# Risk assessment among drivers via the Affect Misattribution Procedure (AMP)

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Initial receipt: 23.03.2014 Final revision received: 02.05.2014 Accepted: 15.05.2014

***Abstract:*** Based on noticing the limits of risk assessment measures in traffic research, we plan to adapt and use the AMP technique in order to measure the attitudes towards risk-taking in traffic. Our goal is to analyze the empirical relevance of two distinct methods of traffic risk investigation (the explicit approach vs. the implicit approach). A group of 47 drivers were assessed regarding their attitudes towards risk-taking behavior using the AMP technique, in which it is expected that images of speedometers showing different speeds will bias the judgments of Chinese characters, by positive or negative affective reactions. The results provide evidence on the use of AMP in order to assess attitudes to speeding. The uses of implicit techniques counterbalance the explicit measurement of attitudes, especially regarding the reliability of data that are not affected by social desirability of self-reported responses.
***Keywords***: Traffic; Risk-taking behavior; Affect misattribution

## Introduction

Speeding is a major risk factor in road accidents, both the frequency and severity (Vernon, Cook, Peterson & Dean, 2004). In this regard, the campaigns developed to warn and to persuade drivers to adjust their behavior of driving at excessive speed are continually maintained and improved (Brown & Gould, 2012; Rundmo & Iversen, 2004). All statistics highlight the alarming increase in the number of traffic accidents with an impressive number of deaths, especially among young people whose age does not exceed 25 years, the traffic accident being the main cause of deaths to this age (Rhodes & Pivik, 2011). Moreover, is expected that by 2030, road accidents will become the fifth leading cause of death worldwide, regardless of driver age (Brown and Gould, 2012). Car crashes cause about 127,000 deaths and 2.4 million injuries a year in the European Region. Speed is the single most important determinant of safety in road transport systems. The consequences of accidents are almost twice as severe for pedestrians as for car occupants (WHO, World Health Organization, 2013).

In Romania statistics highlight a critical situation. In 2010 there were more than 2,377 people killed on Romania roads. This equates to a rate of 11.1 deaths per 100,000 people, which is lower than Montenegro (15/100,000 people), Ukraine (13.5/100,000 people), Greece (12.2/100,000

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people) but considerably higher than the European leaders, such as Sweden (3/100,000 people) and the the UK (3.7/100,000 people), Germany and Denmark (4.7/100,000 people) or France (6.4/100,000 people) (WHO, 2013).

The importance of behavior in accident prevention has been extensively addressed in research and requires the promotion of those behaviors that ensure safe driving. Currently, the focus has shifted from explaining the traffic performance based on driving abilities into exploring the risk-taking tendency. Statistics indicate that risk-taking is a major factor explaining producing collisions.

***Risks in traffic***

Risky driving is a very important factor that has contributed to road crashes, highlighted by many studies. Speeding is estimated to be a substantial contributing factor to road accidents. Thus, speeding increases both the frequency and severity of road accidents (Vernon et al., 2004; Wagenaar, Streff & Schultz, 1990). An average growth of rate speed of one mile per hour was associated with a higher risk of 3% to be involved in an accident that results in injury and a higher risk of 4-5% to be involved in a fatal accident (Fildes & Lee, 1993). In addition, Blows, Ameratunga, Ivers, Lo and Norton (2005) found that people who reported higher levels of speed and participated in racing last year are four times more likely to be injured in a car accident while driving in the same period.

As a result, the study of the drivers' attitudes toward travelling at excessive speeds in terms of actual risk and the explanation of the relationship between risk perception and risk-taking behavior is an important research direction with pragmatic aims in reducing the number of accidents due to speeding.

*Risk perception and risk-taking behavior*

Risk perception theories are based on the idea that people are motivated to change their risk-taking behaviors when they perceive there is a high level of risk (Brown & Gould, 2012). The theorethical framework for risk perception is focused on examining the links between risk perception and self-protective behavior, which is the individual's attempt to protect themselves from factors that represent threats for their health (Brewer et al., 2007; Rogers, 1975). Much research shows that speeding is an often studied factor when it comes to risk perception in the context of traffic (e.g., Brown & Cotton, 2003; Brown & Gould, 2012; Machin & Sankey, 2008).

Risk perceptions are usually operationalized as subjective cognitive judgements on the likelihood and severity of negative consequences of dangerous or unhealthy behavior (Weinstein, 1993), although the prediction of behavior is stronger for those predictors that involve both cognitive and emotional components (Weinstein et al., 2007, cited in Brown & Gould,

2012), such as perceptions of vulnerability (Weinstein et al., 2007), traffic safety and danger (Brown & Cotton, 2003). Although there is a link between them, the actual risk and perceived risk are different from the actual and subjective safety (Havârneanu, 2011). Research direction which aims to elucidate this discrepancy explores risk perception and tries to explain the difference between the real and subjective risk and why some people take greater risks while others do not.

Here we should differentiate among the *objective risk*, the *subjectively estimated risk* (subjective risk estimate), also known as the *perceived risk*, and the *risk as an emotion* (the feeling of risk). The objective risk refers to the objective likelihood of being involved in a crash and is most often measured through statistical analysis of the outcome of road crashes, while subjective risk refers to the subjective perception of each driver on the probability (objective) of a car accident and is mostly the result of cognitive processes (Havârneanu, 2013).

Some theories do not center on the risk of being involved in an accident but on the sensations generated by the risk to drivers that may or may not be associated with their perceived risk of being involved in an accident (Lewis-Evans, De Waard & Brookhuis, 2010). These theories include models such as the Risk Allostasis Theory (Fuller, 2008) and the Monitor Model (Vaa et al., 2000; Vaa, 2003, 2007). For the Monitor Model, the sentiment of risk is one of the emotions possibly felt when making decisions in traffic, and the ability to monitor the risk sentiment carries great importance from an evolutionary perspective. The importance of risk, established in Monitor's Model is based on the Somatic Marker Theory proposed by Damasio (1994, 2003), suggesting that certain bodily states and emotions are the outcomes of the activation of certain environmental triggers. These body states can bias the action for particular situations, even if the individual is not aware of them. Based on the fact that the relationship between bodily states and action is explained in terms of the evolutionary process, it is assumed that the body sensations that signal the risk have a considerable impact on the basis of their survival value and self-protective behavior.

The theoretical model proposed by Allostasis Risk Theory (Fuller, 2008) also refers to the somatic marker theory as well as to the body's ability to react and to activate certain processes and procedures in order to survive, and assumes that individuals live a certain sentiment of risk (Lewis-Evans, De Waard & Brookhuis, 2010).

*Risk assessment techniques in traffic*

Studies on risky traffic behavior often use self-reporting as a method to measure a driver's behavior and even until recently was seen as the only way to measure attitudes (Hatfield, Fernandes, Faunce & Job, 2008). Self-

reporting may be affected by a number of response biases, such as socially desirable responses, acquiescence, extreme or moderate responses or affective biases. Socially desirable responses were considered the most problematic issues in the context of research on traffic safety (Lajunen et al., 1997, cited in Hatfield et al., 2008).

In traffic, drivers' responses may be influenced by many motivations and beliefs, and this aspect becomes relevant to measure behaviors, attitudes and beliefs about risk-taking in traffic, for which legislation and advertising form social norms. For example, social influence can be noticed in negative images of those driving with excessive speed and considered careless drivers. These issues cause some drivers not to report their speeding behavior in order to avoid being similarly categorized. On the other hand, speeding behavior may also be viewed positively, and some drivers may choose to not accurately report their slow driving in order to avoid being considered as unskilled or unsafe drivers (Corbett, 2001).

Although some research suggests that socially desirable responses, influences the self-reporting of risky driving, while other research evokes the accuracy of self-reporting (Hatfield et al., 2008). Research is pressed to consider the impact of social desirability when it comes to measuring attitudes towards risk-taking in traffic. At the same time, classic paradigms for measuring the tendency of risk-taking, which refers to tasks or scenarios presenting different dilemmas / problems of choice. They offer two possible answers, one of which has a small and secure gain, and the other a high but risky gain, such as the Rogers Betting Task (Rogers et al., 1999) and the Balloon Analog Risk Task (BART - Lejuez et al., 2002), which does not improve the methods of measuring traffic behavior limits. Moreover, computerized traffic risk measurement paradigms have tried to achieve a symbiosis between the questionnaire and the simulated scenario's methods, but the posibility of still social desirable responding continues to guide the researchers to develop techniques which can capture and measure traffic risk-taking behavior as accurately as possible.

Therefore, an "objective", indirect measurement of attitudes toward risk-taking could increase confidence in the relevance of research.

***Implicit methods to explore personality***

The individual's tendency to provide desirable answers in line with perceived social norms in order to put themselves in a favorable light and the introspection limits, are the main drawbacks of explicit measuring techniques of personality or attitudes about various phenomena (Sava & Rusu, 2011, p.112). Therefore, recent years have seen significant development of implicit methods that have tried to meet these limits, in which IAT type techniques (IAT, Implicit Association Test), developed by Greenwald and colleagues (Greenwald, McGhee & Schwartz, 1998) and the

AMP technique, based on the effect of priming (Affect Misattribution Procedure), developed by Payne and colleagues (Payne, Cheng, Govorun & Stewart, 2005), are the most known methods of implicit psychological measurement aspects, with growing popularity, despite their recent development.

In the AMP technique construction, Payne et al. (2005) started from the fact that misattribution is a process that frequently occurs in people's lives, such as misinterpretation (Schwarz & Clore, 1983), or eyewitnesses confounding the investigators suggestions because of their own memories (Wells & Loftus, 2003). Also projective tests, such as the Thematic Apperception Test (TAT) and the Rorshach test, are based on a phenomenon that can be interpreted to be a kind of misattributions. Specifically, on interpretation of ambiguous events or situations, people tend to imbue the event with their own sources of meaning and thus to perceive the unconsciously developed content of personal projections as a quality of the event (Payne et al., 2005).

These assumptions have led to the development by Payne and his colleagues of a technique to measure attitudes, based on the propensity of individuals to make wrong attributions in interpreting the events and on the spirit of projective tests. Framed within implicit methods to measure personality, the AMP technique has gained more and more popularity thanks to its outstanding psychometric qualities and robust priming effects (Payne et al., 2005).

With its use on implicit social cognition studies, the AMP procedure is based on the following reasoning: individuals are asked to make judgments in ambiguous situations. Each case consists of exposure to an attitude object (a prime stimulus, for example, the image of President George W. Bush) who stirs an evaluative reaction, positive or negative, depending on the participant's already existing attitude towards the object. Later, shortly after the appearance of a prime stimulus, a target stimulus is presented which is to be evaluated, the structure of which is ambiguous, abstract (e.g., a Chinese character).

Respondents are asked to evaluate the target on the basis of its visual pleasantness, with the explicit warning to ignore the prime image (Banse et al., 2013; Payne et al., 2005). However, regardless of the explicit warning, on the idea of misattributions, people will assign to target stimulus the attitudinal reactions specific to a primed object. In the example above, the President will bias the evaluation symbol and so individuals will misassign to Chinese character the affective valence associated to the president’s image. Participant’s project their own mental state (determined in advance) on an ambiguous source (Payne et al., 2005).

The AMP procedure is an evaluative priming technique which allows for the measurement of attitudes by measuring the priming effect through judgements toward ambiguous stimuli in a computer-administered test. The key of this priming effect is based on the missatribution of target stimulus valence (which objective is neutral), and this occurs through the transfer of prime stimulus valence to the target image. This effect is possible because the targets are ambiguous stimuli, leaving the participant the task of classifying them as pleasant or unpleasant (Sava & Rusu, 2011, p.112).

Regarding the mechanisms that produce the priming effect, one of the key concepts, such as *affect* must be clarified. "By affect we mean a rudimentary pleasant or unpleasant reaction" (Frijda, 1999). Simple affective reactions differ from emotions in that they are not considered as having a particular source or specific meaning in a particular context. Although all those emotional reactions are usually experienced subjectively, they are the products of underlying processes that may be either conscious or unconscious (Payne et al., 2005).

AMP holds at least two criteria which can label it as an implicit measure: implicit by the fact that it is an indirect measure (participants are not directly required to state attitudes; they are deducted from revealed behaviors); AMP tasks influence people's attitudes and behaviors without them being aware of this, reflecting the automatic, unintentional nature in the expression of attitudes.

In the AMP technique validation studies conducted by Payne and his colleagues (2005), the results showed promising psychometric qualities. This technique presented values of Cronbach alpha coefficients of internal consistency that often exceed the level of 0.80 (Payne et al., 2005, Payne, Burkley & Stokes, 2008), and correlations with explicit attitude measures (often around 0.30 to 0.60) higher than for any other indirect techniques (Sava & Rusu, 2011, p.112). Among all indirect techniques currently used, only the Implicit Association Test (IAT) reported a level of internal consistency comparable to that of AMP (Blaison et al., 2012).

Since its development in 2005, the AMP technique has been used many times by a number of researchers to assess attitudes in various areas: attitudes towards alcohol (Payne, Govorun & Arbuckle, 2008) and smoking (Payne, McClernon & Dobbins, 2007), to Jews and Christians (Imhoff & Banse, 2009), sexual attitudes (Imhoff et al., 2011) or moral attitudes (Hofmann & Baumert, 2009). This study by Payne and his collaborators has been cited more than 170 times in six years after its publication (Nosek, Hawkins & Frazier, 2011).

In their study, Hatfield et al. (2008) used the Implicit Association Test (IAT) developed by Greenwald, McGhee and Schwartz (1998) to measure implicit attitudes of people who drive at high speeds. The results

recommend IAT to measure implicit attitudes toward speeding in the context of generally negative attitudes towards speeding behavior in traffic. The implicit nature of the task is also used to improve the problematic possibility of biased responses considered when using explicit techniques for measuring attitudes, which increases confidence in the accuracy of measurement. Hatfield and his collaborators' study (2008) has become an impuls for using implicit measures in the study of traffic behavior as well as for development and adaptation of the traffic study and also other indirect measures of attitudes.

**The present study**

Based on noticing the limits of research measures on risk assessment in traffic, we plan to adapt and use the AMP technique for measuring the attitudes towards risk-taking in traffic. Our goal is to analyze the empirical relevance of two distinct methods of traffic risk investigation (the explicit approach vs. the implicit approach).

We expected the existence of a positive association between perceived risk and preferred speed for an explicit evaluation of two traffic scenarios. We expected to find positive correlations between the preferred speed on presented travel scenarios and implicit attitudes towards risk-taking. When assessing implicit attitudes towards risk using the AMP technique, we expected that the proportion of positive evaluations of target stimuli would decrease as the speed value stated on the prime stimuli increases.

In order to achieve our goal, on the explicit assessment on risk perception and risk-taking in traffic, we used two visual scenarios with real situations that the participants were asked to analyze. After analyzing the two scenarios, the respondents must appreciate: the degree of perceived danger, the optimal speed that should be used for safe driving purposes and the speed with which they would prefer to travel.

Attitudes towards risk-taking behavior were assessed using the AMP technique in which it is expected that images of speedometers showing different speeds will bias the judgements of Chinese characters, through positive or negative affective reactions. Thus, the higher the difference between the mean of speeds (indicated by priming stimuli) rated as pleasant and the mean of those rated as unpleasant, the positive are the attitudes toward high-speed driving.

If self-reported preferred speed is the cognitive aspect on risk perception and risk-taking, the assessment of attitudes towards different speeds using the AMP technique represents an affective, indirect evaluation. The risk is interpreted in terms of the affective reactions felt to those speeds indicated as prime images. The cognitive assessment is aware and is based

on the estimation of perceived personal driving skills, driving experience and perceived social norms, such as speed limits or negative images about risky and careless drivers (Corbett, 2001).

On the other hand, the implicit risk assessment is based on felt affective reactions, which cause individuals to act close to "instinctive", "gut feelings" (De Houwer & Smith, 2013). In this regard, those theories of risk that focus on the sensations generated by risk are relevant, sensations which may or may not be associated with the perceived risk of involvement in an accident. We believe that AMP, through its reasoning, has the properties to provide an indirect and accurate measurement of attitudes towards risk-taking.

## Method

### *Participants*

A total of 47 drivers (35 males), aged between 20 and 58 years with a mean age of 34 years (*SD* = 10.64), with different experience regarding driving, participated in this study on a voluntary. All of the participants at first were required to fill in a series of general information, such as the year of their driving license, the estimated number of miles traveled up to present and the type of license they have.

### *Materials*

We selected two images that capture risk traffic situations with a particular degree of danger for risk conscious processing. Each scenario represents a picture taken inside a car in real traffic from the perspective of the driver. The two images are specific to traffic in Romania; one that captures travelling within a city and the other travelling outside the city.

Each of the two images evoked a situation with a particular degree of risk, given the elements present in the scenario. Within the city traffic scenario, elements with potential danger are: the presence of a curve to the left, the presence of a pedestrian in a street crossing, the lack of visibility to the left, the presence of two-way traffic, the presence of intersections, buildings and utility poles on the right. For the scenario of traffic outside the city, elements with potential danger are: a stationary utility car on the hard shoulder, the presence of a worker on the roadway, the presence of two-way traffic, the proximity of a vehicle from the opposite direction, the presence of a ditch and telephone poles on the right.

For the AMP adapted form used for measuring attitudes towards risk-taking in traffic, we used as prime stimuli twenty images of speedometers showing different speeds, ten images within the city traffic scenario (from 40km /h to 130km/h) and ten images outside the city traffic scenario (from 80km /h to 170km/h). The speedometer's images are displayed on the centre of a computer screen on a black background with a

red speedometer indicator to obtain a contrast effect and to ensure optimum visibility. Twenty images of Chinese characters that were selected to be similar were used as target stimuli. A mask image consisting of a black and white “noise” pattern was displayed in full screen after the disappearance of the Chinese character. The pattern mask was used to indicate when the assessing target stimuli were pleasant or unpleasant.

***Instruments***

In order to measure the tendency of explicit risk-taking, the participants were confronted with two visual scenarios of actual traffic situations in Romania. Within the city limits scenario, the participants were asked to carefully survey the image displayed on the computer screen and to imagine they were in traffic, driving their own cars and were looking at the pictures presented through the windshield. Then, they were asked to analyze the situation and answer five tasks: (1) identify which scenario elements constitute a potential danger, (2) estimate the probability that the identified element can be a cause to an accident situation, (3) assess (on a Likert scale from five points from 1 = "not very dangerous" to 5 = "very dangerous") the level of danger of the situation as a whole, (4) estimate the speed at which that situation should be use to avoid danger, (5) choose the speed you prefer to travel in that situation. The same instructions and tasks are used for traffic scenario outside the city.

When it came to performing the AMP procedure, the participants had to decide whether the Chinese character they had just observed was visually pleasant or unpleasant after being previously exposed to prime items. Each trial began with the presentation of a speedometer image, which indicates a certain speed. The image was presented in the center of computer screen for 100 ms, followed by a blank screen for 125 ms, followed finally by a target pictograph, a Chinese character (see Figure 1). The target was presented for 125 ms and was followed by a screen mask with random shades of gray that remained displayed until a response was made. The purpose of the mask was to disrupt afterimages, thereby limiting perceptual processing and maximizing ambiguity of the target items (Payne, McClernon & Dobbins, 2007). The participants were instructed to judge the pleasantness of the Chinese pictographs. They were asked to decide whether each pictograph was more or less visually pleasant than the average pictograph and to press one of two keys labeled pleasant / unpleasant. The next trial began as soon as the participants came up with a response.

The participants completed a total of 20 randomly ordered trials, ten for each of the two traffic scenarios they previously had to analyze (10 trials within the city traffic scenario and 10 trials outside the city traffic scenario). Within the city scenario, the speedometers (prime items) indicated speeds of 40 km/h to 130 km/h, and for outside the city traffic scenario, speeds were

from 80 km/h to 170 km/h. Twenty different Chinese characters were used as target items. Each pictograph was associated with a prime-image of a speedometer in random order generated by a computer for each participant. Before actual trials, three practice trials were provided so that the participants could familiarize themselves with a trial sequence as well as with the appearance of a pictograph. In this and previous studies, no participant reported having any trouble making these judgments (Payne, McClernon & Dobbins, 2007). However, in practice trials, the prime-items we used were not the same as in the actual trials (the image of a speedometer showing a certain speed), but other familiar images from drivers (an image of a steering wheel of a car, an image of a wheel, and an image of a car's dashboard).

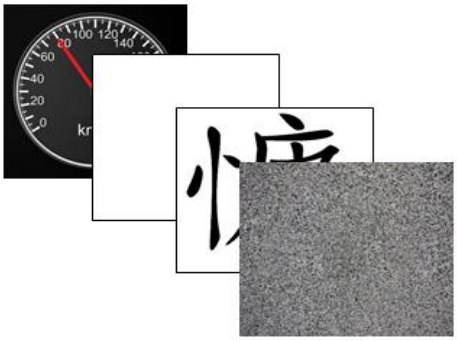

*Figure 1*. The sequence of steps for a trial of the Affect Misattribution Procedure

The instructions were the same for each participant and included warnings to avoid the influence of primes on assessing the Chinese pictographs.

***Procedure***

The participants were seated in front of a computer and were informed that the study examined "how drivers make simple but quick judgments". Furthermore, they were given general instructions on how the procedure will develop and were required to give some information: age, the year of the driving license, the estimated number of miles traveled up to the present.

Then the participants observed the city traffic scenario within city limits. The picture was presented on a computer screen and the participants were asked to imagine that they were driving their own car and they were looking at that scenario on the windshield. The picture was kept on the screen and the participants were asked to respond in writing to five tasks.

After the the completion of the responses, the participants were offered instructions for the next task, which regarded making quick judgements on a number of Chinese characters. They were told that they would see pairs of pictures flashed one after the other on the computer screen, the first one being a traffic image and the second a Chinese character. They were told that the first image only served as a signal for the Chinese character and that they should not consider it when it came to judging the pictograph. Their task was to judge the visual pleasantness of each Chinese symbol by pressing the corresponding key to their preference.

Then, the participants completed three practice trials for practice and achieved familiarity with the quickness of the images pairs. Before starting the actual trials, they had to recall the response keys, respectively the "C" key if the Chinese character is rather pleasant and the "N" key if the Chinese character is rather unpleasant. The participants then completed ten trials, with ten primes randomly indicating speeds from 40km/h to 130km/h. For the outside the city traffic scenario, the entire procedure was replicated, except the practice trials.

**Results**

Unlike other implicit measures, the variable of interest of the AMP is not given by reaction times, but the valence of abstract symbols' judgment. The participants' responses for each AMP trial were scored as one for a pleasant judgment or zero for an unpleasant judgment. The proportion of pleasant judgments for each prime (speed indicated by speedometer) serves as an index for the participants' spontaneous emotional reactions to those speeds / primes (see Figure 2 and 3).

To determine the implicit attitudes towards risk-taking we calculated a difference score by subtracting the average of speeds judged as pleasant from the average of speeds judged as unpleasant for each participant. This produced a score for each participant, with higher values reflecting more of a positive attitude toward risk-taking in traffic.

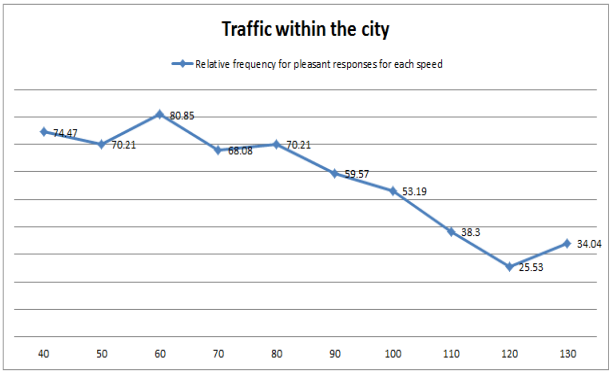


*Figure 2.* Traffic within the city: the percentage of pleasant judgments for each prime (speed indicated by the speedometer)

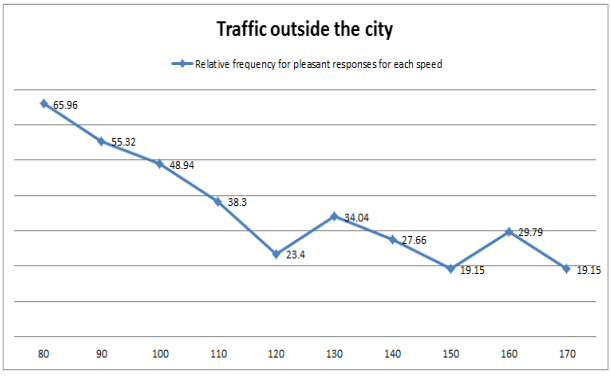


*Figure 3.* Traffic outside the city: the percentage of pleasant judgments for each prime (speed indicated by the speedometer)

The tendency for explicit risk-taking was measured by estimating the speed which the participants would prefer to drive and the degree of perceived danger in the two traffic scenarios that they had analyzed from the perspective of the driver. The descriptive statistics for the two scenarios, both within the city and outside the city traffic are presented in Table 3. We observe that the average of preferred speed in within the city scenario (44.79 km/h) is 5.21 km/h lower than 50km/h, the legal speed limit. For outside the city scenario the average of preferred speed (57.98 km/h) is 32.02-42.02 km/h lower than 90-100 km/h, the legal speed limit.

To study the association between the explicit tendency for risk-taking, given by preferred speed, and the attitude towards risk-taking, given by the unconscious risk assessment by AMP, we conducted a correlation analyses for each of the two traffic scenarios (Table 1). We note the existence of significant correlations between preferred speed for driving in

situational contexts presented in the two scenarios and an implicit attitude toward risk-taking ($r$ = .330, $p$ = .023 for within the city traffic; $r$ = .445, $p$ = .002 for outside the city traffic). But there were no significant differences regarding the difference between preferred speed and optimal speed for within the city traffic (1.06 km/h) and the difference of preferred and optimal speed for outside the city traffic (1.17 km/k).

We also examined, in part, the association between the degree of perceived danger and preferred speed for driving in each scenario, respectively the association between the degree of perceived danger and implicit attitude toward risk-taking. For the conscious risk assessment, we notice a significant correlation between the degree of perceived danger and preferred speed for outside the city traffic ($r$ = -.375, $p$ = .009), but not for within the city traffic ($r$ = -.280, $p$ = .057). Between the degree of perceived danger and implicit attitude towards risk-taking we noticed an absence of significant correlations ($r$ = -.174, $p$ = .242 for within the city traffic; $r$ = -.161, $p$ = .278 for outside the city traffic).

In order to explore the correlation obtained between the degree of perceived danger and preferred speed for outside the city traffic, we conducted a paired-sample *t*-test to investigate the differences between an implicit attitude towards risk-taking in traffic within the city and an attitude toward risk-taking in traffic outside the city. The results indicate a significant difference between the two attitudes ($t_{(46)}$ = 5.27, $p$ < .001), meaning that the implicit attitude towards risk-taking within the city is more positive than the implicit attitude towards risk-taking outside the city traffic ($M_{within}$ = 3.21 > $M_{outside}$ = -42.27) (Table 2). Therefore, the more positive attitude there is towards risk-taking within the city traffic explains the association between perceived danger and preferred speed for outside the city traffic.

| *Within the city traffic* | Degree of perceived danger | Preferred speed |
|---|---|---|
| Preferred speed | -.280 | |
| Implicit attitude toward risk-taking | .174 | .330* |
| *Outside the city traffic* | | |
| Preferred speed | -.375** | |
| Implicit attitude toward risk-taking | -.161 | .445** |

*Table 1.* The correlations' matrix among the degree of perceived danger, preferred speed and implicit attitude toward risk-taking within and outside the city traffic.
*Note:* *p < 0.05, **p < 0.01

| *Implicit attitude toward risk-taking within the city traffic* | | *Implicit attitude toward risk-taking outside the city traffic* | | df | *t*-test |
|---|---|---|---|---|---|
| M | SD | M | SD | *df* | *t* |
| 3.21 | 34.68 | -42.27 | 68.76 | 46 | 5.27* |

*Table 2*. Means, standard deviations and value of a paired sample *t*-test for an implicit attitude toward risk-taking within the city traffic and an implicit attitude toward risk-taking outside the city traffic. *Note*: *p < 0.05

| Traffic within the city | M | SD | Min. | Max. | Skew-ness | Kurtosis |
|---|---|---|---|---|---|---|
| Preferred speed | 44.79 | 13.71 | 20 | 85 | 0.54 | 0.32 |
| Degree of perceived danger | 2.87 | 1.05 | 1 | 5 | 0.14 | -0.51 |
| Implicit attitude toward risk-taking | 3.21 | 34.67 | -67 | 85 | 0.46 | -0.18 |
| Difference between preferred speed and optimal speed | 1.06 | 9.02 | -20 | 20 | -0.008 | 0.53 |
| Traffic outside the city | | | | | | |
| Preferred speed | 57.98 | 18.22 | 30 | 110 | 0.73 | 0.25 |
| Degree of perceived danger | 2.53 | 0.95 | 1 | 5 | 0.61 | 0.49 |
| Implicit attitude toward risk-taking | -42.27 | 68.76 | -125 | 109 | 0.83 | -0.47 |
| Difference between preferred speed and optimal speed | 1.17 | 9.51 | -20 | 25 | 0.61 | 1.15 |

*Table 3.* Summarize: means, standard deviations, minimum and maximum values, skewness and kurtosis coefficients

**Discussion**

The results regarding the use of the AMP technique for assessing attitudes towards risk-taking in traffic support the promising psychometric qualities of this technique for assessing attitudes in traffic. The data presented in Figure 2 and Figure 3 justifies the relevance of using this implicit technique. It is noticed the higher the speed used as a prime, the lower the frequency of pleasant judgements.

The effect of priming with speedometer images indicating high speeds is associated with a decrease in frequency of pleasant judgements for

target items. This fact suggests negative attitudes towards driving at high speeds and therefore toward risk-taking in traffic. When priming with speedometer images indicating low speeds, the frequency of pleasant judgements to target items is much higher.

The association between preferred speed and an implicit attitude toward risk-taking ($r$ = .330* within the city traffic, $r$ = .445** outside the city traffic) suggests that the AMP provides relevant information on attitudes towards risk-taking. Thus, the higher the preferred speed, the more positive the implicit attitude toward risk-taking. In other words, measuring implicit attitudes toward risk-taking by using the AMP can explain an individual's behavioral intention to drive with a certain speed and further the increasing tendency to assume the perceived danger.

The association between the degree of perceived danger and the preferred speed for outside the city traffic is in accordance with the risk homeostatic theory developed by Wilde (1988). Thus, the higher the degree of perceived danger and therefore the lesser the perception of control of the traffic situation, the lower the preferred speed of driving outside the city. But the results indicated an absence of significant correlation between perceived danger and an attitude toward risk-taking for within the city traffic. The lack of association between perceived danger and implicit attitudes toward risk-taking can be explained by the fact that individuals who perceive a certain level of risk do not adjust their attitude toward risk accordingly to the perceived danger.

The association between the degree of perceived danger and preferred speed just for outside the city traffic may be due to the fact that the participants perceive more danger when travelling outside the city than driving inside the city. This explanation is plausible because outside the city driving is at much higher speeds than driving inside the city. Statistics highlight this. Accidents outside the city, in addition to being more numerous, have more serious consequences than those produced in the city. In outside traffic, individuals adjust their behavior accordingly to the perceived danger. In inside traffic, this adjustment is not observed because the danger is underestimated, driving speeds are lower, and the consequences of potential accidents are less serious. These results could also be attributed to negative categorization of those drivers who travel at high speeds and are perceived as unsafe, in order to avoid being similarly categorized (Corbett, 2001). Driving speeds are higher outside the city, and the risk of losing control is increased. The behavior adjustment when driving outside the city can be explained by drivers trying to avoid being categorized as unsafe drivers compared to other traffic participants.

These results are also supported by the difference between an attitude toward risk-taking within the city traffic and an attitude toward risk-

taking outside the city. A more positive implicit attitude towards risk-taking inside traffic is explained by allowed speeds that are lower within the city and which increase the driver's tendency to travel at higher speeds.

Regarding the difference between preferred speed and optimal speed for each traffic scenario, the low value of this score suggests a trend for the participants to underestimate the optimal speed. This explicit underestimation can be the effect of self-reporting and response biases (such as social desirable or moderate responses), suggesting a distortion of optimal speed in the participants' evaluations. Undervaluation of optimal speed leads to an appreciation of preferred speed which in turn can be influenced by certain social biases, such as driver illusions, described by Rothengatter (2002).

Therefore, drivers can be victims of their own illusions: illusions about their own abilities, illusions about themselves and about others, the illusion of invulnerability and control. Self-evaluation biases, such as the illusion of personal superiority over others (the belief to be better than average) occurs independently of driving experience. Experienced drivers have proven themselves as susceptible to the illusion of superiority like everyone else, assessing themselves as better than drivers with similar experience. It follows that they would be able to monitor their behavior more easily but not the perception of behavior (Waylen, Horswill, Alexander and McKenna, 2004). The relative or absolute impression of invulnerability about their own makes drivers believe that only others are vulnerable to the consequences of risky behavior in traffic and so they do not perceive themselves as being threatened by possible dangers. Moreover, the individual's belief that they can cope with risky situations explain the tendency for them to perceive that they have more control over their own behavior or over the environment than they really are.

Thus, the influence of a driver's illusions may explain the appreciation of preferred speed and the underestimation of optimal speed. In this context, the association between implicit attitude towards risk-taking and preferred speed, which is actually explicit risk processing, could explain individual differences on risk perception and risk-taking.

The results of this study are consistent with those obtained by Hatfield, Fernandes, Faunce & Job (2008) which provides evidence for the use of the IAT technique to assess attitudes toward speeding. The use of implicit techniques compensates the explicit assessment of attitudes, especially when it comes to the reliability of data that are not affected by social desirability of self-reported responses.

Using the AMP technique to assess traffic behavior has important implications for an accurate measurement of attitudes towards risk-taking in

traffic and for the improvement of traffic campaigns that encourage safe driving.

Furthermore, future research should consider the relevance of using AMP on risk-taking in traffic and correlate an implicit measurement of attitudes towards risk-taking with other measures of risk-taking tendency. Also, future research should consider the small number of trials within this study and thus multiply the trials when measuring risky traffic behavior by AMP.

In conclusion, the measurement by AMP of attitudes towards risk-taking may better explain the differences in attitudes regarding risky behavior in traffic and driving at excessive speed, with direct implications on improving the campaigns for safe driving and on reducing the number of road accidents due to speeding. Moreover, these results suggest that AMP can be used to measure implicit attitudes toward speeding, and that the attitude toward speeding is generally negative. Speeding (or risky driving) is compatible with the positive judgments of targets primed with speedometers showing high speeds, while cautiously driving, with a reasonable speed, is compatible with the positive judgments of targets primed with speedometers showing low speeds.

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