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Time perception deficits in impulsivity disorders: A systematic review☆,☆☆

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ABSTRACT

This systematic review aims to identify evidences of distortions in time perception (TP) in people with impulsivity disorders or other conditions having impulsivity traits, namely traumatic brain injuries, certain personality disorders, addictive behavior disorders, and pathological gambling. Studies related to TP deficits and impulsivity disorders were retrieved from multiple literature databases, through predefined inclusion and exclusion criteria. From the 197 obtained documents, 47 were selected for analysis, and a final set of 15 studies was retrieved for this review. Regardless of some conflicting findings, the available results suggest that patients with orbitofrontal lesions produce and reproduce significantly less time and estimate time periods significantly longer than healthy subjects. Patients with borderline personality disorder show decreased time perception and patients with antisocial personality disorder seem to execute more premature responses during time estimation tasks. Stimulant dependent individuals also tend to overestimate the time intervals, and pathological gamblers demonstrate shorter time horizons than social gamblers. Taken together, the available data suggest that impulsive individuals tend to overestimate the passage of time and to execute more premature responses, producing and reproducing less time, but more research is necessary to increase the strength of the evidences on this issue. This systematic review updates evidences of distortions in TP in impulsivity, improving the understanding of the relations between these two variables.

Contents

This review aims to identify evidences of distortions in time perception (TP) in people with impulsivity disorders, or in other conditions where impulsivity traits are characteristically present, namely traumatic brain injuries, psychopathy and other personality disorders, addictive behavior disorders, and pathological gambling. This systematic review was informed by the Cochrane Collaboration guidelines (Alderson & Green, 2002; Higgins & Green, 2011).

TP is defined as an inherent ability of human beings and other organisms, necessary to relate impulsive behavior to the environment where it occurs, given that the environment includes stimuli such as lights, smells, sounds, and flavors to which all animals are sensitive (Castro, Carvalho, Kroger-Costa, & Machado, 2013).

Some empirical studies suggest an association between TP and impulsivity (Bauer, 2001; Wittmann et al., 2011). Impulsivity refers to a difficulty of self-control, which may be manifested in the daily routine

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in several ways, for instance: extraversion, impatience, inattention, neglect, engagement in risk situations, search for new experiences and sensations, depleted insight on injury (Hollander & Evers, 2001). This is a symptom in several psychiatric disorders deemed as impulse control disorders (e.g., pathological gambling, substance abuse), as well as in several personality disorders (e.g., borderline personality disorder – BPD, antisocial personality disorder – APD), and mood disorders (e.g., bipolar disorder) (APA, 2013), being also evident in neurological pathologies associated with behavioral disinhibition (Hollander & Evers, 2001).

As Correa, Trivino, Perez-Duenas, Acosta, and Lupianez (2010) explain, impulsivity can be related to a deficient temporal preparation of inhibitory processes. Understanding how impulsive individuals perceive time may shed light on important decision-making and behavior monitoring mechanisms, and this work is all the more important as impulse control difficulties are characterized by a predisposition to gratify immediate desires and impulses, including aggressive and violent ones, regardless of the consequences to one's self or to others. In fact, many studies relate impulsivity to violent and aggressive behavior (e.g., see Chen et al., 2014; Derefinko, DeWall, Metze, Walsh, & Lynam, 2011; Irwin & Gross, 1995; Volavka, 2014).

Regarding the consequences of altered time perception to decision-making processes in impulsive individuals, Wittmann and Paulus (2008) bespeak through a literature review the premise that these individuals have a more subjective experience of time, overestimating the duration of time intervals and, thus, discounting the value of delayed rewards more pronouncedly than people with better self-control. The thesis is that impulsive individuals usually choose smaller and immediate rewards, instead of delayed but larger rewards, possibly because subjects with marked impulsivity traits have an accelerated sense of time (Berlin, Rolls, & Iversen, 2005). A longer TP is associated with higher costs, leading to the selection of alternatives with more immediate results.

With this review we intended to make a further contribution to fill the gap in the existing literature concerning the distortions in TP in people with impulsivity traits.

We oriented this paper as a systematic summary on TP deficits in impulsivity disorders, reviewing their components, describing their results, and providing recommendations for future work.

1. Method

1.1. Search strategy

Studies were identified by searching multiple literature databases in EBSCOhost, including Academic Search Complete, Education Source, MEDLINE, PsycARTICLES, PsycBOOKS, SocINDEX with Full Text, and SPORTDiscus with Full Text. In order to avoid publication and source selection bias, these database searches were supplemented by additional hand searching. The key search terms were: Impulsivity disorders OR psychopath* OR sociopath* OR antisocial* – AB abstract; AND time perception OR temporal perception – Tx All Text; Not psychopatho* – AB abstract. The search was not constrained by any geographic, temporal, or linguistic factors.

As suggested by the Cochrane Collaboration, the selection of studies for eligibility and data extraction was undertaken by three independent reviewers in order to reduce the likelihood of missed studies or errors in classification (Alderson & Green, 2002; Higgins & Green, 2011). Any disagreements between reviewers were discussed and a consensus was reached.

Only empirical studies were included. Studies that did not have a control/comparison group were excluded from this review, except correlational-based studies in which continuous measures of impulsivity were used as predictors of time perception. Studies limited to children were also excluded.

A total of 197 studies, published between 1934 and 2014, were identified from all databases and search methods. After duplicate removal, the abstracts of 49 studies (17 from Academic Search Complete, three from Education Source, 14 from MEDLINE, 12 from PsycARTICLES, one from PsycBOOKS, one from SocINDEX, one from SPORTDiscus) were screened (see Fig. 1). From these, 29 studies were excluded because did not have a comparison group ($n = 12$) and/or comprised children only ($n = 17$). The remaining 20 studies were fully read and assessed for eligibility. Five studies were further excluded for not being related to the theme. Thus, a total of 15 studies were reviewed and their findings presented here.

2. Results

A summary of the characteristics of included studies is presented in Table 1. Across studies, the total number of participants was 1848 ($M = 264.0$, $SD = 513.0$, Min = 15; Max = 679), with 726 ($M = 103.7$, $SD = 190.2$, Min = 15; Max = 266) participating in the experimental groups and 1122 ($M = 160.3$, $SD = 326.3$, Min = 15; Max = 679) in the healthy comparison groups. The studies by Havik et al. (2012) and Schulreich, Pfabigan, Derntl, and Sailer (2013) had only one sample of healthy participants ($n = 58$ and $n = 21$, respectively) and their impulsivity measures were related to time perception.

The studies reviewed use a variety of methods to assess TP: time estimation tasks (6 studies); time reproduction tasks (4 studies); time production tasks (4 studies); and time discrimination tasks (2 studies). Information delivered in five of the studies does not allow accurately knowing the methods used.

In *time estimation tasks*, participants usually observe images separated by a variable time interval of some seconds (Min = 400 ms; Max = 90 s). The participants must indicate the time they believe to have elapsed between images.

In *time reproduction tasks*, participants also observe two images separated by a variable time interval (Min = 500 ms; Max = 14 s). After a few seconds, a new image appears and the participants must press a key when they believe the same amount of time has passed as in the previous time interval.

In *time production tasks*, the computer indicates to the participants a time interval to be produced (Min = 500 ms; Max = 90 s). Then, participants observe an image indicating the start of the time count and press a key when they believe to have reached the indicated time.

In *time discrimination tasks*, two consecutive time intervals are typically presented (varying from a minimum of 100 ms and a maximum of 1875 s) and participants judge if the second was shorter or longer than the first.

Two of the reviewed studies used sounds (Bauer, 2001; Wittmann, Leland, Churan, & Paulus, 2007), while five used images (Berlin et al., 2010; Havik et al., 2012; Mioni, Mattalia, & Stablum, 2013; Mioni, Stablum, McClintock, & Cantagallo, 2012; Schulreich et al., 2013). However, eight studies (Berlin & Rolls, 2004; Berlin et al., 2005; Hodgins & Engel, 2002; Klingemann, 2001; MacKillop, Anderson, Castelda, Mattson, & Donovick, 2006; Petrovici & Scheider, 1994; Petry, Bickel, & Arnett, 1998; Smart, 1968) do not indicate such information, as most of them are focused on self-report measures of time perspective, instead of experimental tasks of TP.

2.1. Time perception and traumatic brain injuries (TBI)

Only four studies were focused on TP in patients with TBI. Research shows that patients with orbitofrontal lesions are significantly more impulsive than healthy comparison groups (e.g., Berlin et al., 2005), although little is known concerning the importance of the orbitofrontal cortex (OFC) for TP. Interestingly, the reviewed studies found that patients with orbitofrontal lesions produce and reproduce significantly shorter time periods