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An investigation into mental illness and its comorbidities from the perspective of supervenience physicalism

Ping Yang[1,2], Xinyue Zhang[1], Hongwen Song[1*] and Xiaochu Zhang[1,3,4,5*]

Abstract

The exploration into the origin of human spirituality has always been a hot spot with many unsolved questions in the philosophy of mind, and issues concerning mental illness and its comorbidities are still unclear. In the 1970s, Donald Davidson first proposed **anomalous monism** with the supervenience concept, a theory that both insists on physicalism and transcends traditional reductionism. This theory provides solid and accessible proof for perceiving the mind-body relationship of spiritual origin in a non-reductionist approach. This paper develops arguments in two aspects. First, three principles of anomalous monism are employed to explore the origin of mental illness. Second, the comorbidity of mental illness is explained with the help of the supervenience theory.

Keywords Supervenience, Non-reductive physicalism, Mental illness, Comorbidity

Introduction

In the broad science world, any science is premised on a philosophical foundation. The development of psychiatry has shown connections with philosophy throughout history. Philosophical trends have profoundly influenced the advancement of psychiatry at different times, and empirical methods and experimental research in psychiatry have also sharpened people's philosophical insights into the mind-body relationship and the origin of spirituality.

As early as ancient Greece, theories on mind-body unity raised by scholars such as Socrates, Plato, and Aristotle greatly influenced the development of psychiatry. Some even believed that these views created a solid foundation for the development of modern psychiatry. However, some supporters of mind-body unity held that mental illness was neither physical nor mental but a "possessed state" of the human body. Such views, which neglect the importance of the mind-body relationship, seriously constrain further thoughts, both medically and academically.

Later, Descartes' mind-body dualism marked a change in the history of psychiatry, which overthrew the previously dominant theory of mind-body unity. Most significantly, dualism gives birth to various modern somatic-oriented schools of psychiatry, represented by the Somatiker emerging in the mid-19th century. The

*Correspondence:
Hongwen Song
shw0519@ustc.edu.cn
Xiaochu Zhang
zxcustc@ustc.edu.cn
[1]School of Humanities and Social Sciences, University of Science and Technology of China, Hefei 230026, Anhui, China
[2]School of Mental Health and Psychological Science, Anhui Medical University, Hefei 230032, Anhui, China
[3]Business School, Guizhou Education University, Guiyang 550018, China
[4]Key Laboratory of Brain-Machine Intelligence for Information Behavior (Ministry of Education and Shanghai), School of Business and Management, Shanghai International Studies University, Shanghai 201620, China
[5]Center for Advanced interdisciplinary science and Biomedicine of institute of Health and Medicine (HM), Division of Life Sciences and Medicine, University of Science and Technology of China, Hefei 230027, China

The representative philosophical thoughts affecting mind-body relationship in psychiatry in modern times

Period	Representative figure	School of theory	Main point
Hellenistic period	Plato、Aristotle et al.	Theories on mind-body unity	Soul and body belong to the world of ideas and phenomena's, soul has transcendence and body has limitations.
17th century	Descartes	Mind-body dualism	The body and the soul are two distinct entities, and man can imagine that the mind exists independently of the body.
17th and 18th centuries	Immanuel Kant et al.	German idealism	The distinction between mind and body is a representation of the phenomenal realm, not a distinction of reality at the level of the thing itself.
18th century	Philippe Pinel	Humanitarian trend of thought	Mental disorders result from the combination of nervous system disorders (physical factors) and psychological trauma (such as emotional shock and social pressure).
19th century, early 20th century	Emil Kraepelin、Kurt Schneideret al	Somatike、Classical psychiatry	Mental illness is essentially seen as a symptom of a physical disease or a physical matrix disease.
19th century, early 20th century	Edmund Husserl、Sigmund Freud et al.	Psychiker、Analytical school	Mental illness is seen as a form of existence of some primordial inner spiritual life.
Early 20th century	Karl Jaspers	General psychosis principle	Mental disorders result from the combination of nervous system disorders (physical factors) and psychological trauma (such as emotional shock and social pressure).
Mid-20th century	Eugene Minkoi	Phenomenal psychiatry	Focus on providing a holistic description while striving to integrate the mind-body phenomenon through the life dynamics.

Somatiker is, in fact, a "natural disease view" gradually evolving from naturalism, which directly influences the stances taken by scholars like Emil Kraepelin on the mind-body relationship. Kraepelin established the first norm in the history of psychiatry by dividing and explaining mental illnesses [1], holding that each mental illness possessed uniqueness in symptoms, pathological-anatomical features, and etiology. Not only did he stick to the strict ontological separation, parallel mind-body structure, and parallel developmental model, but he also stressed the strict and accurate correspondences among ontologies. Moreover, he found that the loss of specific biological functions causes the etiology of a mental illness.

Meanwhile, in the mid-19th century, the opposing "Psychiker" emerged, which was bred out of German idealism represented by Kant. Since then, it has gradually developed into hermeneutic-oriented schools of psychiatry, psychoanalysis, phenomenological psychiatry, anthropological psychiatry, etc. Scholars of the psychiatric school believed that mental illness should be viewed as some primordial way of being in the inner life of the mind and that the mentally ill should not be isolated from life, nor should they be regarded as isolated beings, creatures, or mental machines. They further criticized that psychiatrists should not treat patients like repairing devices that only use the help of pharmaceutical preparations, electroconvulsive therapy, or other means but should re-interpret traditional psychosis and its treatment from existential-phenomenological and analytic perspectives [2].

As a result, psychiatric research went to two extremes when two groups held distinct views. Under the dilemma, there was still a short-term integration. For example, Karl Theodor Jaspers applied phenomenological methods to study psychopathology. They downplayed the long-standing controversy between "somatic school" and "spirit school" through the "subjective turn" of comprehension and description. His work Allgemeine Psychopathologie was published in early 1913, which marked a transition of psychiatric theories from Kraepelin's disease taxonomy to symptom description [3].

However, clinical phenomena typically characterize concreteness and complexity, with many psychosomatic (mental/somatic) symptoms combined and few purely involving somatic or psychiatric conditions. Although modern medicine is aware of the law of mind-body unity in health and disease and attaches importance to studying the influence of mental and psychological factors on the body, it still fails to clear away the shadow of dualism in disease classification and clinical treatment [4].

Therefore, to compensate for the confusion over psychosomatic issues caused by the traditional binary division, the concept of "comorbidity" came into being, as a term first introduced in 1970 by American Professor Feinstein [5] which refers to a condition in which a patient suffering from a specific disease is also identified to have other diseases. This concept mainly focuses on the effect of comorbid disorders on one another, both in terms of horizontal linkage with the simultaneous occurrence and vertical association with sequential onset. For the first time, the concept of comorbidity was introduced into the diagnosis of "chaotic" psychiatric disorders, referring specifically to the phenomenon of multiple illnesses of one patient with psychiatric disorders.

Currently, most mental diseases lack characteristically biological indicators and diagnostic classifications, which only involve the combination of syndromes (or even

subjective symptoms). The introduction of comorbidity seems to solve the big problem in diagnosing and treating "multiple syndromes" confronted by doctors. However, it also reveals that psychiatric ontogeny issues are not being addressed. As a concept, comorbidity has a deficiency in operational definition and criteria. Symptom diagnosis is still applied in practice, and more confusion arises regarding the time window for comorbidity diagnosis, all of which have led to a wide disparity in the understanding of comorbidity among clinicians and researchers.

6 Since Descartes' mind-matter dualism, the mind-body relationship has been the core of the philosophy of mind research, most of the previous mind-body theory belongs to the category of realism, that is, the assumption that mind and its contents are real phenomena or characteristics of the world. Also, in 1970, Davidson proposed anomalous monism while still sticking to the naturalistic framework, he broke the limitation of dualism by assigning a relatively independent role to psychological events and argued that such a role possessed the supervenience of physical properties [6]. Davidson also put forward mind-body attachment in Psychological Events and regarded it as a characteristic of psychological phenomena, which became a universal philosophical height for study. The core concept of dependency in the contemporary philosophical sense has been established precisely because of Davidson's proposal and the controversy triggered. Once introduced, this concept immediately became a crucial resource for academics to explore mind-body issues and provided a new perspective for psychiatry in distress. It also provides an important philosophical resource and a new way of thinking for them to discuss the mind-body relationship and the comorbidity relationship of mental illness.

Supervenience physicalism

In 1970, Davidson made a historical summary of the mind-body relationship problem, and he summarized the mind-body relationship problem into four types: the "nomological monism" represented by the mind-body reductionism and identity theory; The "nomological dualism" represented by the epiphenomenalism. The "anomalous dualism" is represented by the Cartesian entity dualism and the "anomalous monism" proposed by Davidson himself. Davidson aimed to achieve his philosophical ambition of non-reductive physicalism at that point. He then developed a theory that surpasses traditional reductionism while maintaining mind-body principles of physicalism. Davidson's anomalous monism includes three famous and far-reaching principles that may have been questioned due to their seeming contradiction [7].

(1) *Principle of Causal Interaction.* "At least some psychological events can interact causally with physical events." The principle of causal interaction instead conforms to common-sense human experience and is recognized by most philosophers. Attributable to the ontological category, it has two implications. Suppose one is thirsty and goes on to drink water. In that case, there is a causal relationship from the physical to the psychological state, in which the lack of water in the organism causes a response in the cerebral cortex (a physical event), leading to a feeling of thirst (a psychological event). In addition, it also involves a causal relationship from a psychological to a physical event, like the decision to take a drink.

(2) *Principle of the Nomological Character of Causality.* Two events as cause and effect must conform to their laws. The characteristic principle of nomology for causal relationships falls into the epistemological category. There are two examples to compare. In the first one, one person pushes the door, and it opens; in the second one, one pushes the door open, and it rains. There are two examples to compare. In the first one, one person pushes the door, and the door opens; in the second one, one pushes the door open and finds it raining outside. It is generally accepted that causality exists in the first but not in the second. There are possible reasons as follows: The two events, namely "the act of pushing" and "the act of opening," exemplify an inevitable law of nature, while the events in the second, namely, "the act of pushing" and "raining," are only in an accidental relationship. It is simple to find that events can be described in various ways, but not each way consistently describes strict law. Only when two events are as cause and effect do they have law descriptions as first exemplified above [8].

(3) *The Principle of the Anomalism of the Mental.* There are no strict laws to predict psychological events. The principle of psychological abnormality belongs to the linguistic category, and Davidson believes that psychological vocabulary cannot be used to describe strict laws and that no psychological event can exist independently. For instance, one is thirsty and ready to drink tea. Even though the condition for this simple behavior is pure and he does not conceal the intention to drink tea, he may also change his mind. When passing by a shop on the way, he may end up with a cup of milky tea or cola. Or he may completely neglect his need for drinking after receiving a sudden call to deal with an emergency. Due to the holistic nature of psychological properties, there is no strict and absolute closed system between psychology and

behavior. Therefore, a causal relationship between them does not exist.

These three principles provoked some controversies immediately after they came out. Many scholars believe that they are contradictory to one another. From the first two principles, it can at least be inferred that certain mental events are reducible and explainable under certain conditions. Yet, the third one completely overthrows the first two by arguing that mental events cannot be predicted and explained. Davidson explained the question: The first two principles apply to individual events, while the last one applies to category events. A single psychological event can be reducible to a physical event, but not a category one.

In Davidson's view, the laws in physics are all unconditional. All conform to the requirements of strict rules, and any event or phenomenon can be described with a physical concept. However, a particular psychological concept cannot be examined in isolation, for several conditions influence it. For instance, a student has a solid need to study, which may be related to his education, parents' expectations, peer competition, and many other factors. That means we have to discuss the student's need for education from a holistic perspective and attribute the need to the student (the subject). Thus, the reason why there is no strict mind-body law lies in the fact that different requirements exist for mental and physical domains.

These three principles support anomalous monism, but these three principles have also caused some controversy. Scholars such as Kim Jae-Kwon criticized the three principles as contradictory and not self-accurate. The first two principles can at least infer that certain psychological events can be predicted and explained according to laws. The third principle, however, immediately rejects the first two, arguing that no laws that can predict and explain psychological events [7].

Davidson explained that the contradiction does not exist, that the first two principles speak of individual events or individuals, and that the second principle says of a class of events or properties. Thus, anomalous monism can be interpreted as a single mental event that can be reduced to a physical event but as a class of mental events or mental properties that cannot be reduced.

Despite the explanation, Davidson does not provide a systematic argument at this time but only shows this by comparing different representations (realizations) of mental and physical concepts. This only satisfies a few scholars. Since lawless monism holds that events exert causal effect only when they exemplify the laws of physics, how can such causal effect be demonstrated? Kim Jae-Kwon constructed the causal exclusion argument and further pointed out that if the "anomalous monism" claims that there is no mind-body law and the mind-body relationship is irreducible, the independent psychological attribute is bound to be excluded by the physical attribute [7]. For this reason, Davidson further presented the concept of "supervenience," launching that psychological properties can achieve their causal psychological effects by being supervenient to physical properties.

The supervenience concept is considered an excellent supplement to anomalous monism. It not only adheres to the course of physicalism, that is, the recognition of the decisive role played by physical properties on psychological ones but also endows causal effect to psychological attributes, which is achieved through the supervenience to and joint action with physical properties.

The concept of "supervenience" first appeared in moral philosophy, and Davidson was the first to introduce it into the philosophy of mind and the description of mind-body relations [9]. Supervenience describes the ontological relationship between different levels of system attributes, generally, low-level attributes determining high-level or higher-level attributes being supervenient to lower-level ones. The world is constructed by different levels of attributes and conforms to the law that low-level attributes determine high-level ones [10].

Supervenience demonstrates a decisive (or dependent) relationship. For example, an abnormal (physical) state of the brain may lead to psychiatric (psychological) symptoms, that is, the interrelationship between the two being acquired through this supervenience relationship. Assuming that a certain psychiatric symptom A is caused by one specific brain abnormality B, two individuals having the physical characteristics of B must demonstrate symptom A. But the opposite does not hold. It is possible to have the same mental state but different physical bases because there are many possibilities for mental properties to be realized in physical properties. For example, a single neuron does not possess psychological characteristics; it requires a highly complex interaction of many neurons in the nervous system to reveal psychological characteristics. Different neurons can achieve the same psychological state through different actions and pathways in this process. However, it should be noted that although low-level attributes determine high-level ones, like the mental level determining the physical significance, high-level structures are dependent on lower-level ontologies. Without a physical foundation, high-level states would cease to exist.

Interpretation of mental illness and its comorbidity from the perspective of supervenience physicalism

Interpretation of mental illness from the perspective of anomalous monism

Davidson's anomalous monism presupposes that mental events are equal to physical events, namely, being the

same material object but with different descriptions. This is reflected in the principle of the nomological character of the causality of **anomalous monism**. Where there is a causal relationship, there must be regularity, and cause and effect must be governed by strict regularity. Physical events determine psychological events, and a brain base (a physical event) determines the presence of mental symptoms (a psychological event).

This trend continues to advance the understanding of the brain, and from the biological (physical) perspective, psychiatry views the relationship between psychology (behavior) and the brain. After the 1970s, with the advancement of medical technology, the research on mental illness focused on exploring brain mechanisms of mental illness and psychiatric symptoms. In 1986, Andreasen confirmed through MRI that schizophrenia showed smaller structures in the frontal cortex and cerebellum, in addition to enlarged ventricles, and the area, length, and thickness of the corpus callosum were different from those of healthy controls [11]. In 1987, Baxter et al. found increased metabolic rates in the bilateral caudate nucleus and orbitofrontal cortex among patients with obsessive-compulsive disorder, and in 1988, Luxenberg observed a smaller volume of the bilateral caudate nucleus in patients with OCD through CT brain examination [12]. Brain imaging studies on affective disorder found caudate nucleus and frontal lobe atrophy in patients with major depression. Single photon emission imaging discovered that the cerebral cortex, especially the frontal lobe, had decreased blood flow in patients with depression [13].

This idea of reductionism arose as early as the 16th and 17th centuries due to the great success of mechanics and physics, as if any scientific problem could be reduced to a physical problem and explained. Inevitably, biological problems must be explained at the physical and chemical levels before they can be fundamentally explained; that is, they must be reduced to physical and chemical problems. Under the guidance of this idea, medical research is increasingly going in the fine direction of people, from the general level, the tissue level, the cell level, the molecular level, and even the gene level. Nowadays, the continuation of the trend led to a growing interest among psychiatrists and scholars in studying biological markers of psychiatric disorders and the importance of such markers for clinical diagnosis, treatment, and prognosis.

Although some mental symptoms can be found to have a physical basis, Davidson also emphasized the role of mind-body causal interaction in the principle of causal interaction. For patients with a certain disease (symptom), such as depression, compulsion, or some brain damage, when a clear description of the disease or the examination of its physical basis is attempted, consideration should be given to the role of the patient's psychological state on the disease itself. At the same time, psychological symptoms often do not appear alone and may involve other psychological states. For example, patients with depression and compulsion generally show anxiety, fear, and other emotions, and the states will have a more complex impact on the disease itself.

The research in psychiatry and psychology in recent decades has gradually led to a better understanding of the impact of psychosocial factors on health. The medical model has also changed from traditional biomedicine to a bio-psychological-social medical model, with more emphasis on the integrated study of health and disease from groups and ecosystems, which reflects the transition of the medical model from mind-body dualism and natural science analytical reductionism to a systemic and holistic view. In the classification standard of modern psychiatry, psychogenic mental disorders, stress reactions, and culturally relevant mental disorders are impressively listed. These mental disorders are directly and closely related to stressful life events, cultural traditions, religious beliefs, and social environments. It is generally believed that the diseases are triggered by so-called psychogenic stimuli (psychosocial factors combined), and no organic basis for their pathology has been identified.

Clinical evidence also shows both mental self-regulation and psychotherapy play an essential role in maintaining health. Common factors of psychotherapeutic modes, like empathy, support, affirmation, therapeutic alliance, and emotional expression, can all promote symptom alleviation and improve cognitive and social functions. Sufficient evidence has also demonstrated that psychotherapy produces lasting effects on the brain, which can even change the genetic characteristics, neuroendocrine and brain structure [14]. It is confirmed by the study of the effect of psychotherapy on two common mental diseases, a recent study on the treatment of OCD patients with cognitive behavioral therapy found that, after treatment, patients showed significantly increased activity in the right temporal and ventral anterior cingulate cortex in cognitive control tasks, as well as better activation in ventral medial prefrontal, orbitofrontal, lateral prefrontal, and amygdala regions in reward tasks [15]. A study using dialectical behavioral therapy to intervene with a patient suffering from borderline personality disorder found a significant decrease in the amygdala and anterior cingulate cortical activeness after treatment [16].

It can thus be seen that psychological (mental) factors play a role in mental illness and even an important one in some diseases. How is the causal effect of psychology realized? How do psychological factors exert an influence on a physical body as well as the condition?

Many scholars and doctors have tried to answer this question, but it seems that none has crossed the gap between mind and body, either ignoring the

psychological factor or attaching too much importance to mentation, with no satisfactory result ever produced.

At this point, Davidson, by borrowing the concept of supervenience, subtly gave equal status to mind and body and emphasized the mutual influence between them. It can be understood that psychological states exhibited by individuals have supervenience to their physical events and interact with them to produce combined results. A psychological action does not play a decisive real-time role, but it is undeniable that such action is always involved in the effect process. Although psychological actions cannot be explicitly forecast, they influence the entire course of events from beginning to end. In simple terms, causal psychological efficacy indicates the interaction of psychological factors that collectively influence events through the supervenience of their physical fundamentals [17].

As mentioned above, psychogenic mental disorders and culturally related dysphrenia can be understood as the symptoms that occur when these disorders trigger a solid psychological state, which results in changes in brain foundation, and the changes work simultaneously with the psychological state, leading to altered consciousness. The difference is that the former is a stress event, and the latter a triggering event caused by special cultural beliefs.

Although the first two principles of anomalous monism provide a viable explanation for the mind-body relationship in mental illness, mental disease cognition still puzzles researchers and physicians. In the case of schizophrenia, for example, it has been more than 100 years since Kraepelin named it early-onset dementia in 1896, and the etiology of schizophrenia still cannot be determined. One of the primary reasons is that the studies on the brain structure and function of schizophrenic patients reveal abnormalities in almost the entire brain, which involve abnormal structural and functional connections among multiple brain regions. Some individual symptoms possibly correspond to physical causes. For example, positive symptoms of schizophrenia, such as hallucinations, involve abnormal perception, the mechanisms of which include abnormal neurogenic activity in the auditory cortex, temporal lobe-related cortex, or abnormal neurogenic activity in the amygdala and hippocampus, which are temporal-limbic areas of memory encoding. In contrast, negative symptoms, like the scarcity of thought and emotional retardation, involve attention impairment and are often associated with damage to the prefrontal cortex. In contrast, it is not reducible for diseases and syndromes like schizophrenia.

This phenomenon exists as expressed in the **principle of psychological abnormality**: there is no absolute law of mind-body reduction. Such a rigorous causal relationship can only exist between all individual events, but mental events are fundamental and cannot be explained by physical science. That is why the exact cause of many mental disorders cannot be found and why many studies on brain mechanisms of mental disorders fail to yield consistent conclusions or even produce contradictory findings.

Recent studies on executive and salience networks among schizophrenic patients have also confirmed this. Some scholars suggested that [18, 19] schizophrenic patients had significant abnormalities in functional connectivity between verbal and executive networks, which correlated with positive symptoms and auditory networks. However, a study by Woodward et al. found no abnormalities in the salience network of patients with schizophrenia compared to healthy controls [20]. Some scholars attributed these inconsistent findings to the heterogeneity of the disease itself, holding that different pathological mechanisms existed in patients with different clinical presentations [21] and that this so-called individual heterogeneity was an expression of the principle of psychological abnormality.

Interpretation of the comorbidity phenomenon of mental illness from the perspective of the supervenience theory

Once the concept of comorbidity was proposed, it quickly gained recognition in the field of psychiatry due to the complexity and uncertainties of mental illness:

- The etiology and pathogenesis of most psychiatric disorders remained unclear.
- The diagnosis of disorders lacked characteristic biological indicators.
- The diagnosis was affected by different cultures and periods.
- The classification system was still in the process of changing and upgrading.

Thus, based on the concept, the model of "one person with multiple illnesses" was proposed to solve the present dilemma in mental illness with a dialectical approach to diagnostic thinking. However, the model only seems to alleviate the confusion in diagnostic classification temporarily; questions on underlying issues remain unresolved, like the representation of the interchangeable relationship between the two diseases and the mutual influence and "contribution" of the two diseases.

As the concept of supervenience was introduced into the philosophy of mind to address the mind-body relationship, it gradually became the mainstream philosophy of mind [22]. It evolved into the core concept of contemporary physicalism. The idea of supervenience emphasizes the dependence of mental properties on physical ones and expresses the characteristics of covariance and multiple realizations. These characteristics facilitate a

better understanding of dialectical diagnosis thinking for comorbidities and explain the features of comorbidities in greater depth.

Supervenience contains three layers of meaning: dependence, covariance, and multiple realizations.

(1) Dependence refers to the reliance of psychological properties on physical properties in the mind-body relationship, constituting the basis of supervenience. Psychological symptoms (diseases) appear with organic (physical) changes, such as anxiety disorder, depression disorder, personality disorder, and alcohol use disorder, all of which have various degrees of brain damage. This point has been elaborated on previously, so it will not be covered again here. However, comorbidity is more complicated than a single disease. That is reflected in the second characteristic of supervenience: covariance.

(2) Covariance refers to a dynamic covariance in the mind-body relationship. Specifically, when a mental state is supervenient by a physical condition, the former would change with the latter. Compared with a single disease, comorbid patients are characterized by more severe symptoms, longer courses of the disease, worse social adaptation, higher suicide rates, and poorer prognosis [23]. Such complexity and severity can be interpreted as a change in the covariance of comorbid psychosomatic supervenience, where the outcome of comorbidity is often more severe than that of a single disease. Still, the outcome does not mean a simple superposition of the damages of the two diseases but a mutual influence or even a "promotion" between the two. The psychological state M1 of disease X is supervenient to the physical state P1, and the psychological state M2 of disease Y to the physical state P2. The interaction between P1 and P2 in X-Y comorbidities inevitably leads to changes in M1 and M2, and causal psychological efficacy produced by the changes in M1 and M2 as the basis for supervenience interacts with P1 and P2 jointly determine the consequences of the disease. The intricate set of processes leads to a complex outcome of comorbidities. For example, for the brain location of emotional symptoms in patients with depression, a relatively consistent conclusion is that it is the functional circuit shape of the middle prefrontal cortex and limbic system and the structural site of abnormal function [24]. A study of brain damage in patients with simple borderline personality disorder found that brain regions with abnormal emotional processing are located in the amygdala and dorsolateral prefrontal cortex [25]. A neuroimaging study of depression comorbid with a borderline personality disorder also confirmed that, in patients, comorbidities are related to prefrontal cortical dysfunction as well as amygdala hyperactivity [26]. However, a study of borderline personality disorder comorbid with refractory depression found [24] that patients with simple refractory depression show delayed emotions in their facial expressions in response to anger, happiness, and sadness. In contrast, those with refractory depression comorbid with borderline personality disorder only show delayed emotional responses to anger and happiness, not sad expressions. The results suggest that when refractory depressive disorder is comorbid with borderline personality disorder, the impairment of cognitive function in comorbid patients could be compensated to some extent by the emotional sensitization of borderline personality disorder and its emotional-cognitive integrity. As a result, the comorbid patients do not show a significantly delayed response to sad facial expressions. The conclusion also confirms that the single comorbid disease has "cumulative" physical impairment, which is not a simple additive impairment but includes complex changes in the covariance of mind-body supervenience.

(3) Multiple realizability. The theory of supervenience deepens multiple realizations of functionalism. Supervenience physicalism points out that although there is no strict one-to-one reduction relationship between a supervenience matter and its fundamental, the same supervenience matter can be realized by different fundamentals.

There is a common but neglected situation in mental illness comorbidity, in which comorbidity (A + B) meets the diagnostic criteria (symptom criteria) of A and B simultaneously. In other words, such comorbidities are identical on an external psychological basis. Still, comorbidity (A + B) may arise and develop in different ways, either A ahead of B or B ahead of A. A and B have different physical and psychological fundamentals, and thus, they have different interactions, resulting in distinct outcomes. So, does their physical basis look the same? Davidson, in his article Psychological Events [6], introduced supervenience into the discussion of mind-body issues and gave the following description. There is no such situation in which two events are similar physically but different psychologically, or it is impossible that a thing can be different in psychological aspects and remain unchanged physically. Therefore, the same psychological state manifested by comorbidity does not mean the same physical fundamentals. Studies have found that the most common condition comorbid with depression in personality disorders is borderline personality disorder [24]. Studies of

their comorbidity have found that the two diseases had different outcomes if arising in a different sequence. The impact of comorbidity is more significant if borderline personality disorder precedes depression than that in which depression antecedes [24].

Such problems have been found in many comorbidities, including anxiety disorders comorbid with personality disorders and alcohol use disorders comorbid with anxiety disorders. However, few types of research have ever been done on the physical basis (brain mechanisms) and the mind-body relationship regarding sequential emergence and further developments of the two disorders. Although the mechanism of comorbidity between two diseases has not been fully understood, the thinking of mind-body supervenience has an exploratory and guiding significance for the further study of comorbidities.

Conclusion

Davidson's anomalous monism and supervenience theory have framed a new picture of the mind-body relationship, which not only fulfilled his philosophical ambition but also established the importance of non-reductive physicalism in contemporary philosophy of mind. These thoughts have also prompted a major shift in the attitudes toward the issue of psychological causality. The shift also provides a guiding approach to an in-depth understanding of specific disciplines and opens up a new perspective for the understanding of the mind-body relationship and comorbidity phenomena involved in mental illness, into which this paper attempts to make some explorations.

However, Davidson's argument has some shortcomings, and the concept of supervenience is still to be explicitly defined. Davidson believed that his attachment would neither lead to dualism nor deprive mental properties of their physical basis but that if physical systems were not closed, causality would lead to mind-thing dualism. If the physical system is closed, causality depends entirely on physical properties, while mental properties lose their causal status and are confused with epiphenomenalism. Therefore, the supervenience relationship only states the mind-body issue, reflecting the "phenomenal" relationship in attribute covariance, but not the "deep" dependence between these attributes, thus failing to produce solutions to specific mind-body issues.

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Author contributions

All authors were involved in the conceptualisation of the subject of the paper. Ping Yang wrote the manuscript. Xinyue Zhang did the translation and polishing work. Hongwen Song and Xiaochu Zhang revised the manuscript critically for important intellectual content. All authors have approved of the final version to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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References

1. Li Yami. *ng*.Kreapelin and the Time Image of Psychopath [J]. *Medicine & Philosophy* A, 200829 (4): 64–66.
2. Guo Benyu. From existential psychiatry to Anti-psychoitry [J]. J Nanjing Normal Univ Social Sci Ed, 2003(5): 86–91.
3. Meng Hai. Jaspers' psychopathology and its influence on contemporary psychiatry [J]. J Dialectics Nat. 2000;22(3):35–42.
4. Porcelli P, De Carne M, Leandro G. Distinct associations of DSM-5 Somatic Symptom Disorder, the Diagnostic Criteria for Psychosomatic Research-Revised (DCPR-R) and symptom severity in patients with irritable bowel syndrome[J]. Gen Hosp Psychiatry, 2020,64:56–62.
5. Feinstein AR. The pre-therapeutic classification of co-morbidity in chronic disease [J]. J Chronic Dis. 1970;23(7):455–68.
6. Davidson D. Mental events. Boston: The University of Massachusetts Press and Duckworth,1970:79–102.
7. Deng Xinxin C, Xiaoping. A comment on the debate of anomalous monism between Davidson and Kim [J]. *Studies*. Dialectics Nat. 2014;30(3):10–6.
8. Davidson D. Mental events. Boston: The University of Massachusetts Press and Duckworth; 1970. p. 445.
9. Yu Feng. Anomalous monism and Davidson on relation between the mental and the physical [J]. Stud Dialectics Nat 22(10): 42–4562.
10. Jaegwon kin. Mental causation. In Brian McLaughlin, Ansgar Beckermann, Sven Walter, eds. The Oxford Handbook of Philosophy of Mind [M]. Oxford Handbooks Online. 2009: 40.
11. Shen Yucun. Psychiatry. Beijing: People's Medical Publishing House, Fourth Edition 2002: 398.
12. Shen Yucun. Psychiatry. Beijing: People's Medical Publishing House, Fourth Edition 2002: 466.
13. Shen Yucun. Psychiatry. Beijing: People's Medical Publishing House, Fourth Edition 2002: 432.

14. Javanbakht A, Alberini CM, Editorial. Neurobiological models of psychotherapy [J]. Front Behav Neurosci. 2019;13:144.
15. Luke J, Norman., Kristin A, Mannella BA, et al. Treatment-Specific associations between brain activation and symptom reduction in OCD following CBT: A randomized fMRI trial [J]. Am J Psychiatry. 2021;178(1):39–47.
16. Adam Iskric and Emily Barkley-Levenson. Neural changes in borderline personality disorder after dialectical behavior Therapy–A review [J]. Front Psychiatry. 2021;10(12):1–7.
17. Yang Ping Z. An investigation of mind-body relationship from the perspective of nonreductive physicalism [J]. Med &Philosophy. 2022;43(2):60–4.
18. Li P, Fan TT, Zhao RJ. Et a1. Alfred brain network connectivity as a potential endophenotype of schizophrenia [J]. Sci Rep. 2017;7(1):5483.
19. Hare SM, Law AS, Ford JM. Et a1. Disrupted network cross talk. Hippocampal dysfunction and hallucinations in schizophrenia [J]. Schizophr Res. 2018;199:226–34.
20. Woodward ND, Rogers B, Heckers S. Functional resting-state networks ale differentially affected in schizophrenia [J]. Schizophr Res. 2011;130(1–3):86–93.
21. Chen Xiaomin Z, Rongjiang X, Wen, et al. Characteristics of resting-state brain functional network of schizophrenia patients with positive symptoms [J]. Chin Mental Health J. 2022;36(2):97–103.
22. Kim J. Mind in a physical World[M]. The MIT Press; 2000.
23. David Nutt DM. Care of depression patients with anxiety symptom [J]. Clin Psychiatry. 1999;60(Supp l17):23–7.
24. He Wei. Cerebral information processing in treatment-resistant depression: effects of comorbidity and function of cognitive and emotional regulations [D]. Zhejiang University; 2013.
25. Winter D, Krause-Utz A, Lis S, et al. Dissociation in borderline personality disorder: disturbed cognitive and emotional Inhibition and its neural correlates [J]. Psychiatry Res. 2015;233(3):339–51.
26. Herpertz SC, Jeung J, Mancke F, Bertsch K. Social dysfunctioning and brain in borderline personality disorder [J]. Psychopathology. 2014;47(6):417–24.

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