Now or not-now? The influence of alexithymia on intertemporal decision-making

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ABSTRACT

Optimal intertemporal decisions arise from the balance between an emotional-visceral component, signaling the need for immediate gratification, and a rational, long-term oriented component. Alexithymia, a personality construct characterized by amplified sensitivity to internal bodily signals of arousal, may result in enhanced activation of the emotional-visceral component over the cognitive-rational one. To test this hypothesis, participants with high- and low-alexithymia level were compared at an intertemporal decision-making task, and their choice behavior correlated with their interoceptive sensitivity. We show that high-alexithymic tend to behave more impatiently than low-alexithymic in intertemporal decisions, particularly when the sooner reward is immediately available. Moreover, the greater their sensitivity to their own visceral sensations, the greater the impatience. Together, these results suggest a disproportionate valuation of reward available immediately in high alexithymia, possibly reflecting heightened perception of bodily physiological signals, which ultimately would bias their intertemporal decision-making.

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1. Introduction

When the Little Prince started his journey throughout the universe, his conceited Rose, left alone on the planet, was placed in front of a choice: she could choose whether to remain a wonderful rose but to be alone, or to lodge some caterpillars, who could ruin her beauty, but who could allow her to take delight from future butterflies. In other words, the Rose had to make an intertemporal choice: decide whether to go for an immediate option (being beautiful), or to forgo the immediate gratification and wait to get a larger reward (having company) (e.g., Frederick, Loewenstein, & O’Donoghue, 2002; Sellitto, Ciaramelli, & di Pellegrino, 2011). Apart from this example, – which entails personal vs. social rewards – intertemporal decision-making pervades our daily lives. For instance, we might need to decide whether saving money to buy a house in the future instead of spending it for a car right now or – as it occurs in laboratory studies – whether we prefer receiving a small amount of reward right now or waiting two months to get a larger amount of the same reward (Estle, Green, Myerson, & Holt, 2007; Johnson, Bruner, & Johnson, 2015; Johnson, Johnson, Hermann, & Sweeney, 2015; Kable & Glimcher, 2007, 2010; McClure, Ericson, Laibson, Loewenstein, & Cohen, 2007; McClure, Laibson, Loewenstein, & Cohen, 2004; Petry, 2001; Schiff et al., 2016; Sellitto, Ciaramelli, & di Pellegrino, 2010; Sellitto, Ciaramelli, Mattioli, & di Pellegrino, 2016; Sellitto & di Pellegrino, 2014, 2016).

Often, individuals tend to prefer smaller reward available in the short run over larger reward delayed in time, and this tendency is even larger when the sooner reward is immediately available (Loewenstein, 1996; Loewenstein, Rick, & Cohen, 2008). Although intertemporal choice seems prima facie to be a purely rational type of affair, the influence of emotion is essential. Indeed, when people are faced with a choice between competing options, they rely on the anticipated emotion associated with receiving one or the other outcome in order to make their decision (Loewenstein, 1996). Among the range of possible emotional response, the anticipated emotion associated with the potential choice produces bodily reactions (i.e., autonomic changes such as skin conductance, blood pressure, heart rate, pupil dilation), which signal the intensity (salience) of the valence (negative or positive) of stimuli experienced
by individuals. According to recent accounts in neuroeconomics indeed, affective/visceral mechanisms have a crucial role in modu-
lat ing the computation of the subjective rewarding value of options and, in the ultimate instance, of decisions (e.g., Charpentier, De Neve, Li, Roiser, & Sharot, 2016; Kable & Glimcher, 2007, 2010; Lempert, Glimcher, & Phelps, 2015; Lempert & Phelps, 2016; Phelps, Lempert, & Sokol-Hessner, 2014). In the specific case of intertemporal choice, on the one hand, the relative desirability of different options is represented by vis-
cer al sensations linked to the current status of the body (Loewenstein, 1996; Loewenstein et al., 2008). On the other hand, the long term self interests are pursued thanks to the vottional
control of behavior. Thus, during intertemporal choice, individuals may face a conflict between competing drives or motives (Loewenstein, 1996; Loewenstein et al., 2008).

Neuroscience research has proposed several models of the interplay between the emotional and control systems over intertemporal choice. According to dual valuation, β–δ model (McClure et al., 2004; McClure et al., 2007), a limbic system (β) is deemed to be preferentially responsible for impatience choice, tracking the desire for present outcomes (also called “hot-
system”; Luo, Ainslie, & Monterosso, 2014; McClure et al., 2004; McClure et al., 2007; Metcalfe & Mischel, 1999), whereas a more cognitive, prefrontal-cortex-based system (δ) is more involved in far-sighted choices by highlighting the future consequence of actions (also called “cold-system”; McClure et al., 2004; McClure et al., 2007; Metcalfe & Mischel, 1999). In an alternative, single val-
uation model, the values of both immediate and delayed rewards are thought to be represented in a unitary system implicating the medial prefrontal cortex, posterior cingulate cortex, and ventral striatum (Kable & Glimcher, 2007, 2010; Peters & Büchel, 2009).

The extreme unbalance between the affective/visceral and the control components can be easily observed in patients with brain lesions. For instance, increased impatience is detectable following damage to the medial orbitofrontal cortex (Sellitto et al., 2010), a brain region known to promote ‘rational’ decision-making and self-control, necessary to override more valuable immediate grati-
fication (Christakou, Brammer, Giampietro, & Rubia, 2009; De Martino, Kumaran, Seymour, & Dolan, 2006; Hare, Camerer, & Rangel, 2009). On the contrary, if the control system prevails on the affective/visceral one, individuals tend to be more willing to wait for the larger-later reward, acting prudently. This is what hap-
pens following lesions involving the insula (Naqvi, Rudrauf, Damasio, & Bechara, 2007; Sellitto & di Pellegrino, 2016), a brain region known to provide anticipatory interoceptive signals to guide time-based decisions (e.g., Craig, 2009). Devoid of intero-
cognitive signals from the body, patients with insular lesions show dis-
rupted urge for immediate outcomes (Naqvi et al., 2007; Sellitto & di Pellegrino, 2016).

Although the unbalance between the affective/visceral and the control systems is readily observable in brain-damaged patients, relatively little is known about what happens in subclinical popu-
lations where the emotional sphere is affected. In the domain of emotions, alexithymia emerges as a personality trait expressed with variable intensity in the general population (Kokkonen et al., 2001; Salminen, Saarajärvi, Aarela, Toikka, & Kauhanen, 1999). Alexithymic individuals, i.e. those individuals whose alex-
ithymia score falls in the higher 10% of the normal population (Taylor, Bagby, & Parker, 1991), are characterized by only partial elaboration of the emotional content of stimuli, with resulting impoverished emotions’ understanding (e.g., Moriguchi & Komaki, 2013), and regulation (van der Velde et al., 2015). In line with Sifneos’ observations of higher prevalence of alexithymia in psychosomatic disorder patients (Sifneos, Apfel-Savitz, & Frankel, 1977), individuals with high alexithymia (HA) level are known to experience amplified bodily sensations (Naqvi, Barsky, Kumano, & Kuboki, 2002; Nyklíček & Vingerhoets, 2000), such that the so-called somatosensory amplification model of alexithymia has been proposed (Naqvi et al., 2002; Nyklíček & Vingerhoets, 2000; Wise & Mann, 1994). This hypothesis maintains that alexithymia is characterized by an amplification of the normal bodily and vis-
ceral phenomena accompanying emotional arousal, resulting in enhanced activation at the physiological levels and less activation in the cognitive-experiential domains. Accordingly, HA individuals mainly rely on physical/bodily information to judge the emotional content of stimuli, and tend to experience physical sensations in response to emotion-provoking stimuli (Kano, Hamaguchi, Itoh, Yanai, & Fukudo, 2007; Moriguchi & Komaki, 2013; Scarpazza, Lädavas, & di Pellegrino, 2015). Indeed, although being able to detect their own visceral changes (Ernst et al., 2014; Scarpazza et al., 2015), HA individuals usually fail to translate these visceral signals into higher levels of emotional processing and awareness. In this way, the emotion-evoking event is perceived only at the lower, more physical level, and is not further elaborated and inte-
grated with the higher levels of emotional processing.

Despite the crucial influence of emotions on decision-making, choice behavior has been surprisingly poorly studied in alex-
ithymia (Ferguson et al., 2009; Kano, Ito, & Fukudo, 2011), and no studies have so far investigated intertemporal decision-
making in these individuals. During intertemporal choice, the anticipated emotion associated with the potential choice produces important bodily and visceral changes, which are enhanced in individuals with high level of alexithymia, according with the “somatosensory amplification hypothesis”. Since HA individuals are strongly anchored to their own bodily signals, which are con-
sidered to be the critical information upon which the affective component relies (Loewenstein, 1996; Loewenstein et al., 2008), one can argue that the balance between the affective and control component supporting intertemporal choice is altered in favor of the affective one. As a consequence, the cognitive component would be relatively less represented, thus weakening HA ability to pursue long term self interests, and engendering impatience. We predict that this unbalance may result in higher sensitivity to immediate rewards during intertemporal choice. In other words, HA individuals are expected to choose more impulsively, thereby preferring smaller, yet immediately available, reward. Moreover, we reasoned that the evidence that HA individuals may heavily rely on their own bodily sensations during decision-making might be bolstered by demonstrating that links exist between intero-
cesence (as defined by Garfinkel & Critchley, 2013) and intertemporal choice behavior.

To address these questions, participants with low and high level of alexithymia (LA and HA, respectively) were submitted first to an intertemporal choice task (Sellitto & di Pellegrino, 2016) to get a measure of subjective devaluation of monetary reward as the delay until its receipt increases (i.e., temporal discounting, TD; Ainslie, 1975). Two conditions were included: in one, the choice was between a smaller money amount available immediately and a larger amount available later, whereas in the other a fixed delay of 60 days was added to both options (Kable & Glimcher, 2010). Peo-
ple usually increase their preference for smaller reward when this is immediately available (Frederick et al., 2002), since it is more salient as compared to the later one (Loewenstein, 1996). Then, in order to understand whether the TD behavior in HA individuals is linked to its tendency to rely on bodily information, participants performed the heartbeat perception task (Schandy, 1981), which requires to silently count one’s own heart beat and is widely used to measure individual’s interoceptive sensitivity (i.e., the objective accuracy in detecting internal bodily sensations; Garfinkel & Critchley, 2013).
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