decision to break the rules, to include in the story the possible consequences that may occur by making this type of decision thus adding further food for thought. At the end of each story, the feedback returned to the user is customized based on his or her responses during the conversation with the ninja. This story badge serves both as a reward for completing the gamified survey and as an additional element of personal reflection (see Figure 3).
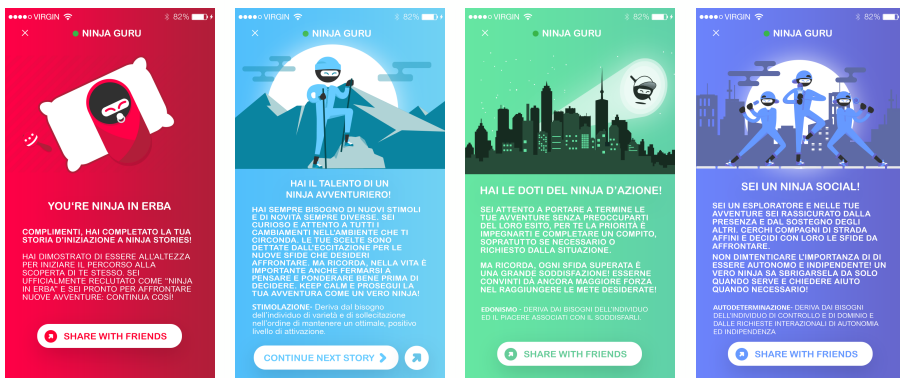

Fig. 3.. Visual badges on the basis of the PVQ values

3.3 Conversational Storytelling for Road Safety: interaction scenarios

Representing an initial introductory encounter, the first conversational scenario marks the user's entry into the simulated conversation. The application is structured to welcome the user, representing the encounter with the guide of this journey, namely Ninja Guru. After preliminary introductions, some general profiling information is requested (gender, name, age, and origin) and the general goals of the dialogue are laid out. After Ninja Guru's description of the application and its goals, the player is given the first badge that will allow them to begin the adventure of discovering their inner ninja. This response motivates and reinforces the user to continue the journey he or she has just begun.

The second story plays out the encounter with Ninja Hisso, who describes the misadventures that occurred on his way to an interview for a job as a chef. The narrative focuses on the contrast between a long and winding path, and the possibility of instead taking a shorter route, but in a forbidden direction, which would allow the user to arrive at the appointment on time. The player is then asked a series of questions, requesting

him or her to assess the opinions about the event or to provide information about his or her travel habits. After the mentioned questions in each narrative, the user has to answer some specific questions from the Portrait Values Questionnaire (PVQ) [20] that, in detail, are related to the dimension of Stimulation as a key value. Users of the application are guided to respond through a 6-level Likert scale. In this conversation, some items can be encountered that express the dissimilarity from the Ninja with respect to the considered value ("not at all similar to me," "not similar to me," and "not very similar to me") while others highlight the similarity ("quite similar to me," "similar to me," and "very similar to me").

In the third conversation, the player is introduced to Ninja Chiko while listening to his story. In addition to proposing some questions, the conversation focuses on one of the most frequent (and dangerous) behaviors among young people: cell phone use while driving. At the end of the dialogue with Ninja Chiko, another piece will be added to one's portrait by referring to the characteristics of a "social ninja" or identifying oneself as a "lone hero ninja." Consistently, Self-Direction is the central value of the third story; this moral motivational goal stems from individual needs for control and domination, interaction and cooperation with others, and the need for autonomy and independence in decision-making. In addition to the main dilemma and items related to aspects that influenced the decision, a number of questions derived again from the Portrait Values Questionnaire were included. Responses to these questions can be formulated via a 6-point Likert scale, which again expresses the user's level of similarity to the Ninja. To enable the assignment of a personalized badge, different scores were assigned in relation to the given answer.

The fourth and final story features the ninja Hiroki, and the topic focuses on leisure time spent with friends. In particular, the story focuses on the experience the ninja and his companions have with a car-sharing service; this will lead to some misadventures. After answering questions and sharing some opinions on the incident, the user will receive a badge that will decree the possession of skills attributable to an 'action ninja' or a 'ninja viveur'. In addition to the moral dilemma and questions asked in a similar manner in all stories, some elements inspired once again by the Portrait Values Questionnaire have been included. The user is asked to express their degree of similarity to Ninja Hiroki via a 6-point Likert scale. These questions focus on the value of Hedonism, i.e. the pleasure derived from satisfying one's needs. Responses of similarity to the character with whom one is conversing ("quite similar to me", "similar to me" and "very similar to me") are given higher scores; whereas ratings emphasizing dissimilarity from Ninja Hiroki ("not at all similar to me", "not similar to me" and "not very similar to me") are represented by low numerical values.

The feedback thus allows the user to enrich the information on their ninja profile. At the same time, insights are given into the way the individual makes decisions, and the value domains crucial for the narrative.

4   Study on Young People Road Safety Culture

4.1   Theoretical Model

Today, the topic of road safety is at the center of numerous debates involving communities and institutions. Despite multiple attempts to raise awareness through educational campaigns and projects, citizens often break the law by causing damage to people and property. In this critical context, we saw how psychological investigation in combination with new technologies could facilitate the understanding of inappropriate mobility behavior by shedding light on ethical choices. In order to achieve the main objective of this research, namely the investigation through the NinjaStories mobile application of those psychological variables relevant to the decisions made by individuals in the road environment, it is necessary to clearly identify the psychological frameworks of reference.

Decision-making and moral dilemmas. In the app Ninja Stories, several questions force users to make a binary choice: observe a traffic rule or break it. The answer seems to be obvious but sometimes this is not the case. The norms and beliefs we have about our ethical behavior do not always match the conduct we practice in everyday life [21].

Until the second half of the last century, the psychological investigation on judgmental mechanisms has supported the primacy of reasoning in moral choices with a cognitive-evolutionary perspective [22; 23]. Some more recent studies have highlighted the potential of intuitive aspects within moral decisions [24; 25; 26]. Essentially, the judgment that occurs from personal dilemmas represents an adequate mixture of emotion and deliberation. Therefore it is clear that moral judgment depends on the functional integration of different cognitive systems. Moral judgment does not have its own territory but relies on certain internal and external elements that allow us to think, feel and decide.

As can be seen from the studies carried out over the years on decision-making and moral judgment, one of the aspects to be taken into consideration in order to understand the process underlying the choice is the relevance to reality [27]. For these reasons, Ninja Stories places decision-making in common accurate contexts. This element, in addition to making the user's response more truthful, allows a departing point of reflection on any unknowns or unforeseen events that may occur while traveling on the roads. In order to represent a conversation as authentic as possible, the authors of Ninja Stories were inspired by narratives of events collected in the initial research phase of the app's development.

Triadic reciprocal determinism and moral disengagement. Social cognitive theory [28] has provided an illuminating vision of unethical behaviors. This theory, conceived by Bandura, takes its first steps within the cognitivist approach [29]. The exponents of this orientation, detaching themselves from the behaviorist theses, argued that the stimulus-response relationship that causes a behavior was not linear. Indeed, they asserted the existence of several intervening factors between the two variables considered. In particular, the key elements that influence the conduct of individuals would arise from the processes of subjective interpretation and processing of events.

Inspired by these concepts, Bandura has developed a system of knowledge to understand and explain moral functioning and conduct.

Triadic codetermination plays a fundamental role in understanding the author's theoretical framework. This issue aims to explain the conduct of the individual within the world in which he is inserted. Mutual triadic determinism embraces three entities that mutually influence each other: self, environment, and behavior [30, 31], in fact, operate as causal factors interacting bidirectionally.

It is in this complex framework that Bandura's conceptions of disengagement from moral agency [32] are generated. According to the author, a complete study of morality requires not only investigating the acquisition of criteria and moral reasoning, but also requires to take into account how people manage to commit inappropriate acts. Indeed, to fully understand this issue, it is essential to grasp the motivational and self-regulating processes with which moral thought is translated into moral action. Within the moral reasoning process, people extract, ponder, and integrate ethically relevant information characterizing the current situation [28]. However, factors such as the ambiguity of the circumstance can lead to interpretative flexibility that culminates in inappropriate behavior. Thanks to the use of disengagement mechanisms, generally upright individuals can therefore engage in deplorable conduct under the influence of certain social factors and then continue to consider themselves righteous [33].

As hypothesized by Bandura through various processes, moral disengagement allows people to selectively interrupt self-sanctions, justifying the unthinkable conduct. It is therefore a question of invoking the exception to the rule on one of the following three stages of moral regulation: evaluation of the conduct itself, evaluation of the consequences, and judgment of the victims [31]. It is precisely based on these distinct moments that the eight main mechanisms of moral disengagement are realized: moral justification, euphemistic labeling, advantageous comparison, displacement of responsibility, diffusion of responsibility, distortion of consequences, attribution of blame, and dehumanization of victims. It is therefore possible to understand how the disengagement maneuvers from the agency performance as a switch that temporarily suspends morality. They are put into practice by everyone in contexts of more or less serious guilt and can be implemented at different levels. For instance, according to Hystad's findings, moral disengagement is connected to risky and unsafe behaviors [34].

Although some researchers examined safety-related moral disengagement in the working environment [35, 36], little is known about moral disengagement in the field of road safety. The goal of using Ninja Stories as an investigative tool, as said, is precisely to examine the decision-making process within a context, taking into account not only the outcome of the decision but also the user's perception of the situation. In this way, it is possible to achieve a better understanding of the personal and contextual balancing of influences.

4.2 Methodology

Sample. The research was carried out on a sample of 42 young adults, all of Italian nationality, aged between 20 and 30 years of which 23 participants were male and 19 female. In the preliminary phase of the research, participants were divided into two age

groups, respectively 20 to 25 years old (69% of the sample) and 26 to 30 years old (the remaining 31% of the subjects). At the time of pre-assessment, the city of residence and geographical origin were requested, as well as the occupational status. From this last aspect, in particular, it emerged that 66.7% of the individuals who took part in the research were employed, while 31% were students; the remaining 2.4% did not specify their professional situation.

In order to allow for a meaningful analysis, only those individuals who were able to complete all of the application's planned paths were considered, which is why the relevant individuals for conducting the analysis are 21 of the initial 42, including 11 males (52.38%) and 10 females (47.62). Through the Ninja Stories application, information regarding urban mobility was also collected: it can therefore be concluded that the sample is made up of 4.76% of subjects who predominantly move on foot, while 14.29% indicate bicycles as their main means of transportation, none selected public transportation as their usual means of transportation, and 80.45% of them prefer to use cars.

Procedure. Data collection for this research was conducted from the beginning of September 2018 to the beginning of October 2018; a battery of tools consisting of an online pre-assessment questionnaire (designed specifically for the research) was given to the aforementioned sample, and subjects were instructed about the use of the Ninja Stories application on Android mobile devices.

Those who participated in the research were informed in advance about the general purpose of the research and the treatment of data. The given questionnaires were completed individually by the same subjects, upon receiving an informed consent declaration duly completed and signed. It is important to emphasize that, in order to ensure the anonymity and privacy of the people who took part in the study, nicknames were used to facilitate correspondence between the two moments of administration and to facilitate possible final feedback. These pseudonyms were freely selected by the subjects and were requested both at the beginning of the questionnaire and on the first screens of the mobile application.

Measures assessed by using Ninja Stories Mobile App. Subjects were asked to download the free application for Android mobile devices called Ninja Stories. The application is presented as an online instant messaging conversation, and as already explained, contains relevant questions for the collection of psychographic and psychometric data. Participants were therefore asked to complete the course of the dialogue structured by the application for a total duration of approximately 30 minutes. With the exception of the first story (purely introductory and a conversational warm-up), the other three Ninja Stories settings present some recurring and other characterizing questions to measure the main variable under study.

In particular, during Ninja-User conversation, the character narrates events concerning its behavioral choices under different conditions in which it has violated the security norms: 1) a violation of road security norms by using a bicycle; 2) a violation by using a mobile phone during driving; 3) improper and unsafe use of a car-sharing service. For each Ninja Stories, the following psycho-social dimensions were assessed:

Unethical choice. During each Story, the Ninja Character presents a moral dilemma about the "safe" thing to do under specific road conditions. After that, the user has to express through binary choice her (un)ethical preference (respect of security norms, versus not respecting these norms).

Security value. For each Ninja Story, the user expresses her level of agreement on the importance of respecting road safety norms on a five-point scale (from 1= "not at all important", to 5= "very important").

Descriptive norms. For each Ninja Story, the user indicates her perception of others' behavior concerning the observance of safety norms on a five-point scale (from 1= "not at all likely" to 5= "extremely likely").

Contextual Moral Disengagement (MD). For each story, during the Ninja-user interaction, the user expresses his or her level of agreement on eight disengaged arguments that the Character uses to justify his unethical choice (from 1= strongly disagree to 5= strongly agree).

Plan of analysis. As a preliminary step, the distribution of unethical choices and the descriptive and correlational analyses on MD, descriptive norms, and security value in the three conversational scenarios were examined. Then, differences in contextual MD, descriptive norms, and security value between subjects that have chosen ethical options and those that have chosen unethical ones were analyzed by using the Student's t-test.

Moreover, ANOVA was performed to examine the difference among stable unethical choices, temporary (un)ethical choices, and stable ethical choices considering factorial scores of MD, descriptive norms, and security value across all conversational scenarios. Finally, correlations among MD, descriptive norms, and unethical choice controlling for security value were examined.

All statistical analyses were performed using SPSS v.25.0.

4.3 Results

The distribution of unethical choice changes across the three conversational scenarios: 38% of unethical choice occurs in the case of the first scenario (bicycle), 23.8% in the case of the second scenario (mobile phone), and 9.5% in the case of the third one (car sharing).

Table 1 shows the mean and standard deviation of the descriptive norms of the scenarios' narrative context, safety values toward road safety, and contextual MD in the three conversational scenarios. All variables are normally distributed. Overall, the descriptive statistics suggest that the levels of descriptive norms decrease from the first scenario to the third one, instead the levels of contextual MD and security values are quite stable.

Table 1. Means and standard deviations across conversational scenarios.

| | Conversational scenarios | | | | | |
| | Bicycle infractions | | Mobile phone use while driving | | Car sharing | |
	Mean	SD	Mean	SD	Mean	SD
Descriptive norms	2.24	0.94	2.14	0.85	1.95	0.86
Security value	4.38	0.67	4.38	0.74	4.38	0.67
Contextual MD	2.17	0.29	2.17	0.55	2.10	0.36

Correlation analysis comparing the three different scenarios (Table 2) shows that contextual MD, safety value, and descriptive norms are significantly associated with ethical choice in the first conversational scenario; safety value is not correlated with ethical choice in the case of the second conversational scenario; and finally, only contextual moral disengagement is significantly and negatively associated with ethical choice in the third scenario.

| | Bicycle infractions | | | Mobile phone use while driving | | | Car sharing | | |
	Ethical choice	DN	SV	Ethical choice	DN	SV	Ethical choice	DN	SV
DN	-.57**			-,83**			-.21		
SV	.68**	-,56**		.15	-.15		.19	-.23	
cMD	-.69**	.60**	-.85**	-.58**	.61**	-.43*	-.52*	,51*	-.26

Table 2. Correlations among the three conversational scenarios.

Note. DN = Descriptive Norms; SV= Security Value; cMD = contextual Moral Disengagement.
* p < 0.05, ** p < 0.01 (2-tailed).

Regarding the first conversational scenario, as shown in Figure 4, the t-test revealed a significant difference between the subjects who selected the unethical option and those who selected the ethical option in descriptive norms [$t(19) = 3.04$, $p < .01$], safety value in the specific context [$t(19) = -4.10$, $p < .01$] and contextual moral disengagement [$t(19) = 4.14$, $p < .01$]. Notably, those who chose the unethical option consistently show significantly lower levels of safety value and higher levels of perceived descriptive norms and contextual moral disengagement than those who chose the ethical option.
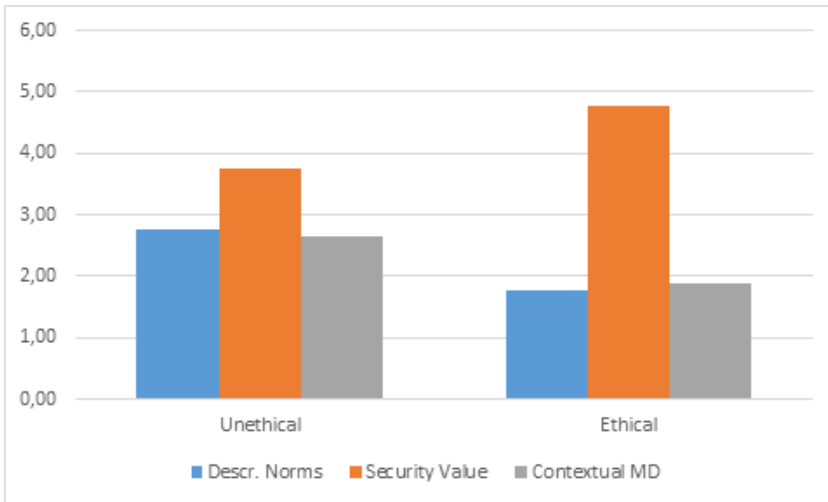
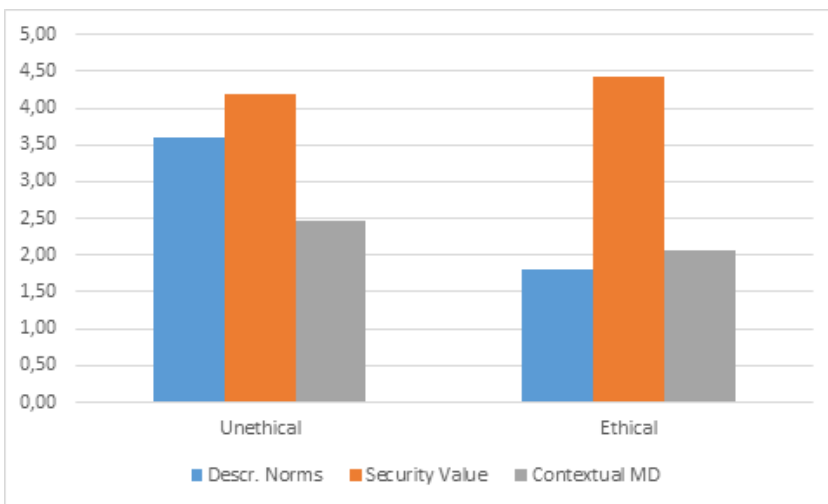**Fig. 4.** First conversational scenario: Bicycle infractions**.**

Fig. 5. Second conversational scenario: Mobile phone use while driving.

With regard to the second conversational scenario, the t-test revealed a significant difference between subjects who have selected the rule-breaking behavior and those who have chosen to comply with the rules on descriptive norms [$t(19) = 6.04$, $p < .01$], and contextual moral disengagement [$t(19) = 3.15$, $p < .01$]. As in the first case, those who have selected the unethical option show significantly higher levels of descriptive norms and contextual moral disengagement than those who have selected the ethical option (Figure 5).

Finally, regarding the third conversational scenario, the t-test revealed a significant difference between subjects who have selected unethical choice and who have selected ethical choice only on contextual moral disengagement [$t(19) = 2.64$; $p < .05$]. Thus, those who have selected the unethical option show significantly higher levels of contextual moral disengagement than those who have selected the ethical option (Figure 6).
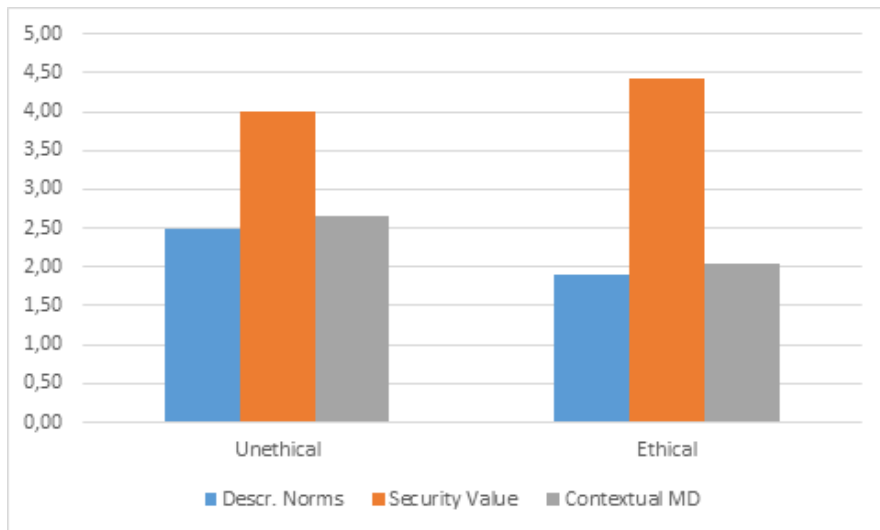

Fig. 6. Third conversational scenario: car sharing

In order to examine the profile among subjects across conversational scenarios, three groups were preliminarily identified: group 1, subjects showing stable ethical options (N=11); group 2, subjects showing at least one unethical option in one of the three conversational scenarios (N=6); group 3, subjects showing stable unethical options (N=4).

Moreover, by using all responses across the three conversational scenarios, factorial scores were extracted for MD (58% of the explained variance), descriptive norms, and security (80% of the explained variance; 57% and 23% for security and descriptive norms respectively). Subsequently, ANOVA was performed using the group as the independent variable and factorial scores as the dependent variables.

Figure 7 shows the profiles of moral disengagement, descriptive norms, and the security value for each group. The ethical stable group shows the lowest levels of MD [$F_{(2, 18)} = 12.89$, $p < .001$] and the highest levels of security values [$F_{(2, 18)} = 3.59$, $p < .05$], on the contrary, the unethical stable group shows the highest level of descriptive unethical norms [$F_{(11, 86)} = 11.86$, $p < .01$].
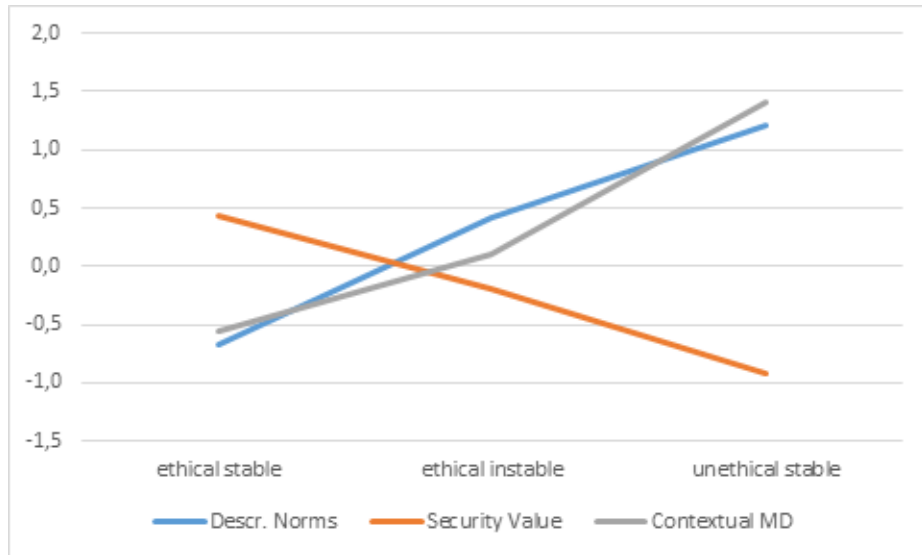

Fig. 7. Stable and unstable ethical choices: social cognitive profiles.

Finally, partial correlations between transversal MD, descriptive norms, and ethical choice controlling for security value attest that both these two social cognitive variables are positively associated with unethical options. In particular, the correlations are .64 for MD and unethical choice, and .67 for descriptive norms and unethical choice.

4.4 Findings' discussion

In analyzing the significance of the results by setting them in the broader theoretical perspective, it is necessary to consider the different influences of situational, personal, and behavioral factors as suggested by the social-cognitive framework in which the study was developed. First of all, with regard to situational factors, it is interesting to note that although NinjaTown is a completely fictional city and not characterized in any way from a descriptive or visual point of view, the subjects who interacted with the mobile application expressed their opinion and acted (albeit virtually) in that specific context by each imagining a specific city; the only contextual information that can be obtained from the description is that related to the different degree of violation of road safety rules.

Moreover, since this was a pilot study to test the effectiveness and possibilities of a new assessment tool, we also wanted to collect and analyze the subjects' response in the context of a rather extreme scenario that is less close to everyday experience, namely the one present in the third narrative, in which the subject witnesses what is closer to an act of vandalism than to a simple transgression of road rules.

Looking at the results in light of the social-cognitive theoretical approach, one can see some general patterns of functioning in agreement with what the literature indicates about rule-breaking behaviors. When subjects have a clear perception of a context in which compliance with rules is not shared and rule-breaking is widespread, then they are generally more likely to engage in misbehavior.

Observing the overall pattern of relationships among the measures, a general trend can be observed as the severity of rule violation increases. In the first, less severe scenarios, those who break the rules believe more than those who abide by the rules that they are in a context of a general infraction, and thus the influence of the environment on their behavior is significant, whereas when we get to the case of the most severe action (i.e., an act of vandalism to someone else's property) the link between context and infraction action is no longer significant. In fact, in this higher severity scenario, the only determinant that maintains a significant correlation with the rule-breaking behavior is moral disengagement: what is actually most correlated with the behavior in the high severity context are cognitive processes, hence individual determinants. In this case, subjects who are most likely to refer to moral disengagement mechanisms will be those who most frequently respond in accordance with a deviant context even under the most extreme, even if simulated, conditions.

Considering stable individual differences, in each of the three simulated situations it is possible to find a group of rule-breaking subjects who are regularly inclined to violate the rules (i.e., who have opted to break the rules regardless of the context).

Conversely, it is also possible to identify a cluster of subjects who just as consistently make the most obviously correct decision, perhaps highlighting the presence of a social desirability bias. Between these two extreme clusters are the context-sensitive individuals who are receptive to behavioral affordances obtained from the environment; by virtue of their plasticity, they are therefore probably the individuals toward whom effective educational intervention can be imagined.

Regarding personal values, the data again go in the direction of recognizing the effectiveness of the instrument's assessment: across the three different scenarios, the assessment of personal values remains perfectly constant, in agreement with the literature that recognizes them as context-independent moral motivational systems.

5 Discussion

The present findings show the possibility of studying the underlying processes and motivations behind the decision to adhere or not to road safety rules through conversational agents designed to encourage young users to reflect on various road safety situations. With the overarching goal of fostering the development of a personal safe mobility culture and increasing awareness of road risks, the results enable us to address the research questions that guided this study, as reported below.

As for the RQ1. *Can moral dilemmas in decision-making effectively explore road safety-related moral disengagement, and if so, how?* we might state that inn the study's framework, decision-making within the presented moral dilemmas was essential for a comprehensive understanding of road safety-related moral disengagement. Participants' responses to varying degrees of road safety violations have shown a consistent difference in moral reasoning. For the less severe scenarios, those who perceive the general context as more pervasive with rule infraction indeed break the rules more. However, when presented with more serious violations (especially those mimicking acts of vandalism), the link between contextual influence and rule infraction is no longer significant. In this higher severity scenario, the only determinant that maintains a significant connection with the rule-breaking behavior is indeed moral disengagement. Therefore, the subjects who most frequently respond in accordance with a highly deviant context are the same who tend more to lean on cognitive moral justifications for their wrongdoings. These results suggest that the presented moral dilemmas not only serve as a tool to examine road safety-related moral disengagement but also elucidate the complex interplay of individual factors and perceived environmental influences in decision-making.

With relation to RQ2. *Do realistic scenarios support the investigation of rule-breaking and rule-compliance behaviours, and if yes, what's the role of fictional elements?* we might say that the level of realism of the scenarios used in this study offered vital insights into the dynamics of rule-breaking and rule-compliance behaviors. Despite the fictional nature of Ninja Town, the lack of specific visual or descriptive markers seemingly increased its perceived realism for participants. As a result, participants were likely to interpret the scenarios based on their personal experiences and based their responses to the varying degrees of road safety violations presented. The data suggests that when participants are in a context where rule adherence is not the norm and rule violations are frequent, there is an increased probability of rule-breaking behaviors: this observation implies that reducing explicit contextual details in the scenarios can enhance their broad applicability and resonance among participants. Of particular note were again the responses to the scenario mirroring acts of vandalism. The realism of participants' reactions appeared to be influenced more by the severity of the situations rather than the fictional setting. This indicates that when constructed with care, fictional elements can augment the realism of a scenario, making them effective for deeper investigations into both rule-compliant and rule-breaking behaviors.

This research results allow to discuss RQ3. *Is interactive conversational storytelling effective as a psychosocial research method?* and to state that the efficacy of interactive conversational storytelling as a psychosocial research method has been confirmed by this study. Its strength was evident when analyzing participants' responses across the three simulated scenarios. With the data collected through interactive conversational storytelling, it was possible to look at the stability of individual differences, demonstrating the existence of three primary clusters of participants: a first group persistently engaging in rule-breaking behaviors, (i.e., those who have opted to break the rules regardless of the context); a second group consistently opting for the conventional correct decisions, which raises the possibility of a social desirability bias influencing their choices, and a third group that comprised context-sensitive individuals. This last group was more receptive to behavioral affordances obtained

from the environment: by virtue of their plasticity, they are probably the individuals toward whom effective educational intervention can be imagined. Additionally, the tool's consistency in assessing personal values, despite the diversity of the presented scenarios, stands out. Participants' foundational moral motivators were not affected significantly by contextual changes, corroborating the existing literature that posits such values as stable and relatively context-independent.

All of these results underscore the potential of interactive conversational storytelling in capturing a comprehensive yet consistent view of individual psychosocial profiles.

Finally, as for RQ4. *Does mobile computing prove to be an effective and valuable psychometric tool?*, we confirm that, given the wide availability of mobile computing, this technology has shown its potential as an effective psychometric instrument, especially for young adults. The mobile application enhanced participant access and enabled efficient data collection across various contexts. The application's user-centric design ensured straightforward interaction with the scenarios, which may have fostered the authenticity of participants' responses. The application allowed to collect and store decision making data on the cloud dataset, providing the researchers with a realtime collection for in progress monitoring of participants' moral reasoning and decision-making data.

6   Conclusion

In this study of decision-making related to road safety, it was crucial to carefully design an effective user interaction to uncover the complex factors influencing road safety compliance. . Attempts to raise awareness, while certainly laudable and to some extent necessary, are unlikely to be sufficient to affect unethical behavior in this area. In particular, the use of a psychographic and playful mobile application such as the one used in the present study proved to have the necessary characteristics to address personal dilemmas with a new and effective approach, while also taking into account the crucial importance of the situation. Moving away from the mere impersonal question related to traditional decision-making dilemmas, this interactive tool has the potential to evaluate decision-making processes in realistic and meaningful situations.

The results obtained with this research encourage further investigation and adoption of interactive conversational storytelling as a mean for deploying psychographic through psychometrics approach. This field benefits from the application of real life scenarios allowing to exploit self-projection in simulated contexts. By engaging the users in interactive scenarios, psychographics enables to elicit users' proxy of behaviours rather than effective behaviours' data.

In this way, it may be possible to better understand acts of rule-breaking through the inseparable interweaving of personal, environmental-situational, and behavioral determinants. For instance, thanks to the conversational interface, it was possible to directly observe the relationship between decision-making outcomes and the situational activation of certain cognitive mechanisms of justification for the choice to break rules, which are otherwise difficult to investigate in vivo - especially among young people.Further to raise awareness about real-life safety-critical behaviors, this research builds knowledge of the human factors implied in urban mobility decision-making and

to the development of artefacts and methods for collecting psychometric data. The contribution from this research is critical for all the entities, policy-makers, and companies dealing with traffic management, mobility services, and valuable insurance packages for young adults' current mobility habits and behaviours and, ultimately, for urban governance to face road safety issues.

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