Progress in Neuropsychopharmacology & Biological Psychiatry 81 (2018) 17–24

Contents lists available at ScienceDirect

Progress in Neuropsychopharmacology & Biological Psychiatry

journal homepage: www.elsevier.com/locate/pnp

How can the depressed mind extract and remember predictive relationships of the environment? Evidence from implicit probabilistic sequence learning

Karolina Janacsek[a,b,1], Emőke Borbély-Ipkovich[b], Dezso Nemeth[a,b,*], Xénia Gonda[c,d]

[a] MTA ELTE NAP-B Brain, Memory and Language Lab, ICNP, RCNS, Hungarian Academy of Sciences, Budapest, Hungary
[b] Institute of Psychology, Eötvös Loránd University, Budapest, Hungary
[c] Department of Psychiatry and Psychotherapy, Semmelweis University, Budapest, Hungary
[d] MTA-SE Neuropsychopharmacology and Neurochemistry Research Group of the Hungarian Academy of Sciences, Semmelweis University, Hungary

ARTICLE INFO

Keywords:
Depression
Fronto-striatal circuits
Implicit sequence learning
Statistical learning
Predictive processing
Consolidation

ABSTRACT

A growing body of evidence suggests that emotion and cognition are fundamentally intertwined; impairments in explicit, more effortful and attention-dependent cognitive functions have widely been observed in negative mood. Here we aimed to test how negative mood affects implicit cognition that is less susceptible to motivational and attentional factors associated with negative mood. Therefore, we examined implicit learning and retention of predictive relationships in patients with major depressive episode (MDE). Additionally, we directly compared subgroups of patients with major depressive disorder (MDD) vs. bipolar disorder (BD) in order to gain a deeper understanding of how implicit cognition is affected by these conditions. Implicit probabilistic sequence learning was measured by the Alternating Serial Reaction Time Task. The acquired knowledge was retested after a 24-hour delay period. Consistent with the frontostriatal deficits frequently reported in depression, we found weaker learning in patients with MDE, with a more pronounced deficit in patients with MDD compared to BD. After the 24-hour delay, MDE patients (both subgroups) showed forgetting, while the controls retained the previously acquired knowledge. These results cannot be explained by alterations in motivation, attention and reward processing but suggest more profound impairments of implicit learning and retention of predictive relationships among neutral stimuli in depression. To the best of our knowledge, this is the first study investigating retention of implicitly acquired sequential knowledge and reporting deficits in this domain in MDE. Our findings not only contribute to a better understanding of the complex interplay between affect and cognition but can also help improve screening, diagnosis and treatment protocols of depression.

1. Introduction

Contrary to the long-standing view of separated emotional and rational (dual) systems (Figner et al., 2009; Kahneman, 2011), a growing body of evidence suggests that emotion and cognition are fundamentally intertwined, both on mechanism and on neural level (for a review see Phelps et al., 2014). Mood is a relatively lasting affective state that, consequently, can have a persistent effect on cognition. A spate of previous work has found impairments in mood disorders in more effortful and attention-dependent cognitive functions, such as cognitive control, executive functions, planning, explicit/declarative learning and memory (Bora et al., 2013; Bourne et al., 2013; Snyder, 2013). However, it remains unclear to what extent are these impairments due to a general decrease in motivation and/or attentional resources. Here we aimed to test the effect of negative mood on implicit cognition that is less susceptible to motivational and attentional factors in order to gain a deeper understanding of the interplay between affect and cognition. To this end, we examined implicit learning and retention of predictive relationships in patients with Major Depressive Episode (MDE).

MDE is one of the most common psychiatric diagnoses (Patten, 2009) characterized by persistently low level of mood that affects interest in daily activities, energy level, sleep, psychomotor functioning (APA, 2000), and more broadly, social and occupational functioning (Godard et al., 2011). Depending on the alterations between different mood states, MDEs can occur in patients with Unipolar Major Depressive Disorder (MDD), where negative mood states can alternate with euthymic phases, and in patients with Bipolar Disorder (BD), where negative mood states alternate with manic or hypomanic phases (APA, 2000). Alterations in the neural circuitries involved both in emotion regulation and cognition have been shown in MDE, primarily in the

* Corresponding author at: Eotvos Loránd University, Institute of Psychology, Damjanich utca 41-43, Budapest 1071, Hungary.
E-mail address: nemeth.dezso@ppk.elte.hu (D. Nemeth).
[1] All authors contributed equally to this work.

http://dx.doi.org/10.1016/j.pnpbp.2017.09.021
Received 27 February 2017; Received in revised form 11 September 2017; Accepted 21 September 2017
Available online 25 September 2017
0278-5846/ © 2017 Elsevier Inc. All rights reserved.

fronto-striatal network (Bora et al., 2012; Brambilla et al., 2001; Koolschijn et al., 2009). Some studies have reported larger morphometric and functional abnormalities of the striatum in patients with MDD compared to BD, where it was mainly present in association with the length of illness (Brambilla et al., 2001; Savitz and Drevets, 2009). Given the striatum's prominent role in predicting future outcomes based on previous experience (Balleine et al., 2007; den Ouden et al., 2010; Li and Daw, 2011), one could assume that implicit learning of predictive relationships is affected in MDE.

Implicit learning occurs when predictive relationships in form of statistical regularities or sequence of events are extracted from the environment without putting conscious effort into the process or realizing the learning process at all (Reber, 1993). Research has showed that implicit learning plays a critical role in guiding our behavior in many day-to-day activities (Kaufman et al., 2010; Norman and Price, 2012; Romano Bergstrom et al., 2012) and it primarily relies on the fronto-striatal circuitries (Doyon et al., 2009; Hikosaka et al., 1999; Poldrack et al., 2005; Reber, 2013). The most common task for measuring implicit learning is the Serial Reaction Time (SRT) Task (Nissen and Bullemer, 1987), in which participants respond to repeating sequences of stimuli presented on the computer screen. With practice, participants become faster in responding to the repeating sequences, and they slow down when the sequence pattern is removed at the end of practice (random block). Studies with SRT found impaired learning during a depressive episode in MDD (Exner et al., 2009; Naismith et al., 2006) as well as in BD (Chrobak et al., 2015). However, these studies had a limited capacity to disentangle sequence-specific learning from more general psychomotor impairments: if patients do not show RT improvement during the sequence blocks at all, then no RT rebound can be expected on the random block (Borbély-Ipkovich et al., 2014; Klivenyi et al., 2012). Hence, based on these studies, one cannot conclude whether implicit learning of sequences is impaired or intact in depression. Moreover, SRT tasks have several additional drawbacks: participants easily become aware of the sequence structure and explicit, attention-dependent strategies may influence their performance (Perruchet et al., 1997), and usually a short version of the task is administered (20–30 sequence presentations), making it difficult to distinguish between a total inability to learn the sequences or just a partial impairment (e.g., a slower pace of learning).

Here we used the Alternating Serial Reaction Time (ASRT) task (Howard and Howard, 1997) as a more suitable tool for measuring implicit learning of predictive relationships. In this task, random elements are inserted in the repeating pattern, creating an eight-element probabilistic sequence (e.g., 2r3r1r4r, where numbers indicate locations on the screen, and r indicates a randomly chosen location). Stimulus *n* can be predicted based on the stimulus *n-2* (e.g., 2_3, where _ indicates any location out of the four possible ones) but only with a 62.5% certainty because other stimulus-triplets can also be formed due to the random elements (e.g., 2_1, 2_4, 2_2) in 37.5% of the time. The former, more predictable stimuli are referred to as high-predictability triplets and the latter ones as low-predictability triplets. Because of these triplet characteristics, the task is also often referred to as an associative learning (Barnes et al., 2010) or statistical learning task (Nemeth et al., 2013a). Learning is defined as RT difference in responses to high- vs. low-predictability triplets, which can be measured from the very beginning of the task. The ASRT task is considered a purer measure of implicit learning, since participants remain unaware of the stimulus structure even after extended practice (i.e., ten days; Howard et al., 2004), and is appropriate to measure the time course of learning, as a typical learning session includes at least 200 sequence presentations (Howard et al., 2004; Howard and Howard, 1997; Nemeth et al., 2013a).

The goal of our study was threefold. First, we aimed to explore implicit probabilistic sequence learning in patients with MDE using a task that overcomes several drawbacks of previous research. Here we used the ASRT task that remains implicit for the participants, and enables us to continuously measure learning performance from the very beginning of the task through a longer learning session (200 sequence presentations). Second, we aimed to characterize the time course of implicit sequence learning not only during the Learning Phase, but also after a 24-hour delay period, which is an entirely novel contribution to the field as, to the best of our knowledge, no study has yet investigated the retention of implicitly acquired sequential knowledge in MDE. Thus, we tested whether participants were able to retain the acquired sequence knowledge for a relatively longer stretch of time after the initial acquisition. Third, although our primary aim was to examine implicit learning and retention in patients with MDE compared to the healthy controls, we also planned to directly compare – for the first time – the implicit learning and retention performance of MDD vs. BD patients. We hypothesized weaker learning and retention performance in patients with MDE compared to the controls. Based on the fronto-striatal dependency of implicit sequence learning and retention, larger impairments were expected in MDD compared to BD.

2. Materials and methods

2.1. Participants

Twenty patients with MDE (M_{age} = 45.95, SD_{age} = 12.39; $M_{education}$ = 14.20, $SD_{education}$ = 3.16; 13 females) were recruited from Kutvolgyi Clinical Center at Semmelweis University in Budapest, Hungary. They had been diagnosed by a team including a licensed clinical psychologist and a board-certified psychiatrist at the clinical center. Based on DSM-IV-TR (APA, 2000), ten patients met the criteria for a diagnosis of MDD, and the other ten patients met the criteria for a diagnosis of BD (demographics by subgroup are presented in Table 1). Exclusionary criteria included co-morbid schizophrenia, ADHD, current anxiety disorder, current substance use disorder, and any neurological disorder (Burdick et al., 2015). All patients received medication at the time of the study (details are reported in Table 1).

Twenty-one healthy control participants were matched to patients based on age, gender and years of education (Table 1). Exclusionary criteria included a current or lifetime diagnosis of any psychiatric or

Table 1
Demographic and clinical data (means, standard deviations, and proportions) for the control (n = 19) and patient groups (n = 20, 10 diagnosed with MDD, and 10 diagnosed with BD). The current state of anxiety (State-Trait Anxiety Inventory – STAI), mood (Positive and Negative Affective Schedule – PANAS), and depressive symptoms of the participants were evaluated (Beck Depression Inventory – BDI).

	Control	MDD	BD	*p*-Value
Age (years)	44.58 (16.25)	47.90 (10.77)	44.00 (14.13)	0.801
Education (years)	14.32 (3.28)	13.20 (3.58)	15.20 (2.44)	0.379
Gender (F/M)	12/7	6/4	7/3	0.891
BDI	4.63 (4.64)*	33.70 (8.68)	26.40 (10.74)	< 0.001
STAI-S	39.47 (8.69)*	52.40 (9.88)	52.90 (9.86)	< 0.001
PANAS-positive affect	39.68 (4.61)*	27.40 (9.30)	23.60 (7.56)	< 0.001
PANAS-negative affect	14.11 (4.34)*	24.30 (8.99)	24.70 (11.02)	0.003
Medications: AD/AP/AE/BD/L	–	9/5/5/3/1	10/10/5/2/1	0.010 (AP only)

Notes: *p*-Values of univariate ANOVAs (for comparisons of three groups), and chi-squared tests (for comparisons of gender and medication proportions across groups) are reported. The patient groups had similar BDI, STAI-S, and PANAS scores but differed significantly from the controls (marked with an asterisk, *, based on LSD post hoc tests). As it is typical in the clinical profile of MDE, 10/10 in the BD group took antipsychotic medications compared to the 5/10 patients in the MDD group. Abbreviations of the medication categories: AD – antidepressants, AP – antipsychotics, AE – antiepileptics, BD – benzodiazepines, L – lithium.

Download English Version:

https://daneshyari.com/en/article/5557882

Download Persian Version:

https://daneshyari.com/article/5557882

Daneshyari.com