targeted intervention and leverage it for individualized therapy is missing. Thus, available pharmacological and behavioral therapies can´t be properly matched to the underlying cause of disease leading to inefficient therapies. There is a substantial risk that the treatments approved and used today are actually making the disease worse over time since often times, conventional treatments are not properly addressing the underlying molecular impairment.

SUMMARY

[0004a] In an aspect, the present disclosure refers to a method for identifying and treating a neurological deficiency, the method performed by a system comprising one or more processors, the method comprising:

receiving information associated with a patient, wherein the received information includes memory information about a plurality of patient memories, wherein, for each of the plurality of patient memories, the memory information indicates: a respective emotional intensity for each of one or more emotions, respective time information, and respective metadata indicating aspects of the memory;

providing a plurality of stimuli to the patient, wherein each of the plurality of stimuli are respectively associated with one or more of the patient memories;

while providing the stimulus to the patient, measuring brain activity of the patient, wherein measuring brain activity comprises collecting data indicating location of brain activity and associated intensity of brain activity;

determining, based on the measured brain activity of the patient, a plurality of neurotransmitter levels for the patient;

identifying, based at least in part on the determined plurality of neurotransmitter levels for the patient, a neurological deficiency with respect to at least a first neurotransmitter for the patient.

[0004b] In another aspect, the present disclosure refers to a system for identifying and treating a neurological deficiency, comprising one or more processors configured to cause the system to:

receive information associated with a patient, wherein the received information includes memory information about a plurality of patient memories, wherein, for each of the plurality of patient memories, the memory information indicates: a respective emotional intensity for each of one or more emotions, respective time information, and respective metadata indicating aspects of the memory;

provide a plurality of stimuli to the patient, wherein each of the plurality of stimuli are respectively associated with one or more of the patient memories;

while providing the stimulus to the patient, measure brain activity of the patient, wherein measuring brain activity comprises collecting data indicating location of brain activity and associated intensity of brain activity;

determine, based on the measured brain activity of the patient, a plurality of neurotransmitter levels for the patient;

identify, based at least in part on the determined plurality of neurotransmitter levels for the patient, a neurological deficiency with respect to at least a first neurotransmitter for the patient.

[0004c] In another aspect, the present disclosure refers to a non-transitory computer-readable storage medium storing instructions for identifying and treating a neurological deficiency, the instructions configured to be executed by one or more processors of a system to cause the system to:

receive information associated with a patient, wherein the received information includes memory information about a plurality of patient memories, wherein, for each of the plurality of patient memories, the memory information indicates: a respective emotional intensity for each of one or more emotions, respective time information, and respective metadata indicating aspects of the memory;

provide a plurality of stimuli to the patient, wherein each of the plurality of stimuli are respectively associated with one or more of the patient memories;

while providing the stimulus to the patient, measure brain activity of the patient, wherein measuring brain activity comprises collecting data indicating location of brain activity and associated intensity of brain activity;

determine, based on the measured brain activity of the patient, a plurality of neurotransmitter levels for the patient;

identify, based at least in part on the determined plurality of neurotransmitter levels for the patient, a neurological deficiency with respect to at least a first neurotransmitter for the patient.

[0005] Accordingly, provided herein are systems and methods for evaluating the underlying molecular (e.g., brain reward system molecules) cause for a depressive disorder and developing a treatment plan based on the identified molecular cause. In one or more examples, the systems and methods described herein can utilize any combination of brain imaging techniques, subjective emotion data taken from a patient, and/or one or more algorithms for translating emotional states to brain reward system molecules (e.g., neurotransmitters) to determine an underlying molecular cause for a depressive disorder of a patient. In one or more examples, the subjective emotion data can be collected or received from a patient through an initial interview or other master data compilation regarding the patient's current and/or past mental condition. In one or more examples, subjective emotion data are collected systematically, for example using one or more of the techniques described in U.S. Application No. 17/389,023, which is hereby incorporated by reference in its entirety. In one or more examples, the initial interview or master data compilation can include an assessment of the actual emotional wellbeing state by a subjective wellbeing self-assessment questionnaire. In one or more examples, the initial interview or master data compilation can include an assessment of the actual depression state of the patient by any clinical depression assessment questionnaire that allows for the categorization of mental states (e.g., HAMD17 or any other similar depression assessment questionnaire). In one or more examples, the patient's answers to the questionnaires or interview questions can be used to determine one or more neurotransmitter (e.g., molecular) deficiencies in the brain of the patient.

[0006] In one or more examples, the systems and methods described herein can also include applying one or more algorithms to convert a patient's recorded memories and emotion data (e.g., subjectively reported emotion data) in reactions to various events into neurotransmitter transmitter levels (e.g., reward system molecules), thus allowing for the identification of

neurotransmitter deficiencies. In one or more examples, the algorithms can input a patient's emotional reactions to daily events and activities, translate the events/reactions into one or more

neurotransmitter levels, and thus be used to identify one or more deficiencies in neurotransmitter levels.

[0007] In one or more examples, the system and methods described herein can include using brain imaging techniques such as functional magnetic resonance imaging (fMRI) and/or other similar techniques to determine deficiencies in neurotransmitter levels within a patient's brain. In one or more examples, a patient's brain can be imaged in real-time while the patient is being randomly exposed to photos and/or music that have emotional significance to the patient and thus are likely to cause reward center activity in the brain of the patient. In one or more examples, the signal intensity data from the brain scan and/or 3D location of brain activity can be used to identify distinct regions of interest in the brain that can be correlated with distinct emotions and/or reward system molecules (e.g., neurotransmitters).

[0008] In one or more examples, once the underlying molecular cause for the depressive disorder is identified (using any combination of the techniques described above), the systems and methods described herein can create a personalized anti-depression prevention and/or treatment protocol that is specifically tailored to the identified neurotransmitter deficiencies

[0009] In some examples, a first method for treating a neurological disorder is provided, the first method comprising: receiving information associated with a patient, wherein the received information includes information about one or more past events that the patient has engaged in and one or more emotions associated with the one or more events; determining one or more reward molecule levels of the patient based on the received information associated with the patient; receiving one or more scans of the patient's brain; determining one or more reward molecule levels of the patient based on the received one or more scans of the patient's brain; and determining one or more reward molecule deficiencies of the user based on the determined one or more reward molecule levels of the patient based on the received information associated with the patient and based on the determined one or more reward molecule levels of the patient based on the received one or more scans of the patient's brain.

[0010] In some examples of the first method, the method comprises selecting a predetermined treatment plan for the determined one or more reward molecule deficiencies based on an identity of each reward molecule deficiency,

[0011] In some examples of the first method, wherein the identity of the reward molecule deficiency is selected from a group consisting of: dopamine, serotonin, testosterone, oxytocin, cannabinoids, opioids.

[0012] In some examples of the first method, determining one or more reward molecule levels of the patient based on the received information associated with the patient comprises

applying the received information associated with the patient to a positive emotion to a neurotransmitter (PE-NT) matrix.

[0013] In some examples of the first method, the received one or more scans of the patient's brain comprise real-time functional magnetic resonance imaging (rt-fMRI) scans.

[0014] In some examples of the first method, the received one or more scans of the patient's brain comprise electroencephalogram (EEG) scans.

[0015] In some examples of the first method, the received one or more brains scans are acquired using a method comprising; exposing the patient to one or more stimuli; determining one or more locations within the brain where a signal is generated in response to the stimuli; and determining a signal intensity associated with each location of the brain where a signal is generated in response to the stimuli.

[0016] In some examples of the first method, determining one or more reward molecule levels of the patient based on the received one or more scans of the patient's brain comprises: associating the one or more determined locations within the brain where a signal is generated in response to the stimuli to one or more types of reward molecules; and determining the one or more reward molecule levels of the patient based on the determine signal intensity associated each location of the brain where a signal is generated in response to the stimuli.

[0017] In some examples of the first method, the one or more emotions associated with the one or more events received information associated with the patient of the information associated with the patient comprises an emotion from the group comprising: enthusiasm, sexual desire, pride/recognition, nurturant love, contentment, attachment love, amusement, pleasure, and gratitude.

[0018] In some examples of the first method, the received information associated with a patient comprises the patient's responses to one or more questionnaires configured to diagnose depression in the patient.

[0019] In some examples, a second method for identifying and treating a neurological deficiency is provided, the method performed by a system comprising one or more processors, the second method comprising: receiving information associated with a patient, wherein the received information includes memory information about a plurality of patient memories, wherein, for each of the plurality of patient memories, the memory information indicates: a respective emotional intensity for each of one or more emotions, respective time information, and respective metadata indicating aspects of the memory; providing a plurality of stimuli to the patient, wherein each of the plurality of stimuli are respectively associated with one or more of the patient memories; while providing the stimulus to the patient, measuring

brain activity of the patient, wherein measuring brain activity comprises collecting data indicating location of brain activity and associated intensity of brain activity; determining, based on the measured brain activity of the patient, a plurality of neurotransmitter levels for the patient; and identifying, based at least in part on the determined plurality of neurotransmitter levels for the patient, a neurological deficiency with respect to at least a first neurotransmitter for the patient.

[0020] In some examples, the second method comprises: identifying, based on the memory information and based on the identified neurological deficiency, a subset of the plurality of patient memories associated with a positive neurological response as indicated by the brain activity of the patient; identifying, based on the identified subset of the plurality of patient memories and based on the respective metadata indicating aspects for the identified subset, a first aspect that is common across a plurality of the memories; and generating and providing a personalized treatment plan for the patient comprising an indication of the first aspect.

[0021] In some examples of the second method, identifying the neurological deficiency comprises: based on the determined plurality of neurotransmitter levels for the patient, generating a provisional indication of the neurological deficiency; applying one or more rule sets based on pharmacological and/or clinical biochemical information regarding the patient to determine that the provisional indication of the neurological deficiency should not be negated.

[0022] In some examples of the second method, identifying the neurological deficiency comprises: based on the determined plurality of neurotransmitter levels for the patient, generating a provisional indication of the neurological deficiency; applying one or more rule sets based on the memory information for the patient, including by comparing emotional intensity information for the patient to emotional intensity threshold information, to determine that the provisional indication of the neurological deficiency should not be negated.

[0023] In some examples of the second method, identifying the neurological deficiency comprises: based on the determined plurality of neurotransmitter levels for the patient, generating a provisional indication of the neurological deficiency; and applying one or more rule sets based on the memory information for the patient, including by analyzing changes in emotional intensity information for the patient over time, to determine that the provisional indication of the neurological deficiency should not be negated.

[0024] In some examples of the second method, identifying the neurological deficiency comprises: based on the determined plurality of neurotransmitter levels for the patient, generating a provisional indication of the neurological deficiency; and applying one or

more rule sets based on the memory information for the patient, including by applying the memory information to a positive emotion to a neurotransmitter (PE-NT) matrix, to determine that the provisional indication of the neurological deficiency should not be negated.

[0025] In some examples of the second method, the first neurotransmitter is selected from the group consisting of: dopamine, serotonin, testosterone, oxytocin, cannabinoids, and opioids.

[0026] In some examples of the second method, measuring brain activity of the patient comprises using a functional magnetic resonance imaging (fMRI) scan.

[0027] In some examples of the second method, the fMRI scan is a 7 Tesla fMRI scan.

[0028] In some examples of the second method, measuring brain activity of the patient comprises using an electroencephalogram (EEG) scan.

[0029] In some examples of the second method, measuring brain activity of the patient comprises using functional near-infrared spectroscopy (fNIRs).

[0030] In some examples of the second method, determining, based on the measured brain activity of the patient, the plurality of neurotransmitter levels for the patient comprises: determining one or more locations within the brain for which a signal is to be measured in response to the stimuli; determining one or more signal intensities, based on the measured brain activity of the patient, associated with each of the one or more locations of the brain; and determining the plurality of neurotransmitter levels based at least in part on the determined one or more locations and on the determined one or more signal intensities.

[0031] In some examples of the second method, determining the plurality of neurotransmitter levels comprises comparing a determined signal intensity for a determined location to a threshold signal intensity level for that location.

[0032] In some examples of the second method: the plurality of stimuli presented to the patient are analyzed based on the one or more emotions associated with the memories associated with the stimuli, as indicated in the received information, and determining the one or more locations within the brain is based at least in part on the one or more emotions indicated in the received information.

[0033] In some examples of the second method, the one or more emotions comprise an emotion from the group comprising: enthusiasm, sexual desire, pride/recognition, nurturant love, contentment, attachment love, amusement, pleasure, and gratitude.

[0034] In some examples, a system for identifying and treating a neurological deficiency is provided, the system comprising one or more processors configured to cause the

system to: receive information associated with a patient, wherein the received information includes memory information about a plurality of patient memories, wherein, for each of the plurality of patient memories, the memory information indicates: a respective emotional intensity for each of one or more emotions, respective time information, and respective metadata indicating aspects of the memory; provide a plurality of stimuli to the patient, wherein each of the plurality of stimuli are respectively associated with one or more of the patient memories; while providing the stimulus to the patient, measure brain activity of the patient, wherein measuring brain activity comprises collecting data indicating location of brain activity and associated intensity of brain activity; determine, based on the measured brain activity of the patient, a plurality of neurotransmitter levels for the patient; and identify, based at least in part on the determined plurality of neurotransmitter levels for the patient, a neurological deficiency with respect to at least a first neurotransmitter for the patient.

[0035] In some examples, a non-transitory computer-readable storage medium storing instructions for identifying and treating a neurological deficiency is provided, the instructions configured to be executed by one or more processors of a system to cause the system to: receive information associated with a patient, wherein the received information includes memory information about a plurality of patient memories, wherein, for each of the plurality of patient memories, the memory information indicates: a respective emotional intensity for each of one or more emotions, respective time information, and respective metadata indicating aspects of the memory; provide a plurality of stimuli to the patient, wherein each of the plurality of stimuli are respectively associated with one or more of the patient memories; while providing the stimulus to the patient, measure brain activity of the patient, wherein measuring brain activity comprises collecting data indicating location of brain activity and associated intensity of brain activity; determine, based on the measured brain activity of the patient, a plurality of neurotransmitter levels for the patient; and identify, based at least in part on the determined plurality of neurotransmitter levels for the patient, a neurological deficiency with respect to at least a first neurotransmitter for the patient.

[0036] Any one or more of the features of the above-listed examples may be combined, in whole or in part, with one another and/or with any other disclosure herein.

BRIEF DESCRIPTION OF THE FIGURES

[0037] FIG. 1 illustrates an exemplary process for determining molecular deficiencies in the brain of a patient according to examples of the disclosure.