

# A Network Approach to Understanding and Diagnosing Adolescent Borderline Personality Disorder

Natasha Matta\*

October 18, 2021

## Abstract

Borderline personality disorder is a prevalent mental disorder characterized by instability in emotion regulation, interpersonal relationships, impulse control, and self-image and a high mortality rate due to suicide. Adolescent borderline personality disorder is a heavily debated topic as personality disorders are not formally diagnosed until age 18 and personality is still developing during adolescence, but borderline personality disorder has been found to be just as reliable in adolescents as in adults, and adolescents can benefit from early intervention and targeted treatment. The DSM employs a categorical approach to psychopathology in which disorders are viewed as distinct entities that cause symptom occurrence and covariance, but this framework fails to reconcile heterogeneity within disorders, symptom overlap across multiple disorders, and high rate of comorbidity among mental disorders. I propose taking a network approach to adolescent borderline personality disorder, which postulates that mental disorders can be conceptualized and studied as systems of interconnected, mutually reinforcing symptoms. Studying patterns of symptom dynamics, such as node activity and connectivity between nodes, through a network architecture could yield vital insights into what tips the metaphorical scale from normal to maladaptive during development. These insights can inform key periods of intervention and more targeted treatment options for psychopathology, equipping patients with tools to better cope with symptoms and focusing on deactivating central nodes, which in turn downregulate the activity of connected nodes.

---

\*Advised by: Erik Nook

Currently, clinicians take a categorical approach to diagnosing borderline personality disorder in patients. This method fails to account for high comorbidity of mental disorders and symptom overlap between conditions, and patients' symptoms rarely fit neatly into its narrowly defined categories. However, a network approach to psychopathology may account for the insufficiencies of the categorical approach and provide more accurate insights into why a patient's symptoms arise and the most effective treatment options for their condition. First posited in 2008, the network approach postulates that mental disorders can be conceptualized and studied as systems of interconnected, mutually reinforcing symptoms [Rob20] [Bri18]. I propose using a network approach to understand adolescent borderline personality disorder as a product of interacting symptoms rather than a single diagnostic category and redefine the debate over the validity of the disorder. In this paper, I will explain the differences between adult BPD and adolescent BPD pathology and neurobiology, how adolescent BPD differs from normative cognitive, emotional, and neural development, the network approach to psychopathology and how it accounts for the drawbacks of the categorical approach currently employed by clinicians, and finally, application of the network approach to clarifying adolescent BPD.

## 1 Borderline Personality Disorder and Its Development

### 1.1 Adult BPD Pathology and Neurobiology

Borderline personality disorder is a common mental disorder characterized by severe functional impairment and a pervasive pattern of instability in emotion regulation, interpersonal relationships, impulse control, and self-image [Lie04] [Ass13] [Lei11] [Kul18]. It affects an estimated 1-2% of the general population, 10% of psychiatric outpatients, and between 15% and 25% of psychiatric inpatients [Lie04] [Lei11]. The disorder is associated with a high risk of suicide, negative effect on the course of depressive disorders, extensive use of medical and psychiatric services, high costs to society, and high comorbidity with Axis I pathology (e.g., anxiety disorders, panic disorder, social anxiety disorder, and post-traumatic stress disorder) as well as other cluster B personality disorders (i.e., disorders characterized by dramatic, overly emotional or unpredictable thinking or behavior; e.g., antisocial personality disorder, histrionic personality disorder, and narcissistic personality disorder) [Lei11] [Cla05] [Bon14] [Zan90] [Zan98]. Studying the neurobiology of BPD patients can yield vital insights into how structural abnormalities in the brain contribute to cognitive, emotional, and behavioral differences in patients with BPD. Structural and functional neuroimaging of adults with BPD consistently reveals dysfunction and reduced volume in the frontolimbic network, including the anterior cingulate cortex (ACC), the orbitofrontal cortex (OFC), dorsolateral prefrontal cortex (dlPFC), the hippocampus, and the amygdala [Lie04] [Kae14]. The ACC mediates affective control, so dysfunction in this region may contribute to affective instability, one

of the hallmark features of borderline personality disorder [Lie04]. Activity in the dlPFC has been implicated in emotion regulation and inhibiting inappropriate responses to situations [Kro19] [Och05]. The role of the amygdala has been a subject of much debate; however, it has been implicated in receiving and processing emotions, and it interacts with the hippocampus to activate emotional responses [RL00] [Yan17].

## 1.2 Developmental Psychopathology Framework and Adolescence

Adult borderline personality disorder is widely accepted as a valid disorder and diagnosis, but there are many unanswered questions surrounding diagnosis of BPD in adolescents. Researchers have begun studying developmental psychopathology to better inform prevention, early detection, and critical windows for treatment [Cha12] [Mar16] [Cha17]. Developmental psychopathology examines the interface of the normal and maladaptive to better understand the course of development and which processes go awry in individuals with mental disorders [Cic02]. Recent decades have seen a surge of interest in adolescence—the time period beginning with the onset of puberty and ending with the achievement of a stable, independent role in society [Saw12] [Pfe12]. Adolescents strive to gain independence and the perceived rewards that come with adulthood when they are unprepared to assume full adult responsibilities [Cic02]. This struggle with identity and changing of responsibilities and roles characteristic of adolescence opens the door to potential internal and external conflicts, but this period also allows for the opportunity for growth and self discovery [Cic02]. Hall described adolescence as a period of “storm and stress” with heightened mood disruptions, risk behaviors, and conflict with parents [Hal04] [Arn99]. Most adolescents successfully cope with and adjust to the changes, demands, and adversities that come with development but others evidence extreme maladaptations [Cic02]. Thus, this time period is marked by a heightened vulnerability to psychopathology as neural, cognitive and behavioral systems mature across different timeframes and are influenced by both independent and common underlying factors [RL05]. The boundaries between the normal and abnormal in adolescence begin to blur and open the door to a number of questions: When are irritability, dysphoria, and emotional lability indicative of mood disorder versus part of normative adolescent emotional development and self-searching? When does experimentation with alcohol and drugs turn into substance abuse? Why are some adolescents more vulnerable to psychopathological extremes than others? Why do many adolescents adapt successfully, and what protects them from developing significant disturbance? What are the future ramifications of adolescent psychopathology? [Cic02] To answer these questions, we need to have a clearer understanding of the normative trajectory of cognitive, affective and neural development during adolescence. Once we clarify the interface between the normal and atypical, we can understand how and why psychopathology arises and how to minimize distress to an individual.

### 1.3 Normative Cognitive, Affective and Neural Development During Adolescence

During adolescence, brain development is primarily concentrated in the brain regions and systems that regulate emotion, judgement, and behavior [RL05]. Thus, adolescents show striking improvements in reasoning and information processing, become more capable of abstract, multidimensional and hypothetical thinking, and develop executive functioning skills like long term planning, metacognition, and self-evaluation [RL05]. Underlying neural processes include myelination of nerve fibers supporting rapid communication and connectivity between the prefrontal cortex and limbic system, changing the way adolescents evaluate risk and reward, and synaptic pruning in frontal areas vital to executive functioning [RL05]. Adolescents' social reasoning, similar to that of adults, is influenced not only by basic intellect and reasoning, but by personal desires and motives, and emotional sensitivity and reactivity, sensation-seeking, and risk-taking in adolescence are influenced by puberty and maturation [RL05]. Although high rates of automobile accidents, drug and alcohol use and unprotected sex paint a picture of adolescents as poor decision-makers, there is substantial empirical evidence to the contrary: adolescents engage in dangerous behaviors fully aware of the risks involved [RL05]. In practice, adolescents do not simply rationally compare the risks and consequences with the benefits, but their actions are largely influenced by emotions and social influences from peers or popular culture [RL05]. Only by understanding the cognitive, emotional and neural changes that are normative during adolescence can we discern which traits are maladaptive and which processes go awry in development to give rise to psychopathology like adolescent BPD.

### 1.4 Adolescent BPD Pathology and Neurobiology

BPD is a lifelong condition thought to have its roots in childhood and onset in adolescence; however, there is still much debate surrounding diagnosing the disorder before age 18 [Kae14]. Earlier versions of the Diagnostic and Statistical Manual (DSM) required an individual reach adulthood before a formal personality disorder diagnosis could be given, instability of affective regulation and self-image is normative in adolescents, personality is still developing during adolescence, and there is stigma surrounding borderline personality disorder diagnoses that clinicians often do not want to subject patients to [Bor09] [Kae14]. However, adolescent BPD has concurrent validity because adolescents diagnosed with the condition experience distress and functional impairment [Bon14]. There are also group differences between adolescents with BPD and adults with BPD (clear distinctions between the two diagnoses of BPD) [Bon14]. Additionally, adolescents can benefit greatly from intervention and disorder-specific treatment, making the case for diagnosing and treating BPD in adolescence [Kae14]. Thus, psychiatric classification systems and national treatment guidelines now recognize adolescent borderline personality disorder as a diagnosis [Kae14]. Mental disorders in childhood like oppositional

defiant disorder (ODD) from ages 8 to 10 and attention-deficit hyperactivity disorder (ADHD) in ages 10 to 13 uniquely predicted BPD at age 14, further cementing the notion that borderline personality disorders has its roots in childhood and onset in adolescence [Cha12] [Kae14] [Ste12] [Bur12]. Neurobiological research has found abnormalities in the frontolimbic network in both adolescents and adults with BPD, but it is unclear whether these irregularities are a cause, result, or epiphenomenon of the disorder [Cha12] [Lie04]. However, within the frontolimbic network, reduced volumes of the anterior cingulate cortex and orbitofrontal cortex were reported in adolescents, but reduced volumes of the hippocampus and amygdala, associated with adult BPD, were not found [Cha12] [Lie04] [Lei11]. Thus, abnormalities in the frontolimbic network in individuals with BPD may begin manifesting in adolescence but differentiate adolescent BPD from the adult form of the disorder. Adolescent BPD is a complex condition influenced by changes in the severity of instability in affective regulation and self image during development and abnormalities in the frontolimbic network of the brain. To begin to understand the elaborate set of relationships between personality traits and neurobiology and how and why atypical symptoms arise, we need to employ a broader approach to psychopathology: evaluating the connections between symptoms rather than trying to find a certain set of neurological abnormalities or traits that definitively cause a disorder.

## 2 Network Approach to Psychopathology

### 2.1 Contrasting Categorical and Network Approaches to Psychopathology

Prior to the DSM 5, the DSM employed a categorical approach to psychopathology in which disorders are viewed as distinct entities that cause symptom occurrence and covariance [McN16] [Kru02]. However, this model fails to account for high rates of comorbidity amongst DSM-defined mental disorders: 79% of all the lifetime mental disorders observed in the NCS were found in individuals with a history of more than one disorder [Kru02]. Moreover, many individuals meet criteria for as many as four or more mental disorders, further blurring the boundaries defining separate disorders, an assumption that is integral to the categorical approach [Kru02]. DSM-IV states, “a categorical approach to classification works best when all members of a diagnostic class are homogenous, when there are clear boundaries between classes, and when the different classes are mutually exclusive,” but these homogenous groups with clearly defined boundaries are rare in empirical data concerning psychopathology [Ass94]. Across questionnaires and interviews used by healthcare professionals to diagnose mental disorders, there is substantial inconsistency in inclusion and severity of symptoms, symptom overlap between disorder-specific diagnostic criteria, and bias towards emotional, cognitive, behavioral, and physical symptoms [New20]. These diagnostic tools are often disorder-specific, but a patient’s experiences

and symptoms rarely fit into the narrowly defined boundaries of the categorical framework [New20]. In that vein, if clinicians use assessment tools that differ by the degree to which they ask about a patient’s symptoms and life events, they could construct an incomplete or differing picture of the patient’s experiences and contributing factors, which could misinform treatment options or create conflicting evidence about the condition(s) that a patient has [New20]. Within a single disorder, symptoms can manifest differently in individuals, further blurring the lines of the diagnostic categories defining mental disorders [New20] [Kru02]. In contrast, a new approach to psychopathology was posited in 2008: the network approach in which mental disorders are viewed as complex systems of symptoms and underlying causes, which accounts for the inefficiencies of the categorical approach [Rob20] [Bak19] [Hud07] [Bor13] [War13]. From this perspective, mental disorders are conceptualized as networks of interacting symptoms that form mechanistic property clusters: sets of causally intertwined properties that do not necessarily share a fundamental underlying cause [Bri18]. Symptoms of psychopathology influence and evolve alongside each other: when one symptom arises, it gives rise to another symptom (e.g. insomnia leads to fatigue) [Bri18] [Bor13]. Specific groups of symptoms interact and cohere to form syndromes, which in turn cohere in broader families of disorder or spectra [Kru02]. Within this approach, differences in phenotype and severity or the degree to which a disorder manifested can be mapped at different levels ranging from broad differences to narrow and specific ones [Kru02] [Hud07]. Networks are comprised of two fundamental parts: nodes (circles) that represent variables (e.g. symptoms) and edges (lines) that connect nodes and symbolize relationships between them (e.g. correlation between symptoms) [Bor13]. A network approach can clarify the interface of normal and maladaptive and what goes awry in psychopathology. It can account for the insufficiencies of the categorical approach: heterogeneity of symptoms within a disorder, symptom overlap across different disorders, and high rates of comorbidity of mental disorders [New20] [Kru02]. Individuals rarely fit into the strictly defined boundaries of the categorical framework because of differences in genetics, neurobiology, culture, adverse life events, and relationships with family, and it is hard to single out an underlying cause or entity [New20] [Kru02]. Studying patterns of symptom dynamics through a network architecture could yield vital insights into how and why psychopathology manifests differently in individuals and inform more effective treatment options [Bri18].

## 2.2 Network Approach to Developmental Psychopathology

A network approach to psychopathology could help differentiate between healthy and unhealthy development and better inform key periods of intervention and elucidate targeted treatment options based on node activity. Within the period of childhood or of adolescence, neurobiology, cognition, affectivity, and behavior differ drastically between individuals due to cultural and societal expectations, hormonal changes and puberty, adverse life events, and relationships with family,

specifically parental figures [Cic02]. The categorical approach to developmental psychopathology currently employed in the DSM fails to account for the way that the differences that come with an individual’s gender and age and their ability to cope (e.g. for two individuals that experience maternal neglect in childhood, one may go on to develop depression, and one may not) contribute to how a disorder manifests [Hud07]. As such, adolescents rarely fit into the strictly defined diagnostic categories of mental disorders in the DSM, and it is difficult if not impossible to discern a single underlying cause or entity for psychopathologies. For example, an individual who experiences difficulties with emotion regulation may be diagnosed with an anxiety disorder, depression, a personality disorder, conduct disorder, or another psychopathology altogether. Thus, they may be misdiagnosed and receive treatment for a condition they do not have, which could increase functional impairment and distress or be completely ineffective for their symptoms. Even if they do receive the correct diagnosis, the individual may not have a targeted and effective treatment for their specific set of symptoms. The categorical framework also fails to reconcile the high rates of comorbidity between conditions, especially between disorders that share similar symptoms or fall within the same axis or cluster like axis I disorders anxiety and depression [Hud07]. In contrast, the network approach focuses on mapping interactions (edges) between individuals symptoms (nodes) rather than trying to divide mental disorders into distinct categories and sub-categories when there is so much variability in how a mental disorder manifests based on the point in time of the individual’s life, environment, culture, genetics, and neurobiology [Bri18] [Bor13] [Kru02]. The transition from childhood to adolescence is a key period in development and is characterized by heightened vulnerability to psychopathology, yet it has rarely been studied using a network architecture. In a study from middle childhood through adolescence assessing maternal reports of children at ages 7.5, 10.5 and 14, a consistent network structure emerged at the three points in time, and nodes clustered together in two regions broadly reflecting internalizing and externalizing traits [McE18]. Relationships between these symptoms gave rise to what we believe to be different mental disorders [McE18]. These findings demonstrate that a network approach can elucidate relationships at the symptom or disorder level as well as broader connections between internalizing and externalizing psychopathology as early as in childhood and adolescence [McE18]. Early intervention and symptom-specific treatment can provide children and adolescents with the necessary skills to cope with their condition from a young age, allowing them to attain the stable role in society and independence that adolescents strive for. The network architecture to developmental psychopathology could spare young people years of distress in adulthood and reduce costs (e.g. hospital bills, reduced productivity, etc.) to society.

## 3 Network Approach to Adolescent Borderline Personality Disorder

### 3.1 Changing Approaches to Diagnosis of Personality Disorders

Overwhelming evidence contradicts the notion that personality disorders are categorical and that there are 10 (or any set number of) discrete types of personality disorders [Hop18]. The categorical approach to personality disorder diagnosis comes with low reliability, high comorbidity, and heterogeneity of symptoms within each disorder [Hop18]. Recognizing the categorical approach’s limitations, the DSM-5 and the ICD-11, the primary handbooks for healthcare professionals diagnosing mental disorders, are moving towards a dimensional approach to psychopathology: rating personality disorders on a gradient from personality difficulty to severe personality disorder and quantifying the severity of several trait domains, such as negative affectivity and detachment [Hop18] [Bac17] [Sko12]. Although the dimensional approach is a step in the right direction for diagnosing personality disorders, there is still a need for a network approach to understand how symptoms manifest differently in individuals and give clinicians clearer insight into the most effective treatment options. Although the dimensional approach accounts for some of the drawbacks of the categorical approach, it is still too rigid in defining mental disorders in childhood and adolescence. The ICD-11’s severity gradient only includes four classifications: personality difficulties, mild personality disorder, moderate personality disorder, and severe personality disorder when an individual’s distress level and ability to function on a daily basis may vary further within each grouping. Similarly, the rating from 0 (healthy functioning) to 4 (severe impairment) of personality functioning in the DSM-5 does not fully encompass nuances in impairment in individuals who present similar symptoms. A network approach does not try to simplify the complexity of mental disorders and put them in a single category or delineate one underlying cause or entity but rather focuses purely on an individual’s symptoms and how those symptoms in turn give rise to other symptoms. In that sense, mental disorders are no longer viewed as diagnostic categories but as a web of connections (edges) between symptoms (nodes) that continue to evolve alongside each other. Furthermore, nodes’ activity and strength can be measured on a gradient as severity of symptoms varies so much by the individual.

### 3.2 Network Approach to Adolescent BPD

A network architecture could clarify in developmental psychopathology, what “tips the scale” from tolerable to distress or dysfunction. This approach focuses solely on the symptoms that manifest and how these in turn give rise to other symptoms, accounting for heterogeneity of symptoms in different patients with the same disorder, symptom overlap across disorder-specific criteria, and high rates of comorbidity amongst mental disorders that the categorical approach



fails to resolve. A network approach can also account for global heightened emotional sensitivity and reactivity in adolescence by measuring the activity of emotion regulation nodes and better elucidate the interface between the normal and abnormal during development (e.g. when quantifying activity of the node measuring instability of self image, subtracting a certain baseline height of activity of that node that adolescents universally experience to give a more accurate picture of which individuals struggle significantly with self image). Within development, numerous factors including neurobiology, cultural and societal norms and expectations, hormonal changes and onset of puberty, environment, genetics, adverse life events, parental influences, and an individual's ability to cope with the demands of adolescence shape how symptoms manifest uniquely in different individuals. A simple numerical rating system like the four point scale of personality functioning used in the DSM can not properly account for the extreme variability of those factors. Using a network architecture takes a new lens on the current body of work concerning the validity of adolescent borderline personality disorder as a diagnosis by disregarding the study of its underlying causes. Individuals with vastly different life experiences, environment, and genetics, all of which influence symptoms, can fall under the umbrella of the same disorder (adolescent BPD) within the categorical approach. Because of these differences, certain treatment methods like talk therapy or medication will be more or less effective for different patients although in theory they have the same condition. Viewing adolescent BPD as a matrix of relationships between symptoms rather than one diagnosis makes the argument over its construct validity irrelevant and can elucidate the best treatment options for an individual.

### **3.3 Illustrating the Model: Connections Between Childhood ODD and ADHD and Adolescent BPD**

There is a growing body of work into oppositional defiant disorder (ODD) and attention deficit hyperactivity disorder (ADHD) in childhood as predictors of BPD in adolescence. In a study of girls aged 8-14, higher ODD and ADHD scores at age 8 uniquely predicted BPD symptoms at age 14, and the rate of growth in ADHD scores from age 10 to 13 and the rate of growth in ODD scores from 8 to 10 uniquely predicted higher BPD symptoms at age 14 [Cha12]. The behavioral dimension of ODD rather than the affective one predicted later BPD symptoms [Bur12] [Cha12]. This suggests that difficulties with emotion regulation and interpersonal relationships in childhood might precede problems with impulse control later in life in adolescence [Bur12] [Cha12]. A network architecture could measure activity of specific nodes in children with ODD and ADHD that correspond with nodes in adolescents who had the two conditions in childhood and now experience BPD (e.g. heightened activity of the emotional reactivity node for ODD and for ADHD in childhood could correspond to heightened activity of the emotional reactivity node in the BPD network in adolescence whereas heightened activity of a hyperactivity node in ODD and in ADHD would not lead to development of BPD in adolescence).

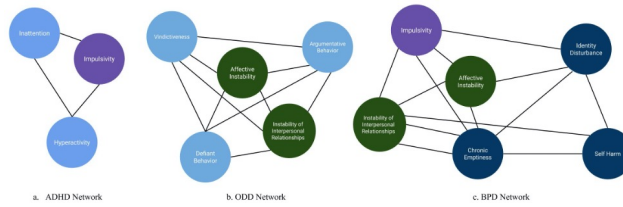


Figure 1: Networks for ADHD, ODD, and BPD.

The networks show the relationships and interconnectedness between symptoms within ADHD, ODD, and BPD. Nodes found in both the ADHD and BPD networks are shown in purple, and nodes found in both the ODD and BPD networks are shown in dark green. This supports the notion that symptoms of ADHD and ODD in childhood are later found in BPD in adolescence.

## 4 Discussion

### 4.1 Summary

Borderline personality disorder (BPD) is marked by difficulties maintaining relationships, regulating emotions and reactivity, resisting temptations and impulses, and viewing oneself realistically. These instabilities are exacerbated further by heightened emotional sensitivity and reactivity, difficulties with self image, and changes in personality that are characteristic of adolescence. The DSM uses a categorical approach to psychopathology where mental disorders are viewed as diagnostic categories with an underlying cause or entity. However, there come problems with heterogeneity of symptoms in a disorder, similar symptoms across multiple disorders, and high rates of comorbidity of mental disorders, which can misinform treatment options and which disorder(s) a patient has. Because of variability in genetics, neurobiology, environment, life events, and relationships with parents, patients rarely fit into the rigid diagnostic categories used in the categorical approach. The network architecture accounts for these insufficiencies by mapping the relationships between different symptoms and measuring the activity of nodes (the degree to which these symptoms manifest). This framework can clarify what goes awry in development to cross the boundary from normal to maladaptive and give rise to adolescent borderline personality disorder pathology. Further, it can provide clearer insights into which children will go on to develop BPD in adolescence based on different symptoms of ODD and ADHD and those nodes' activity, informing more personalized treatment options and key periods for intervention.

### 4.2 Limitations

A limitation of the network approach to adolescent borderline personality disorder is a lack of empirical data backing it. However, research is moving towards quantifying different levels of heterogeneity of symptoms: heterogeneity across

people or groups (p-level), heterogeneity across different symptom dimensions (s-level), and heterogeneity over time (t-level) [War13]. Latent class analyses (LCA) have identified subtypes (p-level heterogeneity but does not account for variability over time), factor analyses (FA) have identified symptom dimensions (s-level but assumes stability across people and over time), and mixture growth analyses (MGA) identified course-trajectory groups (t-level but fails to account for heterogeneity across symptom dimensions) [War13]. However, to truly understand the complex relationships between symptoms (how they augment, sustain and change other symptoms), we need to evaluate these levels of heterogeneity of symptoms together (i.e. p-by-s-by-t analysis) [War13]. In that vein, as the network approach was only posited in 2008, there is limited research into its applications to developmental psychopathology and personality disorders. However, network approaches to adult mental disorders, such as depression, have been helpful in clarifying individual differences in symptoms (e.g. one person might have a strong self-loop of worrying, so when he or she starts to worry, that person will continue worrying for a longer time than someone with a weak self-loop) and global and population trends in severity and occurrence of symptoms and the relationships between them (e.g. differing levels of neuroticism based on occurrences of sadness, cheerfulness, worrying, fearfulness, and relaxation) [Bri18]. Understanding variability in an individual can inform more personalized and targeted therapeutic intervention options to treat negative self-loops [Bri18]. Thus, similar to adult psychopathology, the network approach could clarify the interface between the normal and abnormal during development and how symptoms evolve and influence each other to give rise to what we classify as personality disorders. This would involve analyzing (e.g. using measures such as centrality (betweenness) of nodes) and mapping the variability of symptoms in individuals and a population and local and global network connectivity for patients with different forms of personality disorders as well as comparing which nodes and loops differ in adolescents who undergo normative development versus those who develop psychopathology, similar to the data collected in the study taking a network approach to depression in adults.

### 4.3 Implications and Areas of Future Research

Using a network architecture to understand adolescent borderline personality disorder could inform key time periods for intervention, more accurate predictions of which children will go on to develop the disorder in adolescence based on activity of certain nodes, and more personalized and targeted treatment to an individual based on the dynamics between the symptoms that manifest and height of node activity. With an early intervention strategy, clinicians have time to teach developing individuals skills to better cope with their symptoms through treatments like dialectical behavioral therapy (DBT) to learn how to manage emotions, tolerate distress, and improve interpersonal relationships, which set them up for more fulfilling and successful futures [Lyn07] [Lie04]. The network approach can help make up for the lack of standardization across self-assessment questionnaires and interview questions that clinicians employ to

diagnose psychopathology by measuring the degree to which symptoms manifest instead of trying to fit a patient to a strictly defined diagnostic category. Further research should be done into how to most effectively quantify the severity of symptoms and then discern the most productive treatment options for a patient based on those measurements and the symptoms presented. A study employing an integrative network approach to social anxiety disorder found turning off a central node (e.g. avoidance of social situations) may foster a beneficial cascade of downstream effects, deactivating other nodes in the network (e.g. fear of social situations) that the central node interacts with [Hee16]. A multitude of studies support the notion that successful treatment of social anxiety disorder involves the identification of over and subtle avoidance behaviors and encouragement of the patient to stop employing these strategies before engaging in social situations to reduce the individual's fear of them, bolstering the network approach's findings [Hee16]. Targeting nodes that exert the strongest influence on a network has promising therapeutic implications to psychopathology [Hee16].

## 5 Conclusion

A network approach can elucidate the interface between the normal and abnormal in developmental psychopathology and inform the most effective treatment options for an individual based on the activity and connectivity of nodes in the network of the symptoms they manifest. This framework focuses on which symptoms manifest and how those in turn give rise to other symptoms, accounting for heterogeneity of symptoms in a disorder, symptom overlap across a number of disorders, and high rates of comorbidity of mental disorders that the categorical approach to psychopathology fails to rectify. People rarely fit into the narrowly defined diagnostic categories of mental disorders in the DSM because of differences in neurobiology, genetics, environment, culture, life events, and family dynamics, and it is difficult to single out an underlying cause or set of causes for psychopathologies. Measuring activity of specific nodes in childhood can predict who will go on to develop certain disorders in adolescence: severity and connectivity of a set of symptoms in ODD and ADHD in childhood can more accurately predict BPD in adolescence. Stronger prediction power allows for early intervention and more targeted treatment, hopefully sparing patients from further distress and functional impairment in the future and lowering the high suicide rate characteristic of borderline personality disorder.

## References

- [Arn99] J. J. Arnett. Adolescent storm and stress, reconsidered. *American Psychologist*, 1999.
- [Ass94] American Psychiatric Association. Diagnostic and statistical manual of mental disorders (4th ed.). 1994.

- [Ass13] American Psychiatric Association. Diagnostic and statistical manual of mental disorders (5th ed.). 2013.
- [Bac17] Sellbom M. Kongerslev M. Simonsen E. Krueger R. F. Mulder R. Bach, B. Deriving icd-11 personality disorder domains from dsm-5 traits: initial attempt to harmonize two diagnostic systems. *Acta Psychiatrica Scandinavica*, 2017.
- [Bak19] Dillon D. G. Patrick L. M. Roffman J. L. Brady R. O. Pizzagalli D. A. Öngür D. Holmes A. J. Baker, J. T. Functional connectomics of affective and psychotic pathology. *Proceedings of the National Academy of Sciences of the United States of America*, 2019.
- [Bon14] Greenfield B. Tse S. M. Bondurant, H. Construct validity of the adolescent borderline personality disorder: a review. *The Canadian Child and Adolescent Psychiatry Review*, 2014.
- [Bor09] Hicks B. M. Iacono W. G. McGue M. Bornovalova, M. A. Stability, change, and heritability of borderline personality disorder traits from adolescence to adulthood: A longitudinal twin study. *Development and Psychopathology*, 2009.
- [Bor13] Cramer A. O. J. Borsboom, D. Network analysis: An integrative approach to the structure of psychopathology. *Annual Review of Clinical Psychology*, 2013.
- [Bri18] Eronen M. I. Bringmann, L. F. Don't blame the model: Reconsidering the network approach to psychopathology. *Psychological Review*, 2018.
- [Bur12] Stepp S. D. Burke, J. D. Adolescent disruptive behavior and borderline personality disorder symptoms in young adult men. *Journal of Abnormal Child Psychology*, 2012.
- [Cha12] Kaess M. Chanen, A. M. Developmental pathways to borderline personality disorder. *Current Psychiatry Reports*, 2012.
- [Cha17] Sharp C. Hoffman P. Chanen, A. Prevention and early intervention for borderline personality disorder: a novel public health priority. *World Psychiatry*, 2017.
- [Cic02] Rogosch F. A. Cicchetti, D. A developmental psychopathology perspective on adolescence. *Journal of Consulting and Clinical Psychology*, 2002.
- [Cla05] Posner M. Clarkin, J. F. Defining the mechanisms of borderline personality disorder. *Psychopathology*, 2005.
- [Hal04] G. S. Hall. Adolescence: Its psychology and its relation to physiology, anthropology, sociology, sex, crime, religion, and education. 1904.

- [Hee16] McNally R. J. Heeren, A. An integrative network approach to social anxiety disorder: The complex dynamic interplay among attentional bias for threat, attentional control, and symptoms. *Journal of Anxiety Disorders*, 2016.
- [Hop18] Kotov R. Krueger R. F. Watson D. Widiger T. A. Althoff R. R. Ansell E. B. Bach B. Michael Bagby R. Blais M. A. Bornovalova M. A. Chmielewski M. Cicero D. C. Conway C. De Clercq B. De Fruyt F. Docherty A. R. Eaton N. R. Edens J. F. ... Zimmermann J. Hopwood, C. J. The time has come for dimensional personality disorder diagnosis. *Personality and Mental Health*, 2018.
- [Hud07] Achenbach T. M. Althoff R. R. Pine D. S. Hudziak, J. J. A dimensional approach to developmental psychopathology. *International Journal of Methods in Psychiatric Research*, 2007.
- [Kae14] Brunner R. Chanen A. Kaess, M. Borderline personality disorder in adolescence. *Pediatrics*, 2014.
- [Kro19] Dunsmoor J. E. Hakimi M. Oosterwaal S. Meager M. R. Phelps E. A. Kroes, M. C. W. Patients with dorsolateral prefrontal cortex lesions are capable of discriminatory threat learning but appear impaired in cognitive regulation of subjective fear. *Social Cognitive and Affective Neuroscience*, 2019.
- [Kru02] Piasecki T. M. Krueger, R. F. Toward a dimensional and psychometrically-informed approach to conceptualizing psychopathology. *Behaviour Research and Therapy*, 2002.
- [Kul18] Kose S. Kulacaoglu, F. Borderline personality disorder (bpd): In the midst of vulnerability, chaos, and awe. *Brain Sciences*, 2018.
- [Lei11] Leibing E. Kruse J. New A. S. Leweke F. Leichsenring, F. Borderline personality disorder. *The Lancet*, 2011.
- [Lie04] Zanarini M. C. Schmahl C. Linehan M. M. Bohus M. Lieb, K. Borderline personality disorder. *The Lancet*, 2004.
- [Lyn07] Trost W. T. Salsman N. Linehan M. M. Lynch, T. R. Dialectical behavior therapy for borderline personality disorder. *Annual Review Clinical Psychology*, 2007.
- [Mar16] O. Marín. Developmental timing and critical windows for the treatment of psychiatric disorders. *Nature Medicine*, 2016.
- [McE18] Shevlin M. Murphy J. McBride O. McElroy, E. Co-occurring internalizing and externalizing psychopathology in childhood and adolescence: a network approach. *European Child and Adolescent Psychiatry*, 2018.

- [McN16] R. J. McNally. Can network analysis transform psychopathology? *Behaviour Research and Therapy*, 2016.
- [New20] Hunter D. Thiagarajan T. C. Newson, J. J. The heterogeneity of mental health assessment. *Frontiers in Psychiatry*, 2020.
- [Och05] Gross J. J. Ochsner, K. N. The cognitive control of emotion. *Trends in Cognitive Sciences*, 2005.
- [Par08] J. Paris. Treatment of borderline personality disorder: A guide to evidence-based practice. *Trends in Cognitive Sciences*, 2008.
- [Pfe12] Blakemore S. J. Pfeifer, J. H. Adolescent social cognitive and affective neuroscience: Past, present, and future. *Social Cognitive and Affective Neuroscience*, 2012.
- [RL00] Akirav I. Richter-Levin, G. Amygdala-hippocampus dynamic interaction in relation to memory. *Molecular Neurobiology*, 2000.
- [RL05] Akirav I. Richter-Levin, G. Cognitive and affective development in adolescence. *Trends in Cognitive Sciences*, 2005.
- [Rob20] Hoekstra R. H. A. Toner E. R. Borsboom D. Robinaugh, D. J. The network approach to psychopathology: a review of the literature 2008–2018 and an agenda for future research. *Psychological Medicine*, 2020.
- [Saw12] Afifi R. A. Bearinger L. H. Blakemore S. J. Dick B. Ezech A. C. Patton G. C. Sawyer, S. M. Adolescence: A foundation for future health. *The Lancet*, 2012.
- [Sko12] A. E. Skodol. Personality disorders in dsm-5. *Annual Review of Clinical Psychology*, 2012.
- [Ste12] Burke J. D. Hipwell A. E. Loeber R. Stepp, S. D. Trajectories of attention deficit hyperactivity disorder and oppositional defiant disorder symptoms as precursors of borderline personality disorder symptoms in adolescent girls. *Child Psychology*, 2012.
- [War13] de Jonge P. Wardenaar, K. J. Diagnostic heterogeneity in psychiatry: Towards an empirical solution. *BMC Medicine*, 2013.
- [Yan17] Wang J. Z. Yang, Y. From structure to behavior in basolateral amygdala-hippocampus circuits. *Frontiers in Neural Circuits*, 2017.
- [Zan90] Gunderson J. G. Frankenburg F. R. Chauncey D. L. Zanarini, M. C. Discriminating borderline personality disorder from other axis ii disorders. *American Journal of Psychiatry*, 1990.
- [Zan98] Frankenburg F. R. Dubo E. D. Sickel A. E. Trikha A. Levin A. Reynolds V. Zanarini, M. C. Axis i comorbidity of borderline personality disorder. *American Journal of Psychiatry*, 1998.