Applying the Implicit Association Test to Measure Intolerance of Uncertainty

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Abstract
Intolerance of Uncertainty (IU) is a key trans-diagnostic personality construct strongly associated with anxiety symptoms. Traditionally, IU is measured through self-report measures that are prone to bias effects due to impression management concerns and introspective difficulties. Moreover, self-report scales are not able to intercept the automatic associations that are assumed to be main determinants of several spontaneous responses (e.g., emotional reactions). In order to overcome these limitations, the Implicit Association Test (IAT) was applied to measure IU, with a particular focus on reliability and criterion validity issues. The IU-IAT and the Intolerance of Uncertainty Inventory (IUI) were administered to an undergraduate student sample (54 females and 10 males) with a mean age of 23 years ($SD = 1.7$). Successively, participants were asked to provide an individually chosen uncertain event from their own lives that may occur in the future and were requested to identify a number of potential negative consequences of it. Participants' responses in terms of cognitive thoughts (i.e., cognitive appraisal) and worry reactions toward these events were assessed using the two subscales of the Worry and Intolerance of Uncertainty Beliefs Questionnaire. The IU-IAT showed an adequate level of internal consistency and a not significant correlation with the IUI. A path analysis model, accounting for 35% of event-related worry, revealed that IUI had a significant indirect effect on the dependent variable through event-related IU thoughts. By contrast, as expected, IU-IAT predicted event-related worry independently from IU thoughts. In accordance with dual models of social cognition, these findings suggest that IU can

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influence event-related worry through two different processing pathways (automatic vs. deliberative), supporting the criterion and construct validity of the IU-IAT. The potential role of the IU-IAT for clinical applications was discussed.

Keywords
Intolerance of Uncertainty, worry, Implicit Association Test, automatic vs. deliberative processes

Introduction

Intolerance of Uncertainty: Construct definition and its measurement

Intolerance of Uncertainty (IU) has a relatively long history as a personality construct. Freeston, Rheaume, Letarte, Dugas, and Ladouceur (1994) first defined the term as the way that people typically perceive information in uncertain situations and respond to uncertain stimuli through a set of cognitive, emotional, and behavioral reactions. Uncertain situations are conditions in which both the outcomes and probabilities, or at least the probabilities associate with an outcome, are unknown or cannot be expressed with any mathematical precision (cf. Meder, Le Lec, & Osman, 2013; Volz & Gigerenzer, 2012). In the Intolerance of Uncertainty Model (IUM; Dugas, Gagnon, Ladouceur, & Freeston, 1998; Dugas & Robichaud, 2007; Einstein, 2014), IU was described as an essential feature of anxiety disorders. According to this model, individuals with Generalized Anxiety Disorder perceive uncertain or ambiguous situations as "stressful and upsetting" (Koerner & Dugas, 2006, p. 62), as well as "threatening" for their life (Lovibond, 2006). In this model, IU serves to set off the chain of chronic worrying, negative problem orientation, and cognitive avoidance.

Originating from clinical observations, the construct's definition has been inconsistent in early formulations; however, it has received more refined conceptualizations over time. For instance, Ladouceur, Gosselin, and Dugas (2000) redefined IU as a disposition to react negatively to uncertain events, no matter how unlikely they actually are. Likewise, the extent to which one considers uncertainty as unacceptable has become part of later definitions (Dugas, Gosselin, & Ladouceur, 2001). Subsequently, other researchers have suggested that IU is a "cognitive filter," biasing one's appraisal of uncertain events (Buhr & Dugas, 2002). Lately, scholars have focused on appraisal reactions that reflect individual differences on the IU trait, such as attaching a negative emotional valence to surprises or ascertaining uncertainty about future events as unfair (Dugas, Marchand, & Ladouceur, 2005).

Clinical interest in IU has motivated the development of self-report scales. The Intolerance of Uncertainty Scale (IUS-27: Freeston et al., 1994) is the most widely used instrument, although no agreement exists on its factorial structure

(Birrell, Meares, Wilkinson, & Freeston, 2011). For instance, different authors have reported either four- or five-factor solutions for the English and the French scale version, respectively (Buhr & Dugas, 2002; Freeston et al., 1994). In an effort to improve the internal structure of the test and to optimize scale internal consistency, Carleton, Norton, and Asmundson (2007) developed a 12-item version of the IUS that has yielded a replicable, two-factor structure along with better psychometric properties. Notwithstanding, due to the evolving definition of IU, recent literature has suggested that both IUS-27 and IUS-12 lack of content validity. For instance, one's tendency to consider uncertainty as unacceptable is not included in any item, despite being a key feature of current definitions of IU (Maack, Deacon, & Abramovitz, 2005).

As an alternative to IUS scales, the recently developed Intolerance of Uncertainty Inventory (IUI: Carleton, Gosselin, & Asmundson, 2010) comprised two distinct sets of items, providing separate assessment for IU core beliefs (Part A) and for the consequences of being uncertain (Part B). IUI-A better fits the current IU definition and yields a single factor, while Part B items have a multidimensional structure that reflects the behavioral manifestations of IU (Carleton et al., 2010).

However, it should be noted that self-report scales are prone to potential sources of bias, such as impression management concerns, difficulties to translate mental contents into a propositional format, and awareness limits that could impair mental introspection (Nosek, Hawkins, & Frazier, 2011).

Dual-processes models and Implicit Association Test

Dual-process models

To overcome the limitations of self-report measures, several experimental paradigms were developed in order to measure implicitly various psychological constructs within the wide framework of dual-process theory of social cognition (e.g., Smith & DeCoster, 2000; Strack & Deutsch, 2004). According to the latter perspective, the realm of social cognition can be divided into automatic vs. controlled processes. In general, the automatic evaluations are described as unintentional, unaware, spontaneous, associative, and requiring little cognitive effort; whereas controlled evaluations are deemed intentional, aware, deliberative, propositional, and requiring high levels of attention. In this perspective, the automatic associations are conceived as simple mnemonic links between specific target categories and specific attributes which can be activated without deliberative effort (Gawronski & Bodenhausen, 2006). On the contrary, the explicit evaluations are conceived as propositional judgments (Gawronski & Creighton, 2013) based on reflexive processes (Strack & Deutch, 2004) and strictly linked to a logical "truth" value.

A dual-process framework for emotional disorders

Various authors (e.g., Beevers, 2005; Brewin, Dalgleish, & Joseph, 1996; Haeffel et al., 2007; Wiers et al., 2007) used the dual-system models to provide an integrative and parsimonious framework to investigate the implicit and explicit processes involved in emotional disorders. In particular, the core assumptions of such models have already been incorporated into cognitive theories of depression (Beevers, 2005; Haeffel et al., 2007), posttraumatic stress disorder (Brewin et al., 1996), addiction (Wiers et al., 2007), and anxiety disorders (Ouimet, Gawronski, & Dozois, 2009). All these theories have their own specific features depending on the automatic associations under investigation. As an example, we will briefly describe the dual-process model of cognitive vulnerability to depression (Beevers, 2005; Haeffel et al., 2007). This model focuses on the interaction processes that occur between implicit and explicit self-evaluations and on their consequences in terms of vulnerability to depression. Negatively biased associations toward the self are considered as the main factors determining cognitive vulnerability to depression. However, automatic negative thoughts can be corrected by reflective judgments, at least when cognitive resources and motivation are sufficient. In this line of reasoning, a cognitive vulnerability to depression can be easily detected when reflective processing is impaired totally or partially by a competing task, time pressure, or life stress.

In line with these premises, dual models may be applied also to provide a theoretical framework to explain the relationship between implicit and explicit measures of IU and anxiety symptoms, such as pathological worry.

Measuring automatic associations: The Implicit Association Test

From this dual-process perspective, implicit measures permit to evaluate the automatic associations toward a target object, while explicit measures permit to evaluate both propositional knowledge and propositional judgments about it (Strack & Deutsch, 2004). An implicit measure is defined as "a measurement outcome that is causally produced by the to-be-measured attribute in the absence of certain goals, awareness, substantial cognitive resources, or substantial time" (De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009, p. 350). Among these measures, the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) is a computer-administered task devoted to measure the strength of automatic mental associations between two opposing target concepts (i.e., Certainty vs. Uncertainty) and two opposing attributes (i.e., Tolerable vs. Intolerable). In each trial, participants are instructed to categorize a stimulus (e.g., a word or an image) as quickly and accurately as possible into the two possible target categories and the two possible attributes (Greenwald et al., 1998). In a first combined block, the two target categories and the two attributes are associated with a certain associative pattern (e.g., Certainty-Tolerable vs. Uncertainty-Intolerable). In a second combined block, the location

of the target categories is switched with an inversion of the associative pattern (e.g., Uncertainty-Tolerable vs. Certainty-Intolerable). A measure of the investigated implicit associations can be obtained computing the difference between the mean latencies of the first and the second combined block. Several studies showed that the IAT can be used successfully to assess attitudes, stereotypes, self-esteem, and personality traits, showing a less proneness to impression management concerns than self-report measures and an adequate criterion validity (e.g., Greenwald, Poehlman, Uhlmann, & Banaji, 2009). Different IATs were also developed to assess clinical phenomena such as depression (Gemar, Segal, Sagrati, & Kennedy, 2001), anxiety (see De Houwer, 2002, for an overview), or addiction (Dickes, Schmukle, Luka-Krausgrill, & Egloff, 2004), providing evidence for their validity.

The IAT usually showed weak associations with the corresponding self-report measures ($r_{mean} = .21$; see Greenwald et al., 2009). However, these correlations varied widely depending on the topic of the study. For instance, the highest and the lowest implicit–explicit correlations were found for political attitudes ($r_{mean} = .54$) and for close relationships ($r_{mean} = .09$) domains, respectively. When the IAT was used to measure personality traits, low correlations were usually found ($r_{mean} = .17$). Such variety of findings spurred several studies (Greenwald & Nosek, 2008; Nosek & Smyth, 2007) aimed at clarifying whether the implicit and explicit measures should be conceived as indicators of the same construct, or alternatively as indicators of distinct, yet related, constructs. For instance, Greenwald and Nosek (2008) examined the results of a 10,000 participants study and showed apparent dissociations in terms of (a) weak correlations between implicit and explicit measures; (b) separation of implicit–explicit means on scales structurally and substantively similar; and (c) significant differences between implicit-criteria and explicit-criteria correlations. Considering these three types of dissociation, Greenwald and Nosek (2008) concluded that implicit and explicit measures indicate different constructs. In a similar line, using a multitrait–multimethod approach across seven-attitude objects (flower–insect, creation–evolution, democrat–republican, humanities–science, straight–gay, thin–fat, and white–black), Nosek and Smyth (2007) demonstrated that implicit and explicit measures refer to distinct, though related, constructs. Consistently with this view, self-report measures are usually efficient predictors of behaviors under deliberate control, while IAT measures usually efficient predictors of behaviors and emotional responses beyond deliberative control (Perugini, Richetin, & Zogmaister, 2010).

The current study

The present study aims to exploring whether the IAT can be used to assess the IU trait (IU-IAT), with a particular focus on reliability and criterion validity issues. Regarding the first point, a split-half procedure was used to evaluate the internal consistency of the IU-IAT. Referring to the second point, adapting the

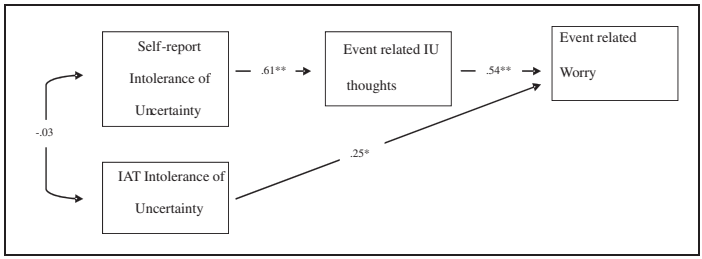

Figure 1. Path analysis model. Path diagram describing the automatic and deliberative pathways that are able to activate worry for a future and uncertain life event ($N = 60$). *$P < .05$, **$P < .01$.

IUM (Dugas et al., 1998; Dugas & Robichaud, 2007; Einstein, 2014), worry about a future life event was used as a criterion, in an augmented model that included not only self-report measures but also implicit measures of IU as predictors. In particular, as illustrated in Figure 1, this augmented model assumes that two different pathways are able to influence worry: (1) in a first deliberative processing pathway, and in accordance with the above mentioned IUM model, a significant relationship between explicit trait IU and worry toward a future life event is hypothesized. Moreover, this relationship is expected to be mediated by the self-report evaluations (i.e., explicit appraisal) toward this potential uncertain situation; (2) in a second automatic processing pathway, and in accordance with the dual-process models, a direct relationship is expected between the IU-IAT and situation-specific worry that should not be mediated by the explicit appraisal. Moreover, this relationship should not change when the other variables are controlled for. In accordance with the aims of the present study, if these expected relationships are confirmed, the criterion and construct validity of the IU-IAT would be empirically supported.

Method

Participants

Sixty-four undergraduate psychology students enrolled at the Sapienza University of Rome and attending a Health Psychology course (84.4% females; M age $= 23.0$, $SD = 1.7$), participated to a single-session study in exchange for course credits. The study was approved by the ethical committee of the Department of Social and Developmental Psychology, at the Sapienza University of Rome.

Measures

IUI (Carleton et al., 2010). The IUI-A was back-translated into Italian by the first and the third author for use in the current study. Its 15 items (i.e., "I have

difficulty accepting that the future is uncertain"; "Not knowing what will happen in advance is often unacceptable for me") were rated on a five-point scale ranging from 1 (*Not at all characteristic of me*) to 5 (*Entirely characteristic of me*). The total score ($\alpha = .94$) represents trait IU.

Worry and Intolerance of Uncertainty Beliefs Questionnaire (Q-III; Grenier & Ladouceur, 2004). This is a scale specifically developed to assess transient fluctuations in event-related IU thoughts and event-related-worry. It included nine items, each of which require participants to specify a number, from 0 (*Not at all*) to 12 (*Extremely*), which reflects their degree of agreement, in empty blanks. In this study, we used a more standard Likert-type scale beside each item, from 0 (*I totally disagree with the item*) to 12 (*I totally agree with the item*). Two items (i.e., Item 1: "When I think that the negative events mentioned above may indeed occur I consider this possibility acceptable" and Item 4: "The experimenter is able to assure me 100% that the negative events mentioned above will never occur") were removed, as the first showed close to zero variance in a pilot administration conducted before the study, while the second was a control indicator not relevant for the present study. The Q-III administered in this study was therefore composed by seven items, four of which assessed the agreement with a series of IU thoughts (i.e., the cognitive appraisal) toward a future negative event (e.g., "I agree with the following statement: I always want to know what my future sets aside for me"), while the other three assessed event-related worry (e.g., "I think that the negative events mentioned above worry me").

Uncertainty Intolerance IAT. Participants were asked to sort, as quickly as possible, a series of words-stimuli (presented sequentially in the center of a computer screen) into four different categories located on the left and right side of the monitor by pressing the "e" key if the word belonged to the category located on the left and the "i" key if the word belonged to the category on the right. In particular, the IU-IAT, opposing certainty vs. uncertainty as target categories and tolerable vs. intolerable as attribute categories (Table 1), was developed following Greenwald et al. (1998) procedures. Participants were requested to perform a series of categorization tasks with five stimuli words for each category (see Table 1 for English translation). The words were presented in random order within each block of trials. The following sequence of blocks was used: a single-target categorization task (certainty vs. uncertainty, 20 trials), a single-attribute categorization task (tolerable vs. intolerable, 20 trials), an initial combined categorization task (certainty or tolerable vs. uncertainty or intolerable, two sub-blocks of 40 trials), a single-target categorization task reversed (uncertainty vs. certainty, 40 trials), and a second combined categorization task (e.g., certainty or intolerable vs. uncertainty or tolerable; two sub-blocks of 40 trials). The order of the two combined blocks was counterbalanced across participants. Words were presented in a random order within each block of trials. No order effects of the combined blocks were found.

Table 1. Target and attribute stimuli used for the IU-IAT.

Certainty	**Tolerable**
Warranty	Tranquilizing
Security	Desirable
Predictability	Hoped
Reliability	Relaxing
Certainty	Comfortable
Uncertainty	**Intolerable**
Insecurity	Unacceptable
Doubt	Unjustifiable
Ambiguity	Unsustainable
Unexpected	Inadmissible
Uncertainty	Unbearable

Data from the combined blocks were used to compute *D* scores, according to the built-in error penalty procedure (Greenwald, Nosek, & Banaji, 2003, p. 213). *D* is computed as the difference between the mean response latencies of the incompatible blocks (i.e., Uncertainty and Tolerable *vs*. Certainty and Intolerable) and the mean response latencies of the compatible blocks (Uncertainty and Intolerable *vs*. Certainty and Tolerable) divided by the "inclusive" standard deviation of participants' response latencies in the two combined tasks. Since intolerant of uncertainty people typically assign negative valence to uncertainty (Carleton, 2012), they were expected to respond faster to the compatible combination (Uncertainty and Intolerable *vs*. Certainty and Tolerable) than to the incompatible combination (Uncertainty and Tolerable *vs*. Certainty and Intolerable). Since mean latencies of the incompatible blocks (Uncertainty and Tolerable vs. Certainty and Intolerable) are subtracted from mean latencies of the compatible blocks (Uncertainty and Intolerable *vs*. Certainty and Tolerable), a larger positive *D* score indicates a less favorable implicit attitude toward uncertainty and thus higher scores indicate higher IU.

Procedure

The study was conducted in the Social Laboratory of the Faculty of Medicine and Psychology, at the Sapienza University of Rome. First, participants completed a self-report questionnaire devoted to measure trait IU (The Intolerance of Uncertainty Index part A; IUI), and then they took the IU-IAT. Upon completion, participants were asked to provide an idiosyncratic event from their own lives that might occur in the future (e.g., failing an exam). Then, participants were asked to fill in a form purposefully developed to elicitate an idiosyncratic event from their own life. In particular, a box allowed each participant to write

down a future outcome that might have potential consequences for him or her in the future. Then, the box was connected via downward arrows to three smaller boxes, each of which could be filled in with the potentially consequences, if that event occurred. Next, each of the three boxes was subsequently connected via downward arrows to other boxes, each of which could be filled with a new potential consequence, if any of the aforementioned consequences occurred. After completing the form, participants' responses in terms of cognitive thoughts (i.e., cognitive appraisal) and worry reactions toward specific uncertain events were assessed using the two subscales of the Q-III (Grenier & Ladoucer, 2004; see also Mosca, Lauriola, & Carleton, 2016).

Data analysis

A split-half reliability procedure was applied to estimate the internal consistency of the IU-IAT, using two test halves that were computed using Blocks 3–6 and Blocks 4–7 separately. As illustrated in Figure 1, and in accordance with other dual models of emotional disorders (e.g., Beevers, 2005), a path analysis was carried out including the IU-IAT and IUI as predictors, a measure of participants' cognitive evaluations toward a future uncertain event (i.e., cognitive appraisal) as a mediator and the event-related worry as a criterion. In accordance with the IUM model, the IUI was expected to show an indirect effect on event-related worry with the mediation of the cognitive appraisal of that event. On the contrary, in accordance with the dual-process model, the IU-IAT was expected to show a direct effect on event-related worry not mediated by the cognitive appraisal of the uncertain event. Moreover, this relationship should remain significant also when the other variables are controlled for. M-PLUS was used for the analyses (Muthen & Muthen, 1999). Importantly, as Hoyle and Kenny (1999) pointed out, parsimonious models with few parameters, like in the present study, can be safely estimated even with small sample sizes (e.g., $N < 100$). In order to evaluate the fit of the model, the following indices and cut-off values were considered (Byrne, 2006; Kline, 2011; Hu & Bentler, 1999; Tabachnick & Fidell, 2007): (1) χ^2 (values should not be significant); (2) Comparative Fit Index (CFI; values must be greater than .90, with ideals approaching or greater than .95); (3) the Standardized Root Mean Square Residual (SRMR; values must be less than .10, with ideals approaching or less than .05); and (4) Root Mean Square Error of Approximation (RMSEA; values must be less than .08, with ideals approaching or less than .05, with 90% confidence interval values below .10).

Results

As illustrated in Table 2, skewness and kurtosis were in the ± 1 range, showing that distributions were approximately normal. IUI showed an optimal level of

Table 2. Descriptive statistics for all variables in the study and zero-order correlations.

						Zero-order correlations			
Variables	M	SD	Sk	K	IC	IU-IAT	Trait IU	IU-T	WO
IU-IAT	1.11	.24	−.80	.77	.70				
Trait IU	2.74	.63	.31	.07	.96	.01			
Event-related IU thoughts (IU-T)	6.37	1.54	.20	.14	.78	.10	.59**		
Event-related worry (WO)	8.17	2.03	−.30	−.65	.57	.30*	.47**	.56**	

Note. Sk: univariate skewness; K: univariate kurtosis; IC: internal consistency.
*$p < .05$, **$p < .01$.

Cronbach's α while event-related IU thoughts and event-related worry exhibited alphas in line with the expected values for short scales as well as an adequate level of test–retest correlation ($r_{tt} = .83$ and $r_{tt} = .73$, respectively) calculated on observations separated by an interval of two weeks. Split-half reliability assessed for the IAT score was adequate. Zero-order correlations of large size emerged among IU trait, event-related IU thoughts, and event-related worry. In accordance with the correlations usually found between IAT and self-report personality traits (see the meta-analysis of Greenwald et al., 2009 cited in the introduction), implicit and explicit IU scores were not significantly related. However, IU-IAT was significantly related to event-related worry.

To test whether implicit and explicit IU measures were related to event-related worry through different pathways, we analyzed the model shown in Figure 1. The model had a good fit with the data, $\chi^2(2) = 2.11$, $p = .35$; CFI = .99; RMSEA = .03; SRMR = .045, and accounted for the 35% of event-related worry. Results showed a significant effect of IUI on event-related IU thoughts along with a significant indirect effect on event-related worry (indirect effect = .33, $p < .001$). Furthermore, scores for the IU-IAT had a significant direct effect on event-related worry. Alternative models were also tested. In a first alternative model, a direct path from IU-IAT to event-related IU thoughts was added to test whether cognitive evaluations mediated also the relationship of implicit IU assessment with worry. The alternative model did not improve fit indices significantly, $\Delta\chi^2(1) = 1.35$, $p = .24$, suggesting that a direct effect for IU-IAT was sufficient to account for the association between the implicit measure and the criterion . Likewise, a second alternative model that added the direct effect of IUI on event-related worry did not improve the fit significantly, $\Delta\chi^2(1) = 0.73$, $p = .39$. Based on the latter findings, we ruled out these alternative models as the model embodying our hypotheses was the most parsimonious and provided a similar fit to the data compared with the alternative, less parsimonious, models. Results were consistent with expectations, suggesting that there

were two independent pathways leading to event-related worry, based on deliberative and automatic processes.

Discussion

The present study investigated the reliability and criterion validity of the IU-IAT. Results showed a satisfactory of reliability in terms of internal consistency using a Spearman–Brown corrected split-half correlation. We found also a nonsignificant correlation with a self-report measure of trait IU, which is consistent with the implicit–explicit associations usually found in personality traits research (e.g., Greenwald et al., 2009). As argued in several studies (e.g., Hofmann, Gawronski, Gschwendner, Le, & Schitt, 2005), these low implicit–explicit correlations can be due to various factors, such as the proneness to social desirability of the self-report measures, a lack of introspection ability, method-related characteristics, or independence of the underlying constructs.

In order to test the criterion and construct validity of the IU-IAT, a model assuming two different IU pathways (automatic vs. deliberative) in the activation of event-related worry was tested (Figure 1). As expected, results showed that self-report IU predicted event-related worry only through event-related IU thoughts (i.e., a cognitive and deliberative appraisal process), while IU-IAT had only a direct effect on worry. Such direct effect appears consistent with an automatic process. These findings lend preliminary support for the criterion and construct validity of the measure. Results are also consistent with a recent application of the dual models (e.g., Gawronski & Creighton, 2013) as a theoretical tool to frame emotional disorders. In particular, these applications investigated the interaction between automatic and controlled evaluations as determinants of the cognitive vulnerability to depression (Beevers, 2005; Haeffel et al., 2007), to anxiety (Ouimet et al., 2009), to posttraumatic stress disorder (Brewin et al., 1996), and to addiction (Wiers et al., 2007). For instance, as illustrated in the introduction, negative self-associations are assumed to be the main factors determining cognitive vulnerability to depression. However, when cognitive resources and motivation are sufficient, automatic negative thoughts can be corrected by reflective judgments. Conversely, when sufficient cognitive and motivational resources are not available, the automatic depressive thoughts become dominant, facilitating the insurgence of different types of depression symptoms. In line with this theoretical framework, adapting the Beevers' model of depression, it may be possible that implicit IU associations are relevant determinants of different types of anxiety symptoms, and that they facilitate the insurgence of pathological worry, especially when mental resources are low.

Accordingly, adapting the IAT to assess for implicit aspects of IU may provide important information for clinicians and researchers. The evaluation of the implicit facet of IU would facilitate trans-diagnostic assessment, treatment

efficacy monitoring, and basic research by extending measurement beyond explicit self-report tools (De Houwer, 2002). The implicit tool could be also used to measure changes across treatment in response to therapeutic interventions because it is generally accepted among cognitive therapists that various forms of psychopathology crucially depend on the existence of dysfunctional beliefs or cognitive structures (e.g., Beck, 1976). These beliefs are often described as being implicit in the sense that patients might not be aware of having them and/or that they can influence behavior in an automatic manner. Given the central role of dysfunctional beliefs in cognitive therapy, therapists and researchers should have tools that can be used to assess also the implicit level of beliefs (De Houwer, 2002).

Some limitations should be acknowledged. First, the unbalanced gender distribution may limit generalizability of results. Second, the small sample could have provided low statistical power for hypothesis testing. Notwithstanding this limitation, the effects exceeded the conventional significance thresholds handsomely. Third, event-related worry has been assessed only through self-report measures and its reliability was low. It is worth noting that impression management and lack of introspective ability could have been affected not only IU self-report measures but also worry ones. Follow-up studies, using physiological indicators for event-related worry (e.g., electro-dermal activity or heart rate variability), may allow to test a (partial or total) double dissociation pattern of prediction (e.g., Perugini et al., 2010), assuming that the implicit measure better predicts spontaneous responses (e.g., physiological indicators) and, on the contrary, explicit measures predict better deliberative responses (self-report assessment of event-related worry). Notwithstanding limitations, the findings support the validity of the IU-IAT, which may become a useful assessment tool to investigate automatic processes related to IU and worry activation.

Authors' contribution

OM and ML developed the theoretical framework. OM and FD elaborated the research hypotheses, devised the methodological content, and collected and analyzed the data. LL conferred with other authors about data analysis and theoretical framework. The final version of the manuscript was written by ML, OM, FD, and LL.

Declaration of Conflicting Interests

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