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The role of urgency and its underlying psychological mechanisms in problematic behaviours

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ABSTRACT

The urgency facet of impulsivity, that is, the tendency to act rashly in response to intense emotional contexts [Cyders, M. A., & Smith, G. T. (2008). Emotion-based dispositions to rash action: positive and negative urgency. *Psychological Bulletin, 134*, 807–828], has been related to a wide range of maladaptive behaviours. The present study further investigates the role of urgency in problematic behaviours by considering distinct psychological mechanisms that may underlie this component of impulsivity. With this aim, 95 volunteer participants were screened with self-reported questionnaires assessing urgency and three problematic behaviours (compulsive buying, excessive mobile phone use, excessive Internet use). They performed two laboratory tasks: a stop-signal task designed to assess the capacity to inhibit prepotent responses in response to both neutral and emotional stimuli; and the Iowa Gambling Task (IGT) measuring the ability to take into account the future consequences of an action. A poor ability to inhibit prepotent responses in the emotional condition of the stop-signal task was found to predict more disadvantageous choices in the IGT, which ultimately results in higher urgency and more problematic behaviours. These findings shed new light on the construct of urgency, its related psychological mechanisms, and its role in problematic behaviours.

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Introduction

Emotions are fundamentally adaptive, as they motivate action tendencies in response to the environment and trigger behaviours to attain various goals such as satisfying a need or maintaining homeostasis (i.e., to reduce the discrepancy between the current state and the desired state; e.g., Frijda, 1986).

Nevertheless, empirical evidence suggests that emotions do not always result in adaptive behaviours. Indeed, several studies have shown that intense emotions may trigger risky or problematic behaviours (i.e., behaviours that are in discordance with long-term interests). In particular, research has shown that the experience of intense negative emotions (e.g., anger, sadness) may promote the occurrence of problematic behaviours such as binge drinking (e.g., Selby, Anestis, & Joiner, 2008), binge eating (e.g., Agras & Telch, 1998; Selby et al., 2008), non-suicidal self-injury (Nock & Prinstein, 2004), compulsive buying (Miltenberger et al., 2003), or

escapism through excessive use of the Internet (Wan & Chiou, 2006). Investigators have proposed that risky or problematic behaviours occurring in negative emotional contexts may serve to relieve or reduce the experience of the negative emotion without the individual considering the potential negative outcomes of these behaviours (the self-medication hypothesis; e.g., Colder & Chassin, 1997; Jacobs, 1986; Swendsen et al., 2000; Thorberg & Lyvers, 2006; Tice, Bratslavsky, & Baumeister, 2001). Furthermore, it has been argued that the proneness to enter into maladaptive behaviours in a condition of negative affect may be at least partly due to a weakness of the psychological mechanisms (e.g., executive functions) involved in the voluntary or controlled regulation of behaviours (e.g., Tice et al., 2001).

Several authors acknowledge that emotional states impair executive functioning (Blair et al., 2007; Nock, Wedig, Holmberg, & Hooley, 2008; Pessoa, 2009), which suggests that persons confronted with intense emotions will have greater difficulty in exerting active or effortful control (e.g., to inhibit an aggressive response in response to an emotion of anger). Pessoa (2009) has proposed that emotional experiences recruit part of the cognitive resources (e.g., via focusing on the affectively significant stimulus or the event having triggered the emotional experience) available for effortful control, which impairs its effectiveness.

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Therefore, it could be supposed that the occurrence of problematic or risky behaviours depends both on individual differences in executive functioning implicated in effortful control (e.g., inhibition functions, the central executive of the working memory) and on individual differences in the way people experience the intensity of emotions (emotional reactivity; e.g., see Nock et al., 2008). From this perspective, the concept of urgency—the facet of impulsivity that refers to individual differences in the proneness to act impulsively and rashly in emotional contexts (see Cyders & Smith, 2008; Whiteside & Lynam, 2001)—may reflect a disposition toward problematic behaviours, depending on the earlier mentioned psychological mechanisms.

The urgency facet of impulsivity

Researchers have for a decade recognised that impulsivity reflects a combination of multiple and separable psychological dimensions (Dick et al., 2010; Enticott & Ogloff, 2006; Evenden, 1999; Whiteside & Lynam, 2001). In an attempt to delimit the facets underlying impulsivity, Whiteside and Lynam (2001) administered several widely used questionnaires of impulsivity and the Revised NEO Personality Inventory (Costa & McCrae, 1992) to a large sample of undergraduate students. A factor analysis conducted on these questionnaires resulted in a four-factor solution, which was the basis for the creation of a scale called the UPPS Impulsive Behaviour Scale (UPPS). The four dimensions of impulsivity measured by the UPPS are (1) urgency, defined as the tendency to experience strong reactions, frequently under the condition of negative affect; (2) premeditation, defined as the tendency to take into account the consequences of an act before engaging in that act; (3) perseverance, defined as the ability to remain focused on a task that may be boring and/or difficult; and (4) sensation seeking, considered as a tendency to enjoy and pursue activities that are exciting and openness to trying new experiences. Interestingly, the distinction between these four self-reported facets of impulsivity has been confirmed by means of semi-structured interviews (Smith et al., 2007), which provides convergent validity for this model of impulsivity. Among these various dimensions of impulsive behaviours, urgency has recently received increased attention, in particular in the domain of problematic or maladaptive behaviours (for a review, see Cyders & Smith, 2008). High levels of self-reported urgency (assessed with the UPPS; Whiteside & Lynam, 2001) are associated with the occurrence of a wide range of problematic behaviours, encompassing alcohol and drug abuse (e.g., Anestis, Selby, & Joiner, 2007; Verdejo-García, Bechara, Recknor, & Pérez-García, 2007); an increased craving for cigarettes (Billieux, Van der Linden, & Ceschi, 2007; Doran, Cook, McChargue, & Spring, 2009); eating disorders (e.g., Fischer, Anderson, & Smith, 2004); aggressive behaviours (Miller, Flory, Lynam, & Leukefeld, 2003); borderline symptoms (Miller et al., 2003); problem gambling (e.g., Smith et al., 2007); compulsive buying (Billieux, Rochat, Rebetez, & Van der Linden, 2008); and problematic use of the mobile phone (Billieux, Van der Linden, d'Acremont, Ceschi, & Zermatten, 2007; Billieux, Van der Linden, & Rochat, 2008). Moreover, this facet of impulsivity is also the best predictor of several problematic behaviours when controlling for other facets of impulsivity and anxiety or depression symptoms (e.g., Billieux, Rochat, et al., 2008; Billieux, Van der Linden, et al., 2008). In this context, researchers have recently suggested that the construct of urgency is a strong indicator of an individual's proneness to engage in a variety of maladaptive behaviours to regulate or relieve negative emotional experience (Cyders & Smith, 2008; Fischer et al., 2004; Selby et al., 2008).

Interestingly, urgency-related behaviours have also been shown to occur not only in experiences of negative emotions, but also in contexts of intense positive emotions. Indeed, positive urgency (i.e., the tendency to act rashly in intense positive affect) relies on a variety of problematic behaviours such as problem gambling, alcohol abuse, or risky sexual behaviour (Cyders & Smith, 2007; Cyders et al., 2007; Zapolski, Cyders, & Smith, 2009) and has been proposed to reflect a tendency to enter into problematic behaviours to regulate positive emotions by maintaining or even enhancing them (Cyders & Smith, 2008). Of note, strong correlations exist between positive and negative urgency (Cyders et al., 2007), which suggests that these two facets of impulsivity may be related to common underlying psychological mechanisms.

Urgency and related psychological mechanisms

Although it is now relatively well established that urgency-related behaviours often aim to regulate emotions, the specific psychological mechanisms underlying this facet of impulsivity remain poorly investigated. The next section provides a review of the studies that have addressed this topic.

Urgency and the ability to inhibit prepotent responses

Bechara and Van der Linden (2005) initially proposed that a poor capacity for prepotent response inhibition, that is, the ability to deliberately control or suppress an automatic response (Friedman & Miyake, 2004; Miyake et al., 2000), may underlie urgency. Indeed, this type of inhibition has been considered as central to the occurrence of impulsive and unplanned behaviours (e.g., Enticott & Ogloff, 2006; Logan, Schachar, & Tannock, 1997) and has also been found to be impaired in a variety of psychopathological states characterised by high urgency levels, such as pathological gambling (Goudriaan, Oosterlaan, de Beurs, & Van den Brink, 2006) or alcohol dependence (Noël et al., 2001). The ability to inhibit prepotent or automatic response is generally assessed via the "go/no-go" and the "stop-signal" paradigms (see Verbruggen & Logan, 2008, for a complete description and a consideration of the differences between these two tasks). In a classical go/no-go task, the participant has to respond as quickly as possible to a target stimulus (the "go" trials) presented most of the time (generally 75% of the trials) and not to respond to another stimulus (the "no-go" trials) presented less often (generally 25% of the trials). In a stop-signal task, participants usually perform a choice reaction task (the "no-stop" trials). On a random part of the trials (generally 25%), a stop signal (e.g., an auditory tone) is presented. Participants are instructed not to make the choice reaction task (the "stop" trials) when the stop signal is presented.

To the best of our knowledge, there are currently only two studies that have investigated the relationships between self-reported urgency assessed with the UPPS and inhibition of prepotent responses measured by a go/no-go task (Gay, Rochat, Billieux, d'Acremont, & Van der Linden, 2008; Perales, Verdejo-Garcia, Moya, Lozano, & Perez-Garcia, 2009). These studies have obtained mixed results: Gay et al. (2008) found a significant positive relationship between urgency and the number of commission errors, whereas Perales et al. (2009) found no relationship between urgency and performance on a go/no-go task. From a methodological point of view, a direct comparison of these two studies may be hazardous, as they have been done with distinctive samples. Indeed, Perales et al. (2009) used a small sample of female undergraduate students ($n = 32$) characterised by either high or low impulsivity scores, whereas Gay et al. (2008) used a larger sample ($n = 126$) that was more representative of the general population, consisting of volunteer participants from the community composed of a quasi equal number of males and females.

With regard to the processes involved in these tasks, a recent study by Verbruggen and Logan (2008) has shown that go/no-go tasks allow the development of automatic associative learning across trials, as the same stimuli are always associated with go/no-go trials. Thus, only the beginning of the task could be considered as assessing effortful inhibition (i.e., the moment in which the associative learning is not yet effective), (…) whereas the remainder of the task relies on automatic subcortical processes. In contrast, stop-signal tasks prevent the development of an automatic associative learning, as target stimuli are inconsistently associated with the stop signal (as the stop-signal onset follows the appearance of the stimulus). Consequently, it is likely that the stop-signal task is more suited than the go/no-go task to measure effortful or cognitive inhibition and thus to be a better potential candidate to assess one of the suggested mechanisms underlying the urgency facet of impulsivity.

No studies have explored the relationships between urgency and the ability to inhibit a prepotent response in emotional situations (e.g., by using emotional material). This latter point is of greater importance because, on the one hand, urgency has been conceptualized as a tendency to act impulsively in an emotional context (Cyders & Smith, 2008) and, on the other hand, emotional contexts have been shown to impair the ability to inhibit a prepotent response (Schulz et al., 2007; Verbruggen & De Houwer, 2007). More specifically, Schulz et al. (2007) have demonstrated by using a go/no-go task that included faces (with or without an emotional expression) that it is more difficult to inhibit a prepotent response for an emotional stimulus than it is for a neutral one, whereas Verbruggen and De Houwer (2007) found that prepotent response inhibition (assessed through a stop-signal paradigm) was compromised when participants viewed high versus low emotionally arousing pictures. More precisely, emotional scenes of the International Affective Picture System (Lang, Bradley, & Cuthbert, 1997) presented before the go and the stop trials of the task increased the difficulty in successfully inhibiting the prepotent response. The results of this study support the idea that arousal induced by emotional pictures (both negative and positive) increased the difficulty in inhibiting an automatic response, which could be because highly emotional stimuli (i.e., stimuli with high arousal properties) automatically draw attentional resources and interrupt ongoing activities, which in turn results in fewer resources available for effortful control (e.g., Schimmack, 2005; Verbruggen & De Houwer, 2007). Therefore, it is possible that individuals with a higher level of urgency are characterised by lower inhibition capacities, which make them less able to inhibit acting rashly in emotional contexts, and/or they experience emotions more strongly (i.e., they have high emotional reactivity), which results in increased difficulties in controlling their behaviours in such situations.

Urgency may also be underlain by a combination of distinct psychological processes rather than solely by difficulties in inhibiting automatized or prepotent response. Such a hypothesis may also be supported by the facts that (1) this inhibitory function is related to several other executive processes (e.g., updating of the central executive of the working memory, shifting, resistance to proactive interference; Friedman & Miyake, 2004; Miyake et al., 2000); and (2) the relationship found by Gay et al. (2008) between urgency and the ability to inhibit prepotent responses is of relatively small amplitude, which implies that other psychological mechanisms may be related to this facet of impulsivity.

Urgency and the ability to take into account the consequences of an action

Cyders and Smith (2008) have proposed that urgency-related behaviours are associated with an elevated focus on the present moment (e.g., the desire to obtain relief from a negative emotion) and a reduced focus on long-term consequences, which ultimately results in maladaptive or risky behaviours. Of note, a majority of the urgency items of the UPPS explicitly refer to acting without consideration of future consequences in negative emotional contexts (e.g., Item 14: "When I feel bad, I will often do things I later regret in order to make myself feel better now"; Item 24: "When I am upset I often act without thinking"; Item 36: "I often make matters worse because I act without thinking when I am upset"). Consequently, it may be hypothesized that high urgency is related to difficulty in taking into account the future consequences of an action in emotional contexts; that is, individuals may have a tendency to make disadvantageous choices in those situations.

The psychological mechanism underlying the ability to make decisions by considering its future outcomes has been theorized in the influential "somatic marker hypothesis" theory (Damasio, 1994; Damasio, Tranel, & Damasio, 1991), which argues that in a context of uncertainty, individuals could unconsciously take into account the positive and negative outcomes of their actions on the basis of emotional or somatic markers, that is, anticipatory emotional reactions provoked by this decision that depend on the consequences associated with similar decisions in the past. From this perspective, elevated levels of urgency could result in an inability to act by taking into account somatic markers. Empirical support of the somatic marker hypothesis is largely based on the findings of a laboratory-based emotional decision-making task: the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994). This task has been developed to factor in several aspects of real-life decision making such as uncertainty, risk, and evaluation of rewards and punishments. In the IGT, participants have to select 100 cards from four different decks that are apparently identical. Each choice leads either to a financial reward or to a combination of a financial reward and a penalty. The two decks are, in fact, disadvantageous in the long term; that is, they are associated with greater financial penalty. A central aspect of the IGT, which makes it relevant for studying urgency-related behaviours, is that in this task participants have to forego short-term gratification to obtain long-term profits (by progressively switching their choices from the two risky decks to the two advantageous decks).

Several authors sustain that the first part of the IGT reflects decision making under uncertainty, whereas the second part of the IGT measures decision making under risk (Bechara & Martin, 2004; Brand, Labudda, & Markowitsch, 2006; Noël, Bechara, Dan, Hanak, & Verbanck, 2007). Indeed, it has been shown that decisions made in the IGT progressively switch from uncertain choices involving no conscious knowledge about reinforcement contingencies of the decks to choices made in a context in which conscious knowledge has emerged concerning the reinforcement contingencies of the various decks (Persaud, McLeod, & Cowey, 2009). Thus, it could be supposed that the first part of the IGT relies largely on unconscious processes (e.g., somatic markers), whereas the second part of the task also recruits effortful conscious processes. Dunn, Dalgleish, and Lawrence (2006) proposed that the IGT is multi-determined and relies on various effortful mechanisms, at least in its second part. These authors proposed that advantageous choices in the IGT require updating of the content of working memory (to be able to bear in mind the reward/punishment schedule of the task), inhibiting responding to previously rewarding decks, and shifting one's preference from risky decks to advantageous decks.

To the best of our knowledge, only four studies have considered the relationships between the IGT and the various facets of self-reported impulsivity assessed with the UPPS (Dolan, Bechara, & Nathan, 2008; Perales et al., 2009; Xiao et al., 2009; Zermatten, Van der Linden, d'Acremont, Jermann, & Bechara, 2005). These studies have shown that urgency is associated with less

advantageous choices in the IGT both in adolescents (Xiao et al., 2009) and in patients with substance use disorder (Dolan et al., 2008). Zermatten et al. (2005), however, found that another facet of impulsivity, namely, lack of premedition, predicted lower performance in the IGT. In another study, Perales et al. (2009) found no relationship between the IGT and the various facets of impulsivity. However, several reasons lead us to believe that poor performance on the IGT should be related to higher levels of urgency.

First, the IGT has for a long time been conceptualized as a task that assesses decision making in emotional contexts (e.g., Bechara, 2004; Xiao et al., 2009). This implies that the task is probably more suited as a reflection of a psychological mechanism underlying the urgency facet of impulsivity, that is, acting rashly in emotional contexts, than as a reflection of the lack of premedition facet of impulsivity, that is, the capacity to plan and deliberate in general, not specifically in emotional contexts. Second, it has been shown that urgency is the facet of impulsivity that better predicts the occurrence of problematic behaviours characterised by poor performance in the IGT, such as pathological gambling (e.g., Goudriaan, Oosterlaan, de Beurs, & van den Brink, 2005) and alcohol or drug use (e.g., Bechara et al., 2001; Noël et al., 2007). Finally, the two studies that did not find a link between the IGT and urgency used small samples (about 30 participants), and Perales et al. (2009) incorporated only a small sample of female undergraduates with high or low impulsivity, which may have had an impact on the findings. As a consequence, further research remains necessary to explore the relationships between the IGT and the urgency facet of impulsivity.

Understanding the role of inhibition and decision making in urgency manifestations

It seems that both the ability to inhibit prepotent responses and the capacity to take into account the future consequences of actions could represent specific psychological mechanisms underlying the urgency facet of impulsivity. However, it is also possible that these two mechanisms act conjointly to promote urgency-related behaviours. Interestingly, recent evidence has shown that poor ability to inhibit prepotent response predicts a proneness to take more risky cards in the IGT, especially in the second part of the task, which represents making choices under risk (Noël et al., 2007; Shuster & Toplak, 2009). From this perspective, central to our argument is how inhibition difficulties promote decisions made without forethought toward future consequences in a situation of decision making under risk. To this end, an in-depth consideration of the various processes involved in risky decision making in the IGT is necessary.

Decision making under risk is a complex process that requires, on the one hand, consideration of "factual knowledge" about the choice and, on the other hand, reflection about the potential consequences of that choice (e.g., Bechara & Van der Linden, 2005). In reference to the IGT, a crucial question is the nature of the choices made by the participants in its second part: Do they choose a card on the basis of unconscious factual knowledge, depending on their previous choices (i.e., mainly by taking into account information provided by somatic markers), or do they make choices in accordance with conscious knowledge about the reinforcement contingencies of the various decks? This question is important because if the participants have acquired conscious knowledge about the IGT, their choices may also be influenced by controlled or executive processes (e.g., inhibiting the choice of a card in a deck known to be risky). In fact, this question has been addressed by Maia and McClelland (2004), who, by asking participants specific questions about the game, showed that they acquired conscious conceptual

knowledge about the IGT across trials (e.g., concerning the reinforcement contingencies of the four decks). More recently, Persaud et al. (2009) conducted a study in which participants performed the IGT and were asked to wager an amount of money after each deck selection. The hypothesis of the authors is that conscious knowledge about the IGT occurs when participants consistently wage the maximum amount of money after selecting the positive packs. Interestingly, this study revealed that advantageous wagering (which reflects an awareness of the strategy used) began approximately on trial 70 ($\pm$13).

From this perspective, it can be postulated that in the second part of the IGT, the participants have to inhibit responses to previously rewarding decks (the disadvantageous decks associated with important positive reinforcements in the beginning of the task) before being able to make a choice that takes into account the conscious knowledge they have acquired during the task. Indeed, the last trials of the IGT require participants to make a choice on the basis of the factual knowledge they have acquired about the task (e.g., which decks represent greater gains and/or greater losses) and also on the basis of the consequences of the choice made (e.g., the likelihood of going bankrupt after that choice; the consideration of the amount of money already won or lost). In other words, it is possible that urgency-related behaviours, considered as rash and non-deliberated actions in emotional contexts, are promoted by weakness of the inhibitory control that precludes entering into a reflexive deliberation about an action (e.g., consideration of the long-term outcomes and not only the immediate reward). From a more general point of view, the distinction between an automatic system on the one hand and an analytical or deliberative system on the other hand (Evans, 2003, 2004; Figner, Mackinlay, Wilkening, & Weber, 2009) is of much interest when considering urgency-related behaviours. More precisely, choices resulting from the automatic system depend on rapid and parallel processes (i.e., they do not recruit controlled or executive processes) created via associative learning and which are unconscious until the decision is made. In contrast, the analytical system is slower and sequential, requires controlled cognitive processes (such as executive functions and working memory), and permits abstract and hypothetical thinking (which is not the case for the automatic system). Thus, it could be supposed that persons with high urgency have more difficulty entering into an analytical or deliberative decision-making process, resulting more frequently in rash and unplanned actions that can potentially have tangible negative consequences.

The current study

The main goal of the current study was to further investigate the relations between the urgency facet of impulsivity and both the capacity to inhibit prepotent responses and the ability to take into account future consequences of an action. Second, we were also interested in confirming the critical role of urgency and related psychological mechanisms in the occurrence of problematic or risky behaviours. Several a priori hypotheses emerged from our review and criticism of the existing literature.

First, we postulated that both (1) a lower ability to inhibit a prepotent response (especially in an emotional context) and (2) difficulty in taking into account future outcomes when making a choice in an emotional context predict a higher level of urgency. As a result of the studies that found that low inhibition capacities predict poor performance in the IGT, we also examined the possibility that decision making mediates the relation between inhibition and urgency, that is, whether this latter relation may exist through the impact of inhibition on the ability to consider long-term outcomes of an action in the IGT.

Second, we expected urgency to predict the involvement in problematic behaviours, as this dimension of impulsivity has been related to proneness to act rashly with the desire to relieve negative emotions (e.g., Cyders & Smith, 2008).

To test these hypotheses, we conducted a study in which volunteer participants from the community performed two laboratory tasks and completed several self-reported questionnaires. More precisely, the ability to inhibit prepotent responses was measured by means of a stop-signal task, using faces with different facial expressions (neutral, joy, sadness). Human faces with positive and negative expressions (joy and sadness) were used as emotionally charged stimuli in the stop-signal task (e.g., see Schulz et al., 2007, for a study using emotional faces in an inhibition task). We decided to incorporate both negative and positive stimuli because Cyders et al. (2007) have shown that urgency-related behaviours may also occur in response to intense positive emotions. The ability to take into account the future consequences of an action in an emotional context was measured with the IGT (Bechara et al., 1994). The urgency and the lack of premeditation facets of impulsivity were assessed with the UPPS (Whiteside & Lynam, 2001). The lack of premeditation facet of impulsivity of the UPPS was also considered in the current study, as it has frequently been shown to positively correlate with urgency (Whiteside & Lynam, 2001; Whiteside, Lynam, Miller, & Reynolds, 2005) and has also been associated with an inability to make advantageous choices in the IGT (Zermatten et al., 2005). Finally, three distinct potential problematic behaviours were considered, namely, compulsive buying, problematic use of the Internet, and problematic use of the mobile phone. We chose to focus on these three behaviours for three reasons. First, these types of problematic behaviours have all been related to high levels of urgency (e.g., Billieux, Rochat, et al., 2008; Billieux, Van der Linden, d'Acremont, et al., 2007). Second, these behaviours have often been considered as a way to relieve or enhance emotions or moods (e.g., Cyders & Smith, 2008; Miltenberger et al., 2003; Wan & Chiou, 2006). Finally, empirical evidence supports these problematic behaviours to be well represented in non-clinical participants from the community (e.g., Billieux, Rochat, et al., 2008; Billieux, Van der Linden, d'Acremont, et al., 2007; Khazaal et al., 2008). The following self-reported questionnaires were used to assess these problematic behaviours: the Questionnaire about Buying Behaviour (QBB; Lejoyeux, Mathieu, Embouazza, Huet, & Lequen, 2007), the Problematic Use of the Mobile Phone Questionnaire (PUMPQ; Billieux, Van der Linden, et al., 2008), and the Internet Addiction Test (IAT; Young, 1999).

Methods

Participants and procedure

Participants were volunteers who received no compensation for their inclusion in the study. They were recruited by means of advertisements. The inclusion criterion was being a native speaker of French. Exclusion criteria were any recent or ongoing major depressive episode or anxiety disorder, and any reported neurological disorder. The sample comprised 95 participants (48 females and 47 males) with an average age of 23.31 years (range 18–30, $SD = 3.07$). The average number of years of education was 14.17 (range 9–20, $SD = 2.13$). Participants were individually tested in a quiet laboratory. They signed an informed consent form before doing the experiment. Participants performed the stop-signal task and the IGT (half of the participants performed the stop-signal task first and the other half performed the Iowa Gambling Task first) and were then screened with various self-reported questionnaires assessing impulsivity and problematic behaviours. The order of the

questionnaires was randomized across participants to control for potential boredom and fatigue effects.

Measures

Emotional Stop-Signal Task

The ability to inhibit prepotent response following the presentation of neutral or emotional stimuli was assessed with a task inspired from a classical stop-signal paradigm (see Logan, 1994; Logan et al., 1997). The stimuli used in the task consisted of human faces with three types of emotional expressions: joy, neutral, and sadness. All pictures were selected from the Karolinska Directed Expressional Faces set (KDEF; Goeleven, De Raedt, Leyman, & Verschuere, 2008; Lundqvist, Flykt, & Öhman, 1998). The task had two distinct parts. In the first one, used to build up a prepotent categorization response, participants were presented with 42 trials in which they had to categorize the gender of faces (1/3 joy, 1/3 neutral, 1/3 sadness) as quickly as possible without making mistakes. The cue stimulus (the face) was preceded by a fixation cross displayed for 500 ms, followed by a blank screen shown for 1000 ms. The second part of the task consisted of two blocks of 96 trials in which participants were told not to respond (i.e., to inhibit the prepotent response of gender categorization) when they heard a computer-emitted tone (25% of the trials), but otherwise to keep performing the same categorization task as quickly and accurately as possible. In the second part of the task, 32 faces (16 male and 16 female, each with the three different emotional expressions) of the KDEF were used. Each stimulus was presented twice (once in the first block and once in the second block). Stop signals were presented at predetermined intervals before the subject's expected response. The length of the interval before the occurrence of the stop signal was 250 ms, 300 ms, 350 ms, or 400 ms (but two identical intervals were never presented in sequence). The dependent variable that reflects the latency of the inhibitory process is the SSRT (see Logan, 1994), which corresponds to the latency of the inhibitory process (a high SSRT corresponds to a lower prepotent response inhibition capacity). The latency of the stop process can be estimated from the start and finish of the stop process. The start of the stop process is experimentally controlled by the interval before the occurrence of the stop signal, but the finish time has to be inferred from the reaction time distribution in the observed no-stop trials. If responses are not stopped in $n\%$ of the stop trials, the finish of the stop process is on average equal to the nth percentile of the reaction time distribution in go trials. The stop-signal interval is subtracted from the nth reaction time to estimate SSRT. SSRTs are calculated for each interval and then averaged. SSRTs are calculated separately for the neutral, positive, and negative condition. We also computed an SSRT for the emotional condition by considering the positive and negative conditions together. Because several of our statistical analyses could be sensitive to non-normal variables, the SSRTs were transformed by using natural logarithm to decrease the skewness of their distribution. Because of technical problems, data for the stop-signal task are missing for three participants. Paired sample t-tests revealed no difference in SSRTs between neutral and emotional conditions, $t(91) = .92$, $p = .36$. Inhibition rates were 72.93% and 71.19% for the neutral and emotional conditions, respectively. The comparison of the inhibition rates between neutral and emotional conditions is not significant, $t(91) = .92$, $p = .36$.

Iowa Gambling Task (IGT)

In the IGT (Bechara et al., 1994), participants have to choose one card at a time from four available decks (A, B, C, and D). The task requires the participant to make 100 choices (100 trials), and in

each trial, participants may win or lose a certain amount of money. The aim is to gain as much money as possible, and the participant starts the task with 2000 Swiss Francs (of fake money) in his or her account. During game instruction, participants are told that some decks are more advantageous than others, but they do not know which decks are better. Actually, two of the four decks (A and B) produce immediate large rewards but higher punishment, at unpredictable points, than the other two decks. In the long run, decks A and B are disadvantageous. The other two decks (C and D) produce immediate modest rewards, but lower punishment. These two decks are advantageous in the long run. To calculate a score that takes into account the evolution of subjects' choices, we divided performance into five blocks, representing five periods of 20-card selection. In each block of 20 cards, the number of cards selected from advantageous decks was calculated (C + D). A score for each block, as well as a total score, was obtained. Following recent proposals by Bechara and Martin (2004) and Brand et al. (2006), we also made the distinction between the initial phase of the IGT (the first 40 trials), in which participants learn to make choices but without any explicit knowledge about the reinforcement contingencies of the various decks of the task (decision under uncertainty), and the second part of the IGT (the 40 last trials), in which choices become more influenced by explicit knowledge about the risks associated with each deck (decision under risk).

UPPS Impulsive Behaviour Scale (UPPS)

The French version of the UPPS (Van der Linden et al., 2006), translated from Whiteside and Lynam (2001), consists of 45 items that evaluate the four different facets of impulsivity, labelled negative urgency (12 items, e.g., "When I feel bad, I will often do things I later regret in order to make myself feel better now"), (lack of) premeditation (11 items, e.g., "I am a cautious person"), (lack of) perseverance (10 items, e.g., "I concentrate easily"), and sensation seeking (12 items, e.g., "I will try anything once"). All items are scored on a Likert scale from 1 = "I agree strongly" to 4 = "I disagree strongly", with higher scores reflecting higher impulsivity on the respective facet. A validation study found the high internal consistency of the French version and its factorial structure to be similar to the original English UPPS (Van der Linden et al., 2006). In the present study, internal consistency is very high for the four facets of impulsivity, namely, negative urgency (Cronbach's alpha = .85), lack of premeditation (Cronbach's alpha = .81), lack of perseverance (Cronbach's alpha = .84), and sensation seeking (Cronbach's alpha = .83).

Problematic Use of the Mobile Phone Questionnaire (PUMPQ)

The PUMPQ (Billieux, Van der Linden, et al., 2008) consists of 30 items measuring four different facets of problematic use of the mobile phone (prohibited use, dangerous use, financial problems, and dependence symptoms). The total score of the PUMPQ was used as a general measure of problematic use of the mobile phone. All items are scored on a Likert scale from 1 = "I agree strongly" to 4 = "I disagree strongly", with higher scores implying higher dependence on the mobile phone. The PUMPQ has been shown to have good psychometrical properties (Billieux, Van der Linden, et al., 2008). The internal reliability of the PUMPQ in the current study is very high (Cronbach's alpha = .89).

Questionnaire about Buying Behaviour (QBB)

The QBB (Lejoyeux, Tassain, Solomon, & Adès, 1997) consists of 19 items representing major features of compulsive buying (e.g., urges to shop and buy, negative feedback from family and friends, post-purchase guilt). Items on the scales are scored 0 or 1 (questions with "yes" or "no" answers). Almost all studies using the QBB have divided their samples into "compulsive buyers" and "normal

buyers" (Lejoyeux et al., 1997) on the basis of diagnostic criteria for uncontrolled buying (see McElroy, Keck, Pope, & Smith, 1994) and on positive answers to certain items of the QBB (e.g., post-purchase guilt, tangible negative consequences of the purchasing behaviour). However, in the present study, compulsive buying was conceptualized from a dimensional perspective. Consequently, total scores on the QBB were considered as reflecting compulsive buying tendencies, with higher scores reflecting higher compulsive buying proneness. To the best of our knowledge, no data are available for the psychometric properties of the QBB. The internal reliability of the QBB found in the present study is high (Cronbach's alpha = .76).

Internet Addiction Test (IAT)

The French IAT (Khazaal et al., 2008), adapted from Young (1999), consists of 20 original items assessing the negative consequences of overuse of the Internet (compromised social and individual quality of life, compensatory usage of the Internet, compromised scholarly/academic/working careers, compromised time control, excitatory usage of the Internet). All items are scored on a Likert scale (never, rarely, occasionally, often, always) corresponding to scores of 1–5, with higher scores implying higher dependence on the Internet. A validation study found the high internal consistency of the French version and its factorial structure to be similar to the original English IAT (Khazaal et al., 2008). In the current study, the internal reliability of the IAT is very high (Cronbach's alpha = .92).

Statistical analyses

Two-tailed Pearson's correlations (with 5% significance criterion) were used to evaluate relations between variables. Pearson's point-biserial correlation was used to evaluate the effect of gender on task and questionnaire variables. Women were set at 1 and men at 2; thus, a positive correlation corresponds to a higher score for men.

Our various a priori hypotheses were tested by means of path analysis (PA). PA evaluates the plausibility of a model that is proposed about the relationships among a set of variables. A benefit of PA is that it permits the analysis of both direct and indirect relations between the variables selected. PA analysis was computed with Mplus by using the Maximum Likelihood statistic test (Muthén & Muthén, 2006). Participants with missing data ($n = 3$) were excluded from the PA. Indirect effects were computed via the product of coefficient strategy (see Preacher, Rucker, & Hayes, 2007) provided by Mplus. To test single parameters, we adopted the 5% significance criterion (i.e., *t*-value of parameters of 1.96). Model fit was evaluated using the chi-square (χ^2) and root mean square error of approximation (RMSEA) indices. A non-significant χ^2 indicates a good fit (Byrne, 1994). The RMSEA measures the difference between the model and the sample data per degree of freedom, with values below .05 indicating a close fit and below .08 indicating a reasonable fit (Byrne, 2001). We also reported the comparative fit index (CFI). A CFI > .90 is generally interpreted as indicating an acceptable fit.

Results

Summary data of the tasks and the self-report questionnaires are presented in Table 1.

Correlation analyses

Table 2 reports the two-tailed Pearson's correlations for all variables of the study.

Table 1
Descriptives for questionnaires and laboratory tasks.

	Variables	M	SD
Impulsivity facets	Negative urgency (UPPS)	26.27	6.24
	Lack of premeditation (UPPS)	21.51	4.73
	Lack of perseverance (UPPS)	19.28	4.82
	Sensation seeking (UPPS)	31.31	7.26
Problematic behaviours	Internet (IAT)	27.51	12.30
	Mobile phone (PUMPQ)	47.62	12.30
	Compulsive buying (QBB)	4.2	3.1
Decision making	IGT: total score (trials 1–100)	56.78	15.13
	IGT: uncertainty (trials 1–40)	20.49	7.00
	IGT: risk (trials 61–100)	24.50	8.23
Prepotent response inhibition	Stop signal: SSRT-neutral	154.88	54.35
	Stop signal: SSRT-positive	155.40	50.60
	Stop signal: SSRT-negative	160.38	41.88
	Stop signal: SSRT-emotional	157.10	36.80

Note. UPPS = UPPS Impulsive Behaviour Scale; IAT = Internet Addiction Test; PUMPQ = Problematic Use of the Mobile Phone Questionnaire; QBB = Questionnaire about Buying Behaviour; IGT = Iowa Gambling Task; SSRT = Stop-Signal Reaction Time.

Correlation analysis revealed several significant relationships between the various facets of impulsivity. More precisely, we found positive correlations between negative urgency and both the lack of premeditation and perseverance, and between the lack of premeditation and the lack of perseverance. The sensation seeking facet of the UPPS did not correlate with the other impulsivity facets.

The urgency facet of impulsivity negatively correlated with both the total score on the IGT and the last 40 trials of this task. No correlation was found between negative urgency and the first 40 trials of the IGT. No significant correlation was found between negative urgency and the SSRTs on the stop-signal task, whether for the emotional or the neutral conditions. Negative urgency negatively correlated with gender, implying that females were found to have higher scores on this facet of impulsivity. Finally, negative urgency positively correlated with the various problematic behaviours measured (problematic use of the mobile phone, problematic use of the Internet, and compulsive buying).

The lack of premeditation and lack of perseverance facets of impulsivity were not related to the stop-signal task or to the IGT. However, the lack of premeditation was positively correlated with the proneness to problematic use of the mobile phone, whereas the lack of perseverance was positively correlated with the overuse

of the Internet. Nevertheless, the sizes of these two correlations are smaller compared with those taking place between problematic behaviours and the negative urgency facet of impulsivity.

A specific relation was found between a high level of sensation seeking and a better ability to inhibit prepotent responses in the positive and the emotional conditions of the stop-signal task. However, no relation occured between sensation seeking and the neutral and the negative conditions of the stop-signal task, the IGT, and the various problematic behaviours measured.

From the performance of the tasks, relationships were found between the IGT and the SSRTs on the stop-signal task. More specifically, inhibitory capacities for all emotional conditions of the stop-signal task correlated with total scores on the IGT and with scores on the last 40 trials of the task. However, no correlation was found between the ability to inhibit prepotent responses in the emotional conditions and the IGT scores for the first 40 trials. In addition, no relationship was found between the ability to inhibit prepotent responses in the neutral condition and all variables of the IGT.

Measurement model analyses

Our various a priori hypotheses about the psychological mechanisms underlying urgency were tested through PAs. The variables entered in the model were selected on the basis of our hypotheses and the correlation analysis. We decided to take into account two variables for the stop-signal task, namely, the SSRTs for the neutral condition of the task, and the SSRTs for the emotional conditions. We chose not to distinguish positive and negative stimuli, as urgency-related behaviours have been shown to rely on both positive and negative emotional contexts (see Cyders & Smith, 2008), and the correlations found between inhibition in positive and negative conditions and the IGT are similar. Concerning the IGT, we chose to consider only the last 40 trials for three distinct reasons. First, firm conclusions based on the total score of the IGT are hazardous, as the beginning and the end of the task appear not to recruit identical types of psychological mechanisms (e.g., Dunn et al., 2006; Persaud et al., 2009). Second, advantageous choices in the second part of the IGT positively correlate with negative urgency, which is not the case for the advantageous choices in the first part of the IGT. Third, the ability to inhibit the prepotent response to emotional stimuli is specifically related to the tendency to make advantageous choices in the second part of the IGT, not in

Table 2
Pearson's correlation between the variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1. Age	–														
2. Gender	**.22***	–													
3. UPPS: negative urgency	−.14	**−.30***	–												
4. UPPS: lack of premeditation	−.07	−.13	**.30***	–											
5. UPPS: lack of perseverance	.06	−.09	**.32***	**.48*****	–										
6. UPPS: sensation seeking	**−.26***	.19	.03	.07	−.10	–									
7. PUMPQ − total score	−.01	−.16	**.44*****	**.23***	.13	−.08	–								
8. QBB − total score	−.10	−.13	**.47***	.10	.16	.04	**.46***	–							
9. IAT − total score	−.14	.01	**.30***	.03	**.24***	.01	.14	**.26***	–						
10. IGT: total score	.14	.16	**−.25***	−.07	−.01	.11	−.12	.04	−.09	–					
11. IGT: trials 1−40	.06	.14	−.15	−.09	−.01	.07	−.02	.00	**.74***	–					
12. IGT: trials 61−100	.10	.13	**−.26*****	−.04	−.03	.09	−.14	.08	−.14	**.81***	**.27***	–			
13. Stop signal: SSRT-neutral	.18	.12	−.03	−.15	.02	−.17	.08	.10	.02	.03	.06	−.02	–		
14. Stop signal: SSRT-positive	.18	.09	.05	−.18	−.02	**−.26***	.10	−.11	.02	**−.33*****	−.20	**−.27***	**.36***	–	
15. Stop signal: SSRT-negative	.06	−.02	.09	−.09	−.11	−.15	.12	.06	−.04	**−.26*****	−.16	**−.28*****	**.30***	**.31***	–
16. Stop signal: SSRT-emotional	.20	.11	.06	−.08	−.11	**−.22***	.10	−.06	−.13	**−.33*****	−.16	**−.34*****	**.41***	**.78***	**.76***

***$p < .001$; **$p < .01$; *$p < .05$.
Note. UPPS = UPPS Impulsive Behaviour Scale; PUMPQ = Problematic Use of the Mobile Phone Questionnaire; QBB = Questionnaire about Buying Behaviour; IAT = Internet Addiction Test; IGT = Iowa Gambling Task; SSRT = Stop-Signal Reaction Time.

its first part. Because correlation analysis revealed that females have higher negative urgency scores than males have, gender was incorporated as a moderator in the model. This moderation was evaluated through the interaction between urgency and gender and the effect of urgency and gender on problematic behaviours. To this end, a new variable was created by multiplying urgency with gender (value for females = 1; value for males = 2). Urgency scores were centered to reduce potential multicollinearity between the main effects and interaction effects in the model (Cohen, Cohen, West, & Aiken, 2003). The lack of premeditation was not incorporated into the model, as this facet of impulsivity is not related to the IGT or to the stop-signal task.

As depicted in Fig. 1, the following causal paths were computed: (1) paths leading from the prepotent response inhibition capacities (either in the emotional or neutral conditions) to the ability to make advantageous decisions under risk; (2) paths leading from the ability to make advantageous decisions under risk to the negative urgency and to the interaction between negative urgency and gender; (3) paths leading from the negative urgency facet of impulsivity to the various problematic behaviours; (4) paths leading from gender to the various problematic behaviours; (5) paths leading from the interaction between urgency and gender to the various problematic behaviours. The following indirect paths were also computed: (1) the indirect effect of inhibition (either in the emotional or neutral conditions) on negative urgency through decision making; and (2) the indirect effects of decision making on problematic behaviours through urgency and through the interaction between urgency and gender. We allowed the inhibition in response to neutral and emotional stimuli to correlate, as we did for urgency and gender.

The tested model has a good fit ($\chi^2(16) = 20.286$, $p = .21$; RMSEA = .053, confidence interval = [0, .115]; CFI = .953). Standardized regression weights (b) for the structural model are presented in Fig. 1. The model showed that (1) the emotional condition of the stop-signal task predicts the ability to make advantageous choices in the second part of the IGT ($b = -.39$), which is not the case for the neutral condition of the stop-signal task ($b = .13$); (2) the ability to make advantageous choices in the second part of the IGT predicts the negative urgency facet of impulsivity ($b = -.24$); (3)
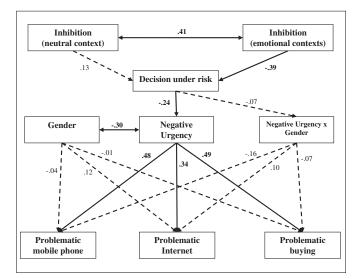
the negative urgency facet of impulsivity predicts the various problematic behaviours, namely, compulsive buying ($b = .49$), problematic use of the mobile phone ($b = .48$), and problematic use of the Internet ($b = .34$). Problematic behaviours are not significantly predicted by gender or by the interaction between the urgency facet of impulsivity and gender. Moreover, two significant indirect effects were found: (1) an indirect effect from the emotional condition of the inhibition task to negative urgency through decision making under risk ($b = .09$); and (2) indirect effects from decision making under risk to compulsive buying ($b = -.12$), problematic use of the mobile phone ($b = -.12$), and problematic use of the Internet ($b = -.07$) through the negative urgency facet of impulsivity.

Discussion

The aim of the present study was first to investigate the relations between the urgency facet of impulsivity and two cognitive mechanisms—the ability to inhibit a prepotent response and the capacity to take into account the consequences of an action—and second to further confirm the role of urgency in the occurrence of various problematic or risky behaviours. The results of the study may be summarized as follows: (1) poor ability to inhibit prepotent responses in emotional contexts predicts the tendency to make disadvantageous choices in a situation of decision making under risk and also indirectly predicts the negative urgency facet of impulsivity through its effect on the ability to make decisions under risk; (2) the tendency to make disadvantageous choices in a situation of decision making under risk predicts the negative urgency component of impulsivity and also indirectly predicts the occurrence of problematic behaviours through its effect on the negative urgency facet of impulsivity; (3) the negative urgency facet of impulsivity predicts the occurrence of problematic behaviours; and (4) being a female is related to higher urgency scores.

The present study shed new light on the role of urgency in problematic behaviours through a direct investigation of its underlying psychological mechanisms. Moreover, our data also confirm and extend previous data highlighting that high urgency is associated with more risky decisions in the IGT (Dolan et al., 2008; Xiao et al., 2009). The discussion is divided in two distinct parts. The first part addresses in detail the question of the psychological mechanisms underlying urgency, whereas the second part focuses on the role of urgency in problematic behaviours.

The psychological mechanisms underlying urgency

The main finding of the study was that a low capacity to inhibit a prepotent response in an emotional context (reflected by the emotional conditions of the stop-signal task) predicts a proneness to act without forethought in a situation of decision making under risk (the second part of the IGT), which ultimately results in more elevated levels of negative urgency, that is, a proneness to act rashly in intense negative emotional contexts.

First, our results clarify the role of prepotent response inhibition in the ability to take into account future consequences of an action. Indeed, disadvantageous choices in the second part of the IGT were predicted by a weak capacity to inhibit a prepotent response in the emotional condition of the stop-signal task but were unrelated to performances in the neutral condition of that task. This latter dissociation is all the more interesting as it is, to the best of our knowledge, the first time that the performances on an emotional decision-making task have been specifically predicted by the performances on a task assessing prepotent response inhibition in an emotional context. Moreover, this result confirms previous findings highlighting that in the IGT, choices progressively switch

Fig. 1. Path analysis ($\chi^2(16) = 20.286$, $p = .21$; root mean square error of approximation = .053, confidence interval = [0, .115]; comparative fit index = .953) including standardized coefficients. Values of the bold single-headed arrows reflect significant standardized regression weights (at the .05 level). The value of the dashed single-headed arrow reflects a non-significant standardized regression weight. The value of the bold double-headed arrow is a significant correlation (at the .05 level).

from a context in which risks associated with each choice are uncertain and mainly associated with unconscious (automatic) processes to a situation in which risks associated with each choice become more conscious and depend on controlled or executive processes (e.g., Brand et al., 2006; Dunn et al., 2006). However, our results also extend the findings of previous studies by emphasizing that risky decisions in the IGT are specifically predicted by difficulty in inhibiting a prepotent response when faced with emotional stimuli (and not neutral stimuli). Considering that the IGT is conceptualized as an emotional decision-making task aimed at simulating real-life risky situations, that is, a situation in which a choice has to be made by balancing short-term gratifications with potential negative future outcomes (Bechara et al., 1994), it is not surprising that risky choices in this task are specifically predicted by the ability to inhibit a prepotent response in emotional or "hot" contexts.

Note that, contrary to the current study, previous studies reported a relationship between a tendency to make disadvantageous choices in the IGT and poor inhibition capacities that were assessed with a task using only neutral stimuli (Noël et al., 2007; Shuster & Toplak, 2009). Nevertheless, this may possibly be allotted to methodological concerns. In the first study, Noël et al. (2007) acknowledge that the task they chose to assess prepotent response inhibition (the Hayling task; Burgess & Shallice, 1996) is not pure and allows the use of additional conscious strategies (not related to prepotent response inhibition). Consequently, the multi-determined task they used to assess inhibition hinders firm conclusions about the nature of the psychological mechanisms related to the ability to make advantageous decisions in the IGT. In the second study, Shuster and Toplak (2009) reported that poor performances in a go/no-go task (made of neutral stimuli) are associated with lower abilities to make advantageous choices in the IGT. In fact, they found a significant relationship between poor inhibition and lower effective gains in the IGT (i.e., the amount of hypothetical money won at the end of the task), but not with the total of number of cards selected in the two advantageous decks C and D (i.e., the "gold standard" measure in the IGT; Dunn et al., 2006). This last result is similar to those of the present study.

The present research helps explain why high urgency individuals often act rashly and without forethought in emotional contexts, although it must be borne in mind that this tendency is only indirectly related to impairment in the ability to inhibit a prepotent response. In fact, we hypothesize that individuals with a high level of urgency often find themselves in emotional contexts that interfere with their ability to act in a deliberative way, which ultimately results in actions focused on immediate positive and negative reinforcement. Indeed, emotional experiences have been shown to interfere with the effectiveness of inhibitory control (Schulz et al., 2007), meaning that behaviours occurring in intense emotional contexts are more often rash, automatic, and unplanned. Moreover, the greater the degree to which an emotional experience is intense or arousing (whether positive or negative), the more this emotional experience is associated with difficulties in inhibiting a prepotent response (Verbruggen & De Houwer, 2007).

From this perspective, we think that the absence of a direct relationship between the inhibition task and the negative urgency facet of impulsivity is possibly due to the stimuli used (faces with positive or negative expressions) not being highly arousing. In fact, emotional arousal properties of the pictures from the KDEF (Goeleven et al., 2008) used in the current study and those from the International Affective Picture System (IAPS; Lang et al., 1997) used in the study of Verbruggen and De Houwer (2007) can easily be compared, as both have been validated with the same procedure. The arousal provoked by these two types of emotional stimuli was measured with a 9-point Likert scale ranging from 1 (*not at all*

arousing) to 9 (*completely arousing*). The mean arousal for the KDEF is 3.72 for happy faces and 3.37 for sad faces (Goeleven et al., 2008), whereas the mean arousal for the IAPS pictures used by Verbruggen and De Houwer (2007) is 5.75 for positive pictures and 6.16 for negative pictures. Thus, it appears that pictures from the IAPS are more arousing than are the faces of the KDEF. Consequently, if urgency reflects poor inhibitory control in response to intense emotions, we likely would have found a higher relationship between this facet of impulsivity and inhibitory control by using a stop-signal task designed with more arousing stimuli (such as the emotional scenes of the IAPS).

Another potential explanation for the absence of a significant relationship between negative urgency and inhibition capacities is that individual differences in the way people experience emotions (i.e., individual differences in emotional reactivity; see Nock et al., 2008) should have an important impact on their tendency to urgency manifestations. Indeed, elevated levels of emotional reactivity (e.g., proneness to experience emotion intensely or for a prolonged period of time) have been shown to be negatively correlated with self-assessed inhibitory control (Fabes et al., 1999; Nock et al., 2008). Accordingly, urgency manifestations may be promoted by a combination of elevated emotional reactivity and a diminished ability not to act rashly and without forethought in the face of intense emotional contexts. Nevertheless, further studies are necessary to explore the relationships between urgency and individual differences in emotional reactivity, as this latter construct was not assessed in the present study.

We found, in addition, a gender effect on the negative urgency facet of impulsivity, as women had higher scores on this facet of impulsivity than men. However, this gender effect has already been found in several studies performed with the UPPS (Billieux, Van der Linden, et al., 2008; Gay et al., 2008) and is in accordance with studies highlighting a greater occurrence of self-reported experiences of negative affect in women than in men (Fujita, Diener, & Sandvik, 1991).

Although the present research focuses on the psychological mechanisms underlying urgency, we have to discuss here the unexpected relationship found between sensation seeking and the stop-signal task. More precisely, persons with a higher level of sensation seeking are better at inhibiting prepotent responses when confronted with emotional stimuli (especially positive stimuli), which raise the relevance of considering the tentative impact of sensation seeking on cognitive control. To this end, we found the Dual Mechanisms of Control theory by Braver, Gray, and Burgess (2007) of much interest. The central hypothesis of these authors is that when persons activate information relevant to a goal, cognitive control is likely to operate through two distinct modes: a proactive control mode and a reactive control mode. Proactive control implies active maintaining of goal-related information in working memory (top-down processes), whereas reactive control is characterised by activation of goal-related information in reaction to the environmental context when necessary (bottom-up processes). In this vein, a proactive mode of cognitive control is probably more suited to perform well at the stop-signal task. Indeed, active maintaining of the contextual information relative to the task within working memory may promote top-down bias (e.g., to exert control on a behaviour that has become dominant), whereas reactive cognitive control remains relatively unbiased and more influenced by bottom-up inputs (implying increased difficulty in inhibiting a behaviour that has become dominant). Consequently, our hypothesis is that high sensation seekers will preferentially adopt a proactive mode of cognitive control when performing the stop-signal task, implying that they are more efficient in inhibiting behavioural responses that have been previously automatized. Ultimately, the link between

high sensation seeking and better performances in the emotional conditions of the stop-signal task can tentatively be allotted to the fact that the adoption of a proactive mode of cognitive control helps to overcome the emotional interference provoked by arousing stimuli.

Urgency and problematic behaviours

The present study confirms that the urgency component of impulsivity plays a crucial role in the occurrence of various problematic and maladaptive behaviours (Cyders & Smith, 2008, for a review). More precisely, we found negative urgency to predict the occurrence of all of the problematic behaviours assessed, namely, compulsive buying, problematic use of the mobile phone, and problematic use of the Internet. Moreover, the current results add supplementary support to the view that a high level of negative urgency may result in maladaptive behaviours that serve to regulate affective states through the relief of negative emotions (e.g., Cyders & Smith, 2008; Selby et al., 2008). Indeed, research has, for example, highlighted that both compulsive buying and excessive use of the Internet may serve as behaviours used to cope with or manage negative affective states (Miltenberger et al., 2003; Wan & Chiou, 2006). Considering the psychological mechanisms underlying the urgency facet of impulsivity, these maladaptive behaviours could be viewed as actions performed with the short-term perspective of emotion management through immediate positive or negative reinforcement. In other words, and in accordance with proposals by other researchers (Evans, 2003, 2004; Figner et al., 2009), our results suggest that these rash actions may take place when the experience of intense emotions interferes with inhibitory control and precludes the activation of the demanding analytical or deliberative processing, which is necessary to consider the immediate benefits in relation to the future costs. Ultimately, it could be supposed that persons with a higher level of urgency are more at risk for developing clinically relevant problems (e.g., addictive or compulsive behaviours) as they become caught in a vicious circle in which rash or unplanned actions performed in emotional contexts result in negative outcomes (personal, professional, social), promoting, in turn, the experience of negative emotions that may be relieved by overwhelming urgency-related behaviours.

Of particular interest regarding the specificity of the various impulsivity facets are strong associations between problematic behaviours and negative urgency; however, the relationships between these behaviours and lack of premeditation is slim or non-existent. This finding confirms previous results highlighting that, contrary to negative urgency, lack of premeditation is not a predictor of both compulsive buying tendencies and dependence on the mobile phone when the effect of all impulsivity facets is controlled (Billieux, Rochat, et al., 2008; Billieux, Van der Linden, d'Acremont, et al., 2007; Billieux, Van der Linden, et al., 2008). Thus, in contrast to urgency, a low level of premeditation may reflect a proneness to act without forethought in general, that is, not in highly arousing emotional contexts. In fact, it could be proposed that low premeditators are likely to make disadvantageous decisions because of inadequate or non-adapted deliberative processes (e.g., they do not use all relevant information when making a decision). Indeed, it has been found that low premeditation is a predictor of certain behaviours or decisions occurring in less emotional or arousing contexts but which could have tangible negative long-term consequences. As an example, low premeditation is a predictor of being a smoker (Miller et al., 2003), which could be considered as a prototypical behaviour implying devastating long-term consequences for health. From this perspective, starting to smoke could be viewed as the result of a poor deliberative process (if deliberation is referred to as a decision making

process that takes into account the balance between short-term and long-term benefits in the light of all factual relevant information for that decision; Evans, 2003; Figner et al., 2009). Accordingly, it has been shown that low premeditators make less advantageous choices than do high premeditators in a "delay discounting" task in which they have to choose between a small amount of fake money that is immediately available or a much higher amount of fake money that is delayed (Lynam & Miller, 2004). However, among smokers, negative urgency (and not lack of premeditation) predicts the intensity of craving (i.e., the desire to smoke that frequently results in an overwhelming impulse to smoke) related to the relief from negative affect (e.g., in response to anxiety, depression, or withdrawal symptoms; Billieux, Van der Linden, & Ceschi, 2007; Doran et al., 2009). Such distinctions between urgency and premeditation help explain their similarities and dissimilarities. Although these two components of impulsivity are related to a kind of "myopia" toward long-term consequences of certain actions, they especially differ in the sense that they take place in "cold" situations (characterised by low emotional arousal) versus "hot" situations (characterised by high emotional arousal). This latter difference may account for the fact that urgency, rather than lack of premeditation, predicts the occurrence of a wide range of problematic behaviours performed with the aim of regulating emotional experiences (e.g., Nock et al., 2008; Selby et al., 2008).

Limitations

Some limitations of the current study warrant discussion. First, potential predictions concerning maladaptive behaviours occurring when individuals experience intense positive emotions are inferential, as positive urgency was not directly assessed in the version of the UPPS used in the present study. Nevertheless, we found that a poor ability to inhibit prepotent responses in emotional contexts (both positive and negative) results in more frequent rash and short-term based actions (i.e., less advantageous choices in the IGT) and higher levels of negative urgency. Thus, in accordance with Cyders et al. (2007), who highlighted by using confirmatory factor analysis that positive and negative urgency are highly correlated and load on a common factor of "emotionally based rash actions" we assume that these two constructs are possibly underlain by similar psychological mechanisms. Such an explanation could on the one hand account for the fact that urgency-related behaviours may be triggered by both positive and negative intense emotional contexts (Cyders & Smith, 2008) and on the other hand for the very strong correlations taking place between positive and negative urgency (e.g., $r = .67$, Verdejo-García, Lozano, Moya, Alcasar, & Pérez-García, 2010; $r = .67$, Zapolski et al., 2009). However, further research assessing both positive and negative urgency is needed to empirically test that these two impulsivity facets are underlain by common psychological mechanisms.

Second, the current study comprises no mood manipulation or measurement (e.g., pre-, post-, or during the stop-signal task). This choice was motivated by our wish to investigate the relationship between urgency and the ability to inhibit a prepotent response in response to an emotional stimuli and not to induce a mood state in participants (e.g., through film or music) and then test the participants with a classical stop-signal paradigm (not designed with emotional stimuli). More precisely, on the basis of a conceptualization of urgency as the tendency to act rashly in response to emotions (Cyders & Smith, 2008), we found it more relevant to use a task designed to trigger emotions (the presentation of faces with positive or negative expression activates the amygdala and related emotion processing networks, see e.g., Hare, Tottenham, Davidson, Glover, & Casey, 2005) rather than to induce mood states in the

participants. Indeed, mood states generally refer to an affective state that is not related to a specific event and that is characterised by longer duration, lower intensity, and a certain diffuseness (Frijda, 1993). Nevertheless, we acknowledge that the use of experimental mood induction is a relevant topic for further research on urgency, especially considering that urgency-related problematic behaviours have been associated with not only the relief of intense negative emotions, but also with the relief of more stable negative mood states (e.g., Anestis et al., 2007).

Third, the current study is cross-sectional in nature. Thus, longitudinal studies are needed to investigate whether the psychological mechanisms related to the urgency facet of impulsivity contribute to the progression and maintenance of problematic behaviours. In addition, further research should also consider the possibility of using more ecological measures to assess proneness to problematic behaviour, rather than being restricted to self-reports. For example, problematic behaviours could be measured with diaries in which participants can record behaviours daily during a certain period. In the framework of research on urgency, this method is all the more relevant, as participants could be instructed to pay particular attention to their emotional state before their involvement in the concerned behaviour.

To summarize, the present study opens new prospects for the comprehension of mechanisms underlying the urgency facet of impulsivity and its role in problematic or maladaptive behaviour (e.g., compulsive buying or overuse of the mobile phone and the Internet). Ultimately, we think that our findings could be generalized to other maladaptive behaviours occurring in response to intense emotions (e.g., non-suicidal self-injury, risky sex, binge drinking or eating).

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