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Dopaminergic and Noradrenergic contributions to divergent and convergent creativity task performance, a systematic review

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - Data analysis.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 25 July 2025 and was last updated on 25 July 2025.

INTRODUCTION

Review question / Objective A range of factors affect performance on tasks associated with creativity, including stress, pharmacology, behavioral interventions, and neural stimulation strategies. Most of the pharmacological impacts have focused on the dopaminergic and noradrenergic systems. However, some evidence suggests that these systems may differ in their impact on performance on divergent and convergent tasks. There has never been a systematic effort to determine how the dopaminergic and noradrenergic systems might differentially impact performance on divergent and convergent tasks. To begin to address this, we performed a systematic review to examine the extant literature regarding the effects of the dopaminergic and noradrenergic systems on divergent and convergent task performance.

Rationale A range of factors have been identified that influence performance on creativity. Creativity performance is known to be impacted by psychiatric conditions [1,2]. Additionally, stress has been shown to impact performance on creativity-associated tasks [3,4]. This has led to a particular interest in the dopaminergic and noradrenergic systems for their impact on creativity [3]. Past research has demonstrated that performance on the alternate uses task is related to eyeblink rate, a marker associated with dopaminergic activity [5], and additionally D2 receptor polymorphisms predict performance on tasks such as object use fluency [6]. The noradrenergic system is most widely recognized for its role in arousal [7,8]. Drugs that block the beta-adrenergic receptors have been shown to reverse the effects of test anxiety [9], and effect also observed for performance on anagram tasks [10]. However, there are two broad categories of creativity-associated tasks utilized in these exemplars. Tasks such as the alternate uses task and object use fluency involve a search to generate multiple potential 'creative' responses (divergent tasks), while for tasks such as the anagrams task, the unconstrained search converges onto on correct answer (convergent tasks) [3,11]. There has never been a systematic

effort to determine how the dopaminergic and noradrenergic systems might differentially impact performance on divergent and convergent tasks. To begin to address this, we performed a systematic review to examine the extant literature regarding the effects of the dopaminergic and noradrenergic systems on divergent and convergent task performance.

Condition being studied Performance on divergent and convergent creativity tasks and the influence of manipulations of the noradrenergic and dopaminergic systems.

METHODS

Search strategy We performed a PubMed review examining the results for 'creativity and (dopamine or dopaminergic' and for 'creativity and (norepinephrine or noradrenergic or adrenergic)', from the entire PubMed database up until March 24, 2024.

Participant or population No exclusions based on this aspect.

Intervention Any manipulation of the noradrenergic or dopaminergic system.

Comparator Noradrenergic vs dopaminergic manipulation.

Study designs to be included All designs included.

Eligibility criteria For the dopaminergic system, 106, and for the noradrenergic system, 68 were excluded as creativity was only mentioned, including cases where it appeared as describing their 'creative approach', and was not the focus of the research. Articles that did not produce new data, including review articles and commentary, resulted in the additional exclusion of 64 articles for the dopaminergic system, and 20 for the noradrenergic system. There were an additional 22 dopaminergic system articles and 2 noradrenergic system articles excluded as they were not based on a task that could be utilized for the contrast between divergent and convergent creativity tasks. One additional paper was excluded for the dopaminergic system as it was exclusively a modeling paper, and 4 dopaminergic system articles and 2 noradrenergic system articles were excluded as they examined drugs impacting too broad a set of neuropharmacological systems to assess specific impact, and 2 additional dopaminergic system articles were excluded because they did discuss creativity and did discuss dopaminergic drugs, but not the effect of dopaminergic drugs on tasks related to creativity.

Information sources PubMed and resulting abstracts, and papers reviewed for included articles, with added articles to which the author had access.

Main outcome(s) Performance on divergent and/or convergent creativity tasks.

Additional outcome(s) None.

Data management This was a descriptive study.

Quality assessment / Risk of bias analysis This was a descriptive study, so no formal subsequent analysis, but this is discussed.

Strategy of data synthesis This was a descriptive study so no formal data synthesis.

Subgroup analysis This was a descriptive study so no formal subgroup analysis.

Sensitivity analysis This was a descriptive study so no formal sensitivity analysis.

Language restriction None.

Country(ies) involved United States.

Keywords creativity, dopamine, norepinephrine, stress, Parkinson's, Tourette's, attention deficit hyperactivity disorder.

Dissemination plans Publication in a journal.

Contributions of each author

Author 1 - David Beversdorf - Author 1 did all of the work.
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