Three Typical Mental Disorders Associated With Behavioral Genetics And Environment

Dongbin Hu1, †, Jiewen Yang2,*, †, Jiankai Zhang3, †

1 Suzhou science and technology town foreign language school, 21500, Suzhou, Jiangsu, China
2 Colorado University of Boulder, Boulder, CO. US
3 College of Life Science and Technology, Guangxi University, Nanning, Guangxi, China
† Those authors contributed equally.

Abstract. The purpose of the paper is to review the studies on family and identify the major factor contribute to these psychiatric problems. The basic psychiatric problem was range from bipolar disorder to antisocial personality disorder with the addition of reading disability. In the study of using the principle of animal behavior to research three different types of the psychiatric problem were being used to find out the influence of genetic and environment on both the history and current condition of the family and the impact on people's future behavior with the experiment of how family study and twin study. This is a common psychiatric disease among current society due to the heavy pressure around people after reviewing different types of articles related to this psychiatric problem. The study was based on several datasets from the previous study, including 3 family studies and 6 twin studies with several different types of DSM questionnaires and interview information from thousands of twins with various in the category. With an analysis of all the statistical information, we conclude that the psychiatric problem is closely related. Both genetic and environmental are differentiated in the percentage of effect to the cause of the related problem.

1 Introduction

An increasing number of human behavioral disorder patients in the word warned that humans should focus on mental health. The brain of a human determines mood and cognitive abilities, and other important behaviors. These behavioral disorders are misjudged by someone as an awful mood, low intelligence, or bad reason, giving patients unfair treatment. Studies have given evidences that several mental disorders are due to gene and environmental influence. For example, a study on schizophrenia found that the effect of genes is significantly higher than the environment’s. The major studies focus on mood disorders like bipolar disorder, depression, antisocial personality disorder, or the recognized disability like dyslexia and motor dysgraphia. These reviews included three mental disorders: Dyslexia, Bipolar disorder, and Antisocial personality disorder.

Reading is a basic human ability that helps people increase the speed at which they acquire new things or objects. However, many people in the world have trouble reading or understanding things. Dyslexia occurs anywhere in the world, at all social levels, regardless of intelligence. We find some references to learn the heritability of the Reading disability (Dyslexia) by family and twin studies. Then, we know that the reading disability is always affected by environmental and genetic factors. Also, we find some approaches to treat those who have disabilities of reading or spelling by references from websites.

Bipolar disorder is a widely mental disorder around the world. We have found that the changeable emotion is uncontrolled because it was related to some particular chemical substances produced in the brain, which means that the emotional expression associate with genes.

An experiment about antisocial personality was established to assess the effect of psychiatric problem inside a family and around a specific environment. It covered two types of approaches: family study and twin study with more than ten types of psychiatric problem that are similar in the cause of genetic aspect that almost all of them are caused by the same gene. Based on the previous study, all of the family and twin study examples are slightly objective due to the method of collecting information from a questionnaire based on DSM-V, which can effectively test if someone has a certain type of psychiatric problem. The consequence from the analysis of the data is significantly consistent with the hypothesis built before.

* Corresponding author: jiya7167@colorado.edu

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (http://creativecommons.org/licenses/by/4.0/).
2 Reading disability and dyslexia

2.1 Background (Definition & Behaviors) for reading disability and dyslexia

2.1.1 Reading disability

Reading is an essential ability for humans, which can help people increase their speed of getting new things or objects. However, many people in the world have difficulty in reading or understanding things. Reading disability occurs anywhere in the world, at all social levels, regardless of intelligence. However, prevalence data cited in the literature can vary widely (i.e., 5-17% of school-age children; Shaywitz et al., 2008) [3]. People who have those diseases cannot make a clear difference between decoding (the accuracy or fluency of reading aloud) and comprehension (the adequacy of understanding text) [1]. Learning to decode problems (developmental dyslexia) and learning to comprehend text problems (reading comprehension disorder) are two different forms of difficulties, both of which seem to depend primarily on disorders of spoken language development [1]. Scientists find out that this phenomenon may be caused by genetic disease, reading disability, and dyslexia.

2.1.2 Dyslexia

Dyslexia is at the low end of a persistent distribution of reading skills in the population. It is the most widely used word to describe children who face reading or comprehension difficulty. Children with dyslexia have trouble recognizing printed words and "reading out" unfamiliar words, so they often read slowly. Dyslexia is more common in men and often coexists with other developmental disorders such as specific language disorder (SLI), attention deficit hyperactivity disorder, or developmental coordination disorder [1].

2.2 Family study & Twin study for reading disability and dyslexia

From Willcutt, E. G., Pennington, B. F., Duncan, L., Smith, S. D., Keenan, J. M., Wadsworth, S., Defries, J. C., & Olson, R. K. (2010) researches which are about reading disability is using family study. On the dimensions of reading, the correlation between siblings was moderate to high (r=0.40 –0.70) [2]. In family studies with classified diagnoses, the relative risk of dyslexia (RD) in first-degree relatives of protostors is 4 to 8 times higher than in relatives of non-protostors [2]. Since members of an intact biological family share a common genetic influence and family environment, other methods are needed to disentangle the relative contributions of genetic and environmental influences. Twin studies provide estimates of the extent to which genetic or environmental influences contribute to disease by comparing similarities between identical twins (MZ) who share all their genes and fraternal twins (DZ) who share an average of half their genes [2].

Family and twin studies clearly show that dyslexia (RD) is familial and hereditary [2]. While more research is needed into the molecular genetic etiology of the disease, preliminary results suggest that each disease is caused by the addition or interaction of multiple genetic and environmental risk factors. Each factor alone can have only a small impact [2].

In most analyses, twins had to have a verbal or behavioral IQ of at least 85 [4]. However, we did not require a difference between reading ability and IQ when we analyzed the average effect of genes on the group’s reading ability and related defects. The difference between IQ and reading ability has traditionally been a requirement for special education services in the United States to provide “specific dyslexia” and some “dyslexia” studies. However, recent evidence suggests that poor readers’ IQ has nothing to do with their basic phonological processing deficits or intervention responses, so there is a strong movement in the US to eliminate differences in IQ standards in the provision of services for diagnosis and treatment of learning disabilities (Lyons et al., 2001) [4].

Gayan and Olson (under review) recently posed a similar bivariate heritability problem for variables in genetic models of these underlying traits, but with individual differences within the normal range rather than population defects. They found a significant genetic correlation between speech decoding and orthographic encoding (0.82) [5] but significant independent genetic variances. These analyses were done by comparing the correlations or covariances of MZ and DZ twins without selecting a biased group of probers. Individual differences within the normal range produced the same basic results as we found in population defects: the genetic correlation between speech awareness and speech decoding (0.79) was significantly higher than the genetic correlation between speech awareness and orthographic encoding (0.55) [5].

### Table 1.

<table>
<thead>
<tr>
<th>Reading disability</th>
<th>Number of pairs</th>
<th>Probandwise concordance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakwin</td>
<td>MZ 31</td>
<td>DZ 31</td>
</tr>
<tr>
<td></td>
<td>MZ 91%</td>
<td>DZ 45%</td>
</tr>
<tr>
<td>Harlaar et al</td>
<td>MZ 308</td>
<td>DZ 246</td>
</tr>
<tr>
<td></td>
<td>MZ 72%</td>
<td>DZ 45%</td>
</tr>
<tr>
<td>Hawke et al</td>
<td>MZ 306</td>
<td>DZ 247</td>
</tr>
<tr>
<td></td>
<td>MZ 66%</td>
<td>DZ 35%</td>
</tr>
<tr>
<td>Stevenson et al</td>
<td>MZ 14-18</td>
<td>DZ 27-38</td>
</tr>
<tr>
<td></td>
<td>MZ 33-50%</td>
<td>DZ 29-54%</td>
</tr>
<tr>
<td>Zerbin-Rudin</td>
<td>MZ 17</td>
<td>DZ 34</td>
</tr>
<tr>
<td></td>
<td>MZ 100%</td>
<td>DZ 52%</td>
</tr>
<tr>
<td>Weighted average</td>
<td>MZ 70%</td>
<td>DZ 41%</td>
</tr>
</tbody>
</table>
2.3 Treatments (recent) for reading disability and dyslexia

Transcription techniques have a variety of remedial and compensatory strategies. For some skills, teachers can flexibly use remedial and compensatory strategies to meet students' needs.

2.3.1 Spelling Development Strategies

Phonetic teaching was the most frequently used teaching component related to spelling achievement and was the focus of eight of the 19 studies. These studies include multi-component speech interventions, including teaching students to recognize and pronounce grapheme-phoneme corresponding words and phonetic graphs, use phonetic spelling and phonetic graphs to decode words, and practice pronunciation and spelling high-frequency words, and to practice coding using phonetic spelling and phonogram.

2.3.2 Spell checking

Spell checking has been around for a long time, and despite limited evidence of its effectiveness [7], the effectiveness of spell checking may depend on a student's ability to use it.

2.3.3 The analysis of morphemes.

Phonetic challenges in children who experience dyslexia may make it difficult for them to use phonetic messages. In some cases, even the best phonics may not improve word reading. One way to solve this problem is to teach children to recognize a different unit, a morpheme. A morpheme is a meaningful unit of a word, including affixes and base words [6].

3 Bipolar disorder

3.1 Brief Introduction

Bipolar disorder is a mood disorder characterized by episodes of mania and depression. Bipolar disorder has become one of the topics of concern. Clinically, patients of bipolar disorder present as depressive or manic or alternate episodes of both. They experience symptoms during the depressive episode are erratic mood, more irritable and more suicidal thoughts. In contrast, during the manic episode, they experience high mood, hyperactivity, rapid speech, decreased need for sleep, and even have hallucinations. Bipolar disorder is a defined disorder but not a bad mood. The differences in behavioral and emotional performance are the evidence to diagnose bipolar disorder. Two standards which used widely are ICD-10 and DSM-V.

The World Health Organization (WHO) announced that as of 2019, there had been about 45 million patients worldwide. Although the true pathogenesis has not been found completely and clearly yet, however, genotype-environment interaction or association with stress reaction have a significant effect. Based on those discoveries, treatment and prevention, which we master of bipolar disorder, are medication, MECT, and mental intervention.

Bipolar disorder has many manifestations which are worth investigating. Hypomania is a special and particular manic episode, and cannot be diagnosed accurately. When manic episodes are mild, which is called hypomania, patients are highly active in server days without hallucination. Some famous artists who were hypomania created wonderful world-famous pictures, statues, or articles due to their surging creativity.

Bipolar disorder was divided into three types base on its severity of symptoms, Bipolar disorrl, bipolar disorder II, and cyclothymia. Bipolar disorderhappens more frequently in teenagers and presents milder than others. Bipolar disorder I recurrently manic episodes, and cyclothymia show significant fluctuations between mania and depression.

3.2 Genotype-environment Interaction

Bipolar disorder has high heritability and the estimate ranging over 50 percent based on the twins and family study [8]. Identical twins show a high risk of bipolar disorder than fraternal twins, while the proportion between patients and unaffected pairs within the twins is nearly consistent.

3.2.1 Genotype Effect

Bipolar disorder probands significantly influence their offerings within a family, and they have a higher risk of getting unipolar disorder relative to offsprings. In research, first-degree relatives of patients are about nine times more likely to develop bipolar disorder than others. Because of the high heritability, bipolar disorder can be passed to offsprings like a normal genetic disease, although parental generation with bipolar relative genes never presents depression or mania. But no difference in this heritability is found between identical twins and fraternal twins. Researchers believe that certain gene segments can be found in human DNA, but the position has not been clarified.

Genetic influence is more important in the risk of bipolar disorder than environmental influence. In early studies, the average twin concordances for identical twins and fraternal twins are significantly different, which the former are outstandingly higher than the latter. Subsequently, a Finnish and a U.K. study draw out a similar result. Identical twins share the same genetic influence.

3.2.2 Environment Effect

Within an adoptive family, the adoptees have less probability of suffering from bipolar disorder even if the adoptive family member develops it when adoptees’ biological parents are healthy. Because there are no significant share environmental effects, while non-shared environmental effects were more outstanding [9], the
different environmental effects such as different schools can influence the probability. However, although the share environmental effect is very small, it cannot be ignored because showing a significant effect in several studies [10].

Correlation between bipolar disorder and lifestyle, environment effect, and genetic effect is the key point. It shows that genes are not the only determinant. A famous study called STAR in Sweden divided the participants into several groups based on a variety of factors, including their sex, age, handedness, substance abuse and dependence, twin study, types of twins, rare apart or together, and how much they contact each other are also included, proving that what extent do these factors contribute to the risk for bipolar disorder and bipolar disorder influences on physical [11].

3.3 Physiology Effect
Bipolar disorder patients’ body has some unnormal changes lead to their emotional disorder. Some regions appear at different activation levels in a patient's brain, contributing to their uncontrollable and changeable emotions. These changes are related to genes, observing some similar phenotype from the patient’s relatives and family members. A twin and family study that scanned the activation of some brain regions by MRI when taking a memory task has found that brain activation within members of identical twins is significant in some regions and concluded that the heritability is about 0.4[9]. It shows an increasing potential risk for family members of bipolar disorder patients.

Improving physical activity can advance the probability of changing the behavior of bipolar disorder [12]. Some neuroplasticity substrates can influence emotional expression. These factors were detected not at a normal level in bipolar disorder patients, which cause seriously emotional fluctuation physiologically, and even endangers their body health. But physical activity can adjust to such disorder. Brain-derived neurotrophic factor level, which can promote nerve conduction and the differentiation of neures, can be improved by high physical activity, which can keep the body healthy and alleviate the symptoms of bipolar disorder [12]. Optimized neurotransmitter level and function, synaptic number and function, and others also have similar functions as brain-derived neurotrophic factor levels [12].

4 Antisocial personality disorder

4.1 Introduction of ASPD
An antisocial personality disorder is a psychiatric disorder that may behave over-emphasizing criminal acts, which is also called psychopathy in terms of the introduction written by the American psychiatric association [15].

It’s a type of psychiatric disorder that can be observed in adult people and used to be called psychopathic personality with many symptoms that focus on the loss of feeling, for example, callous and remorseless disregard for the rights and feelings of other people [13]. People with this type of psychiatric disorder may have some dramatic, impulsive, emotional thoughts and actions and might be aggressive. Also, due to the loss of motivation, and antisocial personality disorder can be hard to treat since the patients tend to be unresponsive to the treatment [14]. Since ASPD is closely related to the change of a specific type of gene, it is usually associated with other psychiatric conditions such as depressive disorder, anxiety disorder, and impulse control disorder. All these different kinds of psychiatric problems can have some similar symptoms among them due to the change of similar genes. Therefore, the cause of ASPD can be varied and much more than its precursor. Either genetic, physiological, environmental, and psychopathy problems can become the cause of this psychiatric problem. For example, several researchers have revealed that antisocial personality disorder is closely associated with the environment of the family.

To further explain the possible reason that may cause ASPD, we need to recall the conduct disorder due to their similarities according to the Diagnostic and Statistical Manual of Mental disorders [16]. It can prove if someone has a certain particular psychiatric disease by considering their symptoms. For example, a person with antisocial personality disorder usually gains conduct disorder when they’re still adolescents. They behaved abnormal and expressed differently to the things contained around the environment they live such as the less sympathy. Similar to an antisocial personality disorder, conduct disorder is also associated with other types of psychiatric disorder that the same gene may cause as both conduct disorder and antisocial personality disorder. For example, the attention deficit hyperactivity disorder and substance use disorders.

4.2 Genetic factors
Two types of study being used to tell the difference and association between genetic influences and environmental influence within the experiment of these animal behaviors are called twin study and family study. The family study is using to determine if a disease has a probably family history that may be associated with higher risk, and twin studies are studies that are related to the behavior of identical or fraternal twins, which can be differentiated by considering if they’re monozygotic or not.

As mentioned previously that antisocial personality disorder was appeared due to the existence of several particular genes. For instance, one of them is called catechol O-methyltransferase, which is also called a COMT gene. The function of this gene is to let a person conduct disorder due to their environment of the family.

4.3 Environmental effect
After reading through a lot of articles, we found out that these studies are usually associated with a specific questionnaire related to the Diagnostic and Statistical Manual of Mental disorders as a basis of the research data related to antisocial personality disorder family study. Twin study were beginning with the observation of the environmental influence of these psychiatric problems. Especially the family study is extremely related to the history of the family, such as if the family has a large
number of people who possibly alcoholic or have antisocial personality behavior. Both studies focus on the effects of the family on parental child and adoptees. How those twins affect each other is an important standard to determine the influence from both environment and genetic on phenotypes of identical and parental twins and other psychiatric disorder [18]. According to a twin study related to antisocial personality disorder and alcoholics, adoptees with antisocial personality behavior were more likely to be alcoholics [19].

4.4 Studies related to ASPD

Through several articles essential to antisocial personality behavior, there are two of them suitable to be mentioned as an example to show the influence of both genetic and environmental factors with the first one comprehends with both an antisocial personality disorder and alcoholic problem.

4.4.1 family study and antisocial personality disorder

The first study uses a small number of base data with only 340 of the adolescents between the ages of 11 and 18. Using ANOVA and MANCOVA as the statistical method, finally found out that there’s no association between alcoholic problem and antisocial personality disorder.[20] But this method will sometimes have the problem since the sample is too small and may not showing results that are stronger enough to prove the relationship between these two. Also, the questionnaire is not like an exact experiment that may not be subjective and may contain too much personal judgment in the experiment and might bring possibly wrong results.

4.4.2 twin study and antisocial personality disorder

Another experiment that can be utilized to tell the difference and similarity between antisocial personality disorder and another psychiatric problem is a twin study that is not much similar to the last one due to their difference in the analysis of statistics. The sample given here is large enough and based on two previous studies using the data from thousands of fraternal and identical twins. Even though there’s an interview and the questionnaire, not all of the twins participate in it, and about 6% of them are absent [21].

Based on the influence caused by environment and genetics, several models are being used for further study and Bayesian to choose the right model according to the lowest value from this statistical method. With the analysis of the best model selected from the previous process, the results given the information one factor has 51% of heritability and 49% were contributed from the non-shared environment with zero percent is shared environmental effects.

5 conclusion

This paper reviewed twin studies and adoption studies on three human psychological and behavioral disorders: the typical species associated with genes and environment. The gene influence gives humans a multidimensional perspective to discuss the problem from multiple perspectives for these disorders and diagnose or intervention them, rather than just focus on behavioral expression, which will cause misdiagnose sometimes.

Environmental influence is not significant. For example, the shared environmental effect in bipolar disorder is just a few effects. However, we can observe that although an element has a very small influence, it can make a significant difference because of the huge population base. The environmental influence illustrates that an unhealthy environment should be intervened to reduce the possibility of mental disorders. The environment needs to be taken care of, including family, social, school, friends, etc.

Even though the studies have proven that psychological and behavioral disorders are associated with genes, many unknown influencing factors need further learning from other papers, which refine pathology. Therefore, promoting social cognition must be the responsibility of the scientific and social, and lead more people to judge these diseases more scientifically.

Reference

7. Graham, S., McKeown, D., Kiuwhara, S., & Harris, K.


