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Implicit attitudes toward risk: the construction and validation of the measurement method

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Methods that are typically used to examine individual differences in risk attitudes (e.g. lotteries, dilemmas, questionnaires) require participants to explicitly declare their willingness to take risk. Therefore, they may be biased by the need for self-presentation or situational characteristics such as time pressure and cognitive constraints that lead to more spontaneous and automatic processing of risk-related information. The aim of this study was to construct an indirect measure of risk attitudes that is free of these methodological limitations. The method based on the Implicit Association Test shows high internal reliability and satisfactory stability over time. It correlates moderately with different explicit measures of risk attitudes that are related to sensation seeking. Finally, it is characterized by a high predictive power. Adding the implicit measure to the set of independent variables representing declarative evaluations of risk attitudes significantly improved the model predicting risky real-life behavior. We argue that the indirect assessment of risk attitudes presented in this paper may be used as an universal measure of people's risk propensity that is free of biases related to self-presentation and situational factors.

Keywords: risk attitude; implicit risk attitude; individual differences in risk perception; Implicit Association Test

1. Introduction

A reliable measurement of individual differences in attitudes toward risk is an important issue from both the theoretical and practical point of view. For example, some theoretical models use risk attitudes to predict real-life risky behavior, and the accuracy of these predictions is highly determined by the reliability of the risk attitude assessment (Bromiley and Curley 1992). The concept of risk attitudes is also used in practice, for example, to forecast adolescents' engagement in high health-risk behaviors (Reininger et al. 2003). Different methods have been developed to test these attitudes: lotteries (Holt and Laury 2002; Kahneman and Tversky 1979), skill tasks (Atkinson and Litwin 1960), or questionnaires (Weber, Blais, and Betz 2002; Zaleskiewicz 2001). All these methods differ from one another in how they elicit attitudes to risk. However, they are similar in the way that people are asked to explicitly declare how much risk they are willing to accept. One obvious limitation of this diagnostic approach is that participants can give untrue answers to present themselves as risk lovers or risk haters depending on their motives or expectations.

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For example, males use risky behavior as a mate advertisement to impress females (Wilke et al. 2006), which might dramatically affect their responses in explicit measures of risk attitudes. On the other hand, people might want to hide their propensity to take risk in domains, in which risky behavior is stigmatized (e.g. moral risk taking, antisocial risk taking, or health-threatening risk taking). Moreover, many decisions under risk are often made under time pressure or cognitive constraints (e.g. under working memory load). Therefore, more explicit and deliberative measures of risk attitudes may give misleading predictions when being used to study risk-taking behaviors in a dynamic environment. This paper proposes a new method of the implicit measurement of individual differences in attitudes toward risk that is based on the Implicit Association Test (IAT) (Greenwald and Banaji 1995) and overcomes these methodological limitations. We argue that measuring spontaneous and automatic evaluative associations with the concept of risk would help us to better understand and predict risk-taking behavior.

The problem with explicit measures of attitudes to risk lies not only in the fact that they are declarative in nature but also in that they are highly inconsistent at the intra-individual level. Slovic (1964) and then Jackson, Hourany, and Vidmar (1972) showed in their classic research that using different methods to elicit risk attitudes resulted in a low consistency in classifying the same person as a risk taker or risk avoider. Wärneryd (1996) documented that different measures of risk taking do not tend to strongly correlate with each other even within the same domain. Furthermore, explicit measures of risk attitude change across domains (Weber, Blais, and Betz 2002). People who declare that they are ready to accept even high risk in business may show themselves as risk avoiders in a personal domain, because their preferences are affected by social or cultural norms (MacCrimmon and Wehrung 1990; Shapira 1997). Hanoch, Johnson, and Wilke (2006) also showed that differences in risk taking across domains at the intra-individual level might be explained within a cost-benefit framework. Weber and Milliman (1997) have tried to challenge the methodological problems described above and introduced the concept of perceived risk attitudes (PRA). These authors argue that individual differences in risk taking might result not only from differences in risk attitudes but also from differences in risk perception (i.e. finding perceived risk as attractive or unattractive). Two individuals who differ in the sense of their risk attitudes might reveal the same level of risk taking, because their risk perception is not the same (e.g. risk avoider perceives the same risk as lower than risk lover). It has been found that the PRA is stable across life domains (Weber, Blais, and Betz 2002), gender, and nations (Weber and Hsee 1998). However, even if the concept of the PRA brings us closer to the understanding of the risk taking processes, the problems with measuring basic attitudes toward risk seem to remain unsolved.

The examples discussed above demonstrate the need to construct a new method of testing individual differences in risk attitudes that would show high cross-situational stability and independence of declarative or self-presentational arguments. We argue that the implicit-measure approach fulfills these methodological requirements by capturing automatic and spontaneous evaluative associations with risk-related concepts (Spence and Townsend 2008; Townsend, Spence, and Knowles 2014).

The idea of implicit cognition was introduced several years ago by Greenwald and Banaji (1995) to reveal and study associative information without making explicit declarations. These two authors have argued that implicit constructs such as

attitudes, stereotypes, or self-esteem can be 'introspectively unidentified (or inaccurately identified) traces of past experience' (Greenwald and Banaji 1995, 5), which might mediate a category of response (i.e. an evaluative judgment). They also assumed that associations acquired from past experience could be revealed in a present situation as a complementary response to or even completely separate from an explicit and deliberate reply. For example, conflict between our beliefs and social norms may prevent us from expressing our true opinions while filling out questionnaires or we could be not motivated enough to retrieve and express our socially negative opinions in self-reports (Nosek, Greenwald, and Banaji 2006).

A substantial amount of evidence has been recently accumulated to address the issue of predictive validity of implicit constructs (Egloff and Schmukle 2002; Greenwald et al. 2009; Maison, Greenwald, and Bruin 2004) showing that, depending on a study domain and experimental task, either an explicit or implicit component of an attitude is superior in predicting real-life behavior. One of the most important conclusions drawn from this research is that explicit attitudes direct our behavior when our cognitive resources are not depleted, whereas implicit constructs that are automatic drive the actual behavior under conditions that impair the conscious control of thought (e.g. time pressure or cognitive overload).

An important problem associated with studying the implicit component of attitudes toward risk refers to its measurement. The method that is presented in this paper was based on the IAT (Greenwald, McGhee, and Schwartz 1998) due to its stable psychometric properties (Nosek, Greenwald, and Banaji 2006) as well as the ability to measure the strength of an evaluative preference for the two target categories (i.e. risk seeking – risk avoidance in this study). The IAT is a well-tested method for the indirect measurement of the strength of association between different psychological concepts. In the typical IAT procedure, participants are asked to sort stimuli exemplars from four concept categories using two response options that are assigned to two of the four concepts. For instance, to measure implicit attitudes toward flowers, participants may be asked to discriminate between exemplars of stimuli from the categories of flowers (e.g. rose, tulip, and marigold) and insects (e.g. bee, wasp, and horsefly) and evaluative positive (e.g. family, happy, and peace) and negative (e.g. crash, rotten, and ugly) attributes. The rationale behind the IAT is that sorting is easier (i.e. faster and less erroneous) for the two concepts that share the same response option when they are strongly associated with each other than when this association is weaker. For example, implicit attitudes toward flowers would be interpreted as positive when participants' responses were faster in the case of combining pleasant words with flower names, and not with insect names. The IAT has been widely and successfully used in a number of diverse areas; nevertheless, it should be noted that some findings suggest unsolved theoretical and empirical problems (Bluemke and Friese 2006; Rothermund, Wentura, and De Houwer 2005; Steffens and Plewe 2001).

Several recent studies have attempted to apply implicit measures to understand risky behavior in such domains as: engagement in unsafe sex (Czopp et al. 2004), excessive alcohol consumption (Ostafin, Marlatt, and Greenwald 2008), nuclear power acceptance (Siegrist, Keller, and Cousin 2006), pilots' risk taking (Molesworth and Chang 2010), and gambling (Dislich et al. 2010). Although the implicit measures in these areas appeared to be reliable in testing risk propensity, they were constructed to assess domain-specific risk attitude, which is hardly applicable to other areas of risk taking. There is little evidence of reliable methods for

providing implicit measures of a more general risk attitude that can be understood as a behavioral risk-seeking or risk-aversion propensity. For example, Ronay and Kim (2006) attempted to apply the IAT that measured general attitude toward risk to investigate gender differences in risk taking. They found that the IAT was a significant predictor of risk taking in the Balloon Analogue Risk Task (Lejuez et al. 2002) and various choice dilemmas, but it surprisingly did not correlate with other explicit measures of risk seeking. This result might have been driven by the fact that the IAT construct was based in this study on stimuli exemplars related to the 'risk,' 'gain,' and 'loss' categories (but not to evaluative categories). We could argue about whether it reflected implicit evaluative associations with risk or only the strength of semantic associations between these categories. Both empirical evidence and theoretical concepts suggest that implicit attitude processes have a clear affective basis (Gawronski and Bodenhausen 2006; Spence and Townsend 2008; Stanley, Phelps, and Banaji 2008), therefore it seems important to retain this assumption while designing the IAT measure. In this paper, we propose a more general implicit measure of attitude toward risk that is strictly based on the classic approach introduced by Greenwald and Banaji (1995) and seems to include both cognitive and affective components.

The main goal of the research that is presented in the later part of the manuscript was to construct the implicit method of measuring risk attitudes and to test its reliability as well as predictive power. In this study, we construct an implicit measure toward risk that is based on the IAT. The psychometric properties of our method are tested by analyzing its relationships with both self-report measures of risk attitudes as well as real-life risky behaviors.

2. Methods

2.1. Participants

One hundred and one undergraduate students of psychology and non-students (70% females) in the age range of 20–41 ($M = 23.3$; SD = 3.6) participated in this study. Each participant gave an informed consent before the experiment. Students participated in research for credit points. Non-student participants (seven participants who graduated from various universities, $M = 34.1$; SD = 5.8) were not incentivized. Students did not differ significantly from non-students in any risk-related measure used in this study.

All materials provided to the participants were in the Polish language (i.e. participants' native language).

2.2. Measures

2.2.1. The explicit measures

Three explicit (self-report) measures were used to collect declarative data related to risk perception and risk attitudes. The order of these measures was counterbalanced.

The first method was the Stimulating-Instrumental Risk Inventory (Zaleskiewicz 2001), which consists of two scales measuring the two different risk-taking dimensions. The instrumental risk (IR) scale diagnoses a propensity to taking risk in goal-oriented situations (e.g. *To achieve something in life, one has to take risk*). High IR scores indicate a more rational approach toward risk and more sophisticated

information processing in risky situations. People high in IR accept risk when it has a clear strategic meaning, that is to say, it increases the chances of reaching an important goal. On the other hand, the stimulating risk (SR) scale measures a more impulsive and affect-driven risk taking (e.g. *I often take risk just for fun*). People high in SR perceive risk taking as a form of sensation seeking and engage in risky behaviors to experience excitement. The scale contains 17 items with a five-point response scale (from *does not describe me at all* to *describes me very well*).

The aim of the second declarative measure was to estimate people's risk attitudes in four specific domains (speeding, investing, parachuting, and gambling). Participants were faced with the above-mentioned one-word descriptions of risk taking and declared their willingness to take risk in a specific scenario using a 10-point scale ranging from *not willing to take risk at all* to *extremely willing to take risk*.

The last declarative measure was associated with answering three questions related to real-life risky behaviors: (1) Have you already started your own business or do you plan to start one? (2) Have you ever invested your money in stocks? and (3) Have you ever engaged in any extreme sport? The three questions were answered with *yes* or *no*. An affirmative answer to each of these questions was recognized as an indicator of positive attitude toward real-life risk taking.

2.2.2. The implicit measure: IAT

In this study, the typical IAT procedure was modified to assess implicit measure of attitudes toward risk, defined as the strength of associations between evaluative attributes (positive vs. negative) and target concepts (words related to risky vs. safe categories). Therefore, the IAT score is the mean difference in reaction time between the automatic evaluative associations with the risky category relative to the safe category.

In order to avoid biases related to inadequate stimuli selection for the IAT, 36 participants were asked in a preliminary study to generate all the words coming to mind that seemed to be associated with evaluative attribute categories (positive vs. negative) and target categories (risky vs. safe). As a result, 819 words were collected. After rejecting repetitions and words close or overlapping in meaning, 51 unique words that belonged to only one of the four categories were left for further consideration. Another group of participants ($N = 42$) was asked to classify each word to one of the four categories (risky, safe, positive, or negative) and rate (using a 7-point scale) the extent to which each stimulus was representative of a particular category. This procedure resulted in six prototype stimuli with the highest mean ratings of representativeness for each of the four categories. In the further analysis, mean word representativeness ratings and the average length of these words (a number of letters) were compared across these categories showing no significant differences between selected sets of stimuli (all Fs < 1). A list of stimuli used in this study can be found in online supplementary materials.

2.3. Procedure and design

In the first task, participants were asked to complete a sample of self-report questionnaires aimed at measuring willingness to take risk. The second task (IAT) involved a rapid classification of words related to the two categories: (1) risky vs. safe and (2) positive vs. negative. These two tasks were computerized and completed in a counterbalanced order. We did not find any significant order effects.

Table 1. Blocks of trials of the IAT assessing implicit measure of attitudes toward risk. In comparison with the original IAT, the number of trials in the practice blocks for complex sorting task was increased.

Block	Number of trials	Function	Stimuli assigned to the *d* key	Stimuli assigned to the *k* key
1	20	Practice	Risky	Safe
2	20	Practice	Positive	Negative
3	24	Practice	Risky or positive	Safe or negative
4	40	Test	Risky or positive	Safe or negative
5	30	Practice	Safe	Risky
6	24	Practice	Safe or positive	Risky or negative
7	40	Test	Safe or positive	Risky or negative

When solving the IAT task, participants sat approximately 50 cm from the computer screen. All word stimuli subtending approximately 1° × 5° of the visual angle were presented one by one in the center of the screen in a random order. Target and evaluative category labels of a distinct color and font type that corresponded to the word stimuli exemplars from these categories were shown on either the upper left or upper right corner of the screen. Participants, who were instructed to work as fast and accurately as possible, sorted the stimuli by pressing *d* or *k* keys on a computer keyboard assigned to the categories presented on the left and right side of the screen, respectively. An error message appeared in case of an incorrect word classification.

The IAT procedure consisted of seven blocks as presented in Table 1. In Block 1, the participants practiced sorting the stimuli between the two target concept categories: risky vs. safe. In Block 2, a similar type of sorting practice was performed using evaluative attribute categories: positive vs. negative. In Blocks 3 and 4, the participants classified all words (i.e. words from all four categories) into target concept and evaluative categories that were randomly assigned to two response options. In Block 5, target/concept labels were switched to the opposite keys. In the last two blocks (6 and 7), target concepts were assigned to the opposite evaluative category. The initial key assignment for the evaluative categories and the order of combined categorization for Blocks 3/4 and 6/7 were counterbalanced across subjects. The whole procedure was administered with the Inquisit 3 software (2012) and took approximately 20 min. Online Supplementary materials include instructions on how to reproduce the risk-IAT procedure.

3. Results

3.1. Data reduction

The *D* measure scoring algorithm originally developed by Greenwald, Nosek, and Banaji (2003) to assess the strength and valence of implicit measure was applied to analyze the reaction time data in this study. The following steps were performed in order to compute the *D* measure revealing a positive implicit attitude toward risk: (1) data from Blocks 3, 4, 6, and 7 were selected only; (2) trials with latencies over 10,000 ms were eliminated; (3) subjects whose responses in more than 10% of trials had latencies of less than 300 ms were eliminated (none of the participants were eliminated due to this criteria); (4) standard deviations were computed separately for

two pairs of blocks: Blocks 3 and 6 (the first pair), and Blocks 4 and 7 (the second pair); (5) means for trials in Blocks 3, 4, 6, and 7 were computed separately; (6) two difference scores (one between means from Blocks 3 and 6, and another between means from Blocks 4 and 7) were computed; (7) each difference score from Step 6 was divided by the corresponding standard deviation calculated in Step 4; and (8) two quotients from Step 7 were averaged, resulting in the *D* measure. Higher *D* values indicate a stronger association between positive concepts and risky concepts and, consistently, a more positive implicit measure of risk attitude. In this study, participants revealed negative implicit risk attitude ($M = -1.01$; SD = .24). That is, they categorized negative and risk-related words faster than positive and risk-related words.

3.2. Test–retest and internal reliability of the IAT

Sixteen randomly chosen participants were invited to take part in the test–retest procedure to examine the reliability of the implicit measure. The retest took place seven days after the test study. Pearson r coefficient for the IAT test–retest score was $r(15) = .63$, $p = .004$. Additional analyses conducted to mitigate small sample confounds showed similar results: Spearman's $r_s(15) = .62$, $p = .005$ and bootstrapped (based on 1000 samples) $r = .63$, $p = .009$, 95% CI [.15, .80].

Internal reliability was calculated on the whole set of data (101 participants) using an odd–even split-half procedure. The *D* score for each participant computed on odd trials was correlated applying the Spearman–Brown correction with the *D* score from an equal number of even trials. Results showed high internal consistency of .86 for the risk-related IAT score.

3.3. The relationship between implicit and explicit measures

To assess the relationship between the IAT score and explicit measures, a series of correlation analyses with self-report variables were performed. Results showed that a positive implicit risk attitude was moderately and significantly related to the individual level of SR taking, $r(100) = .197$, $p = .024$, whereas analogical association with IR taking was not found, $r(100) = .123$, $p = .110$, which was consistent with our expectations. Moreover, this structure of relations between implicit risk attitude and the two risk scales was replicated in the retest study: The IAT score was positively related to SR, $r(15) = .43$, $p = .048$, whereas the similar relationship with IR taking did not reach the level of significance, $p = .458$.

The further analysis was aimed at investigating the relationships between self-report measures of willingness to engage in four risky behaviors (speeding, investing, parachuting, and gambling) and the implicit measure of risk attitudes. We found that the *D* score correlated positively with the willingness to take the risk of speeding, $r(100) = .208$, $p = .018$, gambling, $r(100) = .180$, $p = .036$, and parachuting, $r(100) = .165$, $p = .050$. Marginally, significant correlation between the *D* measure and the perception of a more deliberative form of risk (i.e. investing) was found, $r(100) = .155$, $p = .061$.

In the next step of the analysis, a series of hierarchical logistic regressions were conducted to predict declared real-life risk taking in three domains: engagement in extreme sports, investing in stocks, and running your own business. Three regression analyses were carried out separately for each dependent variable. Dependent

variables were coded as 0 or 1, where 1 indicated *risk taking* and 0 pointed to *risk avoidance*. Self-report (IR and SR) as well as implicit (IAT *D*) measures served as predictors. The IAT score was introduced in the second step in every model (Table 2).

In line with our hypotheses, SR (but not IR) significantly predicted engagement in extreme sports (OR = 1.13, R^2 = 21%). When the IAT measure (OR = 9.06) was entered into the model in the second step, all predictors accounted for R^2 = 26% of the DV variance, $\chi^2(1) = 4.69$, $p = .030$. The findings suggest that a positive implicit attitude toward risk motivates people to take risks associated with threat-rich sports and allows us to predict this behavior more efficiently. In the case of the second regression analysis, only IR significantly predicted risky behavior associated with investing in stocks (OR = 1.25). Similarly, the IAT score significantly increased R^2 of the model by 7%, $\chi^2(1) = 4.17$, $p = .041$. The IAT score was the strongest predictor of investing in stocks (OR = 10.41) in the final model. The last regression analysis was carried out to identify predictors of risk taking associated with running one's own business. Contrary to results described above, but in accordance with our expectations, the measure of implicit attitudes toward risk did not improve the final model in this case, $\chi^2(1) = .07$, $p = .793$. Neither SR nor the IAT score were significant predictors of this dependent variable. Only IR significantly increased the likelihood of a risky behavior in this domain (OR = 1.23).

Table 2. Hierarchical logistic regression analyses predicting risky behavior in real-life situations (N = 101).

	Predictor	*b*	SE	Wald	OR (95% CI)	χ^2 model fit	R^2	$\Delta\chi^2$
Regression A: Engaging in extreme sport as DV								
Step 1						$\chi^2(2) = 16.62$***	.21	
	SR	.13	.05	7.56*	1.13 (1.04–1.24)			
	IR	.11	.08	2.27	1.12 (.97–1.29)			
Step 2						$\chi^2(3) = 21.31$***	.26	$\chi^2(1) = 4.69$*
	IAT	2.20	1.04	4.53**	9.06 (1.19–68.92)			
Regression B: Investing in stocks as DV								
Step 1						$\chi^2(2) = 7.19$*	.11	
	SR	−.07	.05	1.77	.93 (.84–1.03)			
	IR	.22	.09	6.58*	1.25 (1.05–1.48)			
Step 2						$\chi^2(3) = 11.37$*	.18	$\chi^2(1) = 4.17$*
	IAT	2.34	1.16	4.05*	10.40 (1.06–101.81)			
Regression C: Running a business as DV								
Step 1						$\chi^2(2) = 10.09$**	.13	
	SR	−.01	.04	.02	1.01 (.92–1.09)			
	IR	.21	.08	7.56**	1.23 (1.06–1.42)			
Step 2						$\chi^2(3) = 10.16$	.13	$\chi^2(1) = .07$
	IAT	−.25	.93	.07	.79 (.13–.78)			

Notes: SR – stimulating risk, IR – instrumental risk, IAT – Implicit Association Test (*D* measure), *b* – unstandardized beta coefficient, SE – standard error of *b*, OR – odds ratio with 95% confidence intervals (relatively high values of OR for IAT are driven by *D* measure scoring algorithm), χ^2 – model fit, R^2 – Nagelkerke's R^2, $\Delta\chi^2$ – change in model fit due to the implicit measure inclusion.
*$p < .05$; **$p < .01$; ***$p < .001$.

4. Discussion

The main goal of this paper was to propose a new implicit measure of attitudes toward risk and to demonstrate preliminary tests of its reliability and predictive power. The main reason for measuring attitudes toward risk in an indirect way was to avoid the effects of self-presentation that may impair the value of declarative, explicit measures and to capture the impulsive and automatic character of real-life risky behaviors. However, to our knowledge, no method has been developed so far that could be used to measure domain- and context-independent attitudes toward risk. Previous studies on implicit attitudes toward risk focused only on the specific risk-related fields. The method that is proposed in this paper seems to cover different domains and behaviors.

The general problem that ought to be analyzed before discussing results of the empirical project refers to the nature of the theoretical construct that is measured with our implicit test. We argue that it covers the most basic ('pure') attitude toward risk or 'ideal point for risk' to use the term proposed by Coombs (1975) and later by Weber (2001). The Risk-IAT method allows to track people's spontaneous, affective (positive or negative) and very general associations with concepts related to risk or safety. It is assumed that these associations are formed automatically and without conscious control. Therefore, we argue that implicit attitude toward risk reflects people's context-free and even instinctive reactions to risk (similarly to the psychological mechanism of sensation seeking rooted in neurophysiological bases; Zuckerman 2007). The implicit risk attitude impacts further perception of the riskiness level and determines the risk-taking propensity.

Proposed risk-related IAT that was used in the present research project represented both reliability and validity that are comparable to those found in other studies on implicit cognition (Schmukle and Egloff 2004). Previous results have revealed a moderate or even weak relationship between explicit and implicit measures with the implicit–explicit correlation coefficients ranging from .24 to .34 (Hofmann et al. 2005). We found that the IAT score was significantly related to the SR scale, which represents people's tendency to interpret risk taking in terms of sensation seeking (Zaleskiewicz 2001). However, no correlation was found with the IR scale that represents interpreting risk in a more rational and goal-oriented way. These results are consistent with our theoretical assumptions because SR is determined by basic personality traits and indicates a more spontaneous approach toward risky behavior. In this sense, SR taking seems to be very similar to the automatic and uncontrollable nature of implicit attitudes. On the other hand, IR taking is more deliberative and situation-dependent which makes it more suitable and relevant to declarative measures. A similar pattern of results was found when the IAT indicator was correlated with different declarative measures of willingness to take risk. A positive implicit attitude toward risk was significantly related to perceiving the risk of gambling, parachuting, and speeding, which represent a more basic and pleasure-oriented form of risk. A marginal correlation was found between implicit risk attitudes and the perception of investment risk. If we assume that investing is associated with the need to process information in a more conscious and deliberative way, it is not surprising that thinking about this activity is not strongly related to implicit, unconscious, and uncontrollable attitudes toward risk. On the other hand, this result can be explained by the fact that explicit and implicit attitudes are often interpreted as distinctive and separate constructs (Greenwald and Banaji 1995). Under some

conditions, implicit measures may be suppressed and actively controlled by deliberative processes. We argue that examining universal principles of the implicit–explicit interplay is the next important issue in studying risk attitudes.

The final verification of the implicit measure of risk was the test of its predictive power. If the implicit measure reflects a more basic disposition concerning risk than the explicit measure, it should better predict real-life behaviors. Results of several regression analyses showed that adding the implicit measure to the set of independent variables improved the model in two cases: predicting people's risky investment behavior (i.e. buying stocks) and predicting their engagement in different extreme sports. Such results suggest that the IAT measure is indeed a separate and important determinant of real-life risky behaviors that has clear theoretical and practical consequences. Researchers who test theories representing the relationship between risk attitude and risk taking should take into account not only declarative but also implicit measures to obtain a more valid model.

The present paper documents the results of a study that ought to be seen as a preliminary attempt to understand and examine the implicit measurement of risk attitudes. Further studies are required to test this new but very promising methodological approach. First of all, an effort should be made to narrowly investigate and understand the underpinning psychological processes responsible for the origins of implicit risk attitude, that is, how and when are they formed. Greenwald and Banaji (1995) defined implicit attitudes as 'traces of past experience.' It suggests that implicit attitudes are formed along with the process of socialization and we should be able to study them even among children and teenagers.

Secondly, the problem of the generality of proposed implicit measure among different domains seems to be worth studying in a more detailed way. For example, in what areas are implicit measures better predictors of behavior than explicit ones? In other words, to what extent can general implicit attitudes toward risk help us understand risk taking processes in a variety of domains? One aspect that seems to be worth studying in the future in the context of domain-specificity is the interpretation of risk taking as a stigmatized behavior (i.e. behavior that is disapproved by others). Swanson, Rudman, and Greenwald (2001) showed in their research that explicit attitudes were highly and positively correlated with implicit attitudes but only for non-stigmatized behaviors (related to dietary preferences). In the case of stigmatized behavior (smoking), the relation between explicit and implicit measures was much weaker. Risk taking in some specific domains might be seen as morally or socially disapproved behavior (e.g. having sex with unknown partners, engaging in tax evasion, or cheating on an exam). In this case, the implicit measure of attitudes toward risk might be a more powerful predictor of real behaviors than explicit ones what seems to be important not only form the theoretical but also from the practical point of view.

Finally, several previous studies that used declarative willingness to take risk as a predictor of risky behavior might be replicated using the implicit measurement approach, which could provide new insights into the results that have been collected so far.

Supplementary material

The supplementary material for this paper is available online at http://dx.doi.10.1080/13669877.2014.1003957.

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