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Genetic Factors and Environmental Influences during Innovation Explosion on Personality Development. A Review

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Abstract. The development of personality is an ongoing and lifelong process that commences at conception and endures throughout an individual's lifespan. Both genetic factors and environmental variables contribute to its influence. Genetic variables constitute the fundamental underpinnings of personality development, while the environment furthermore assumes a significant role. Environmental influences, such as parents, family, friends, employment, and various social groups, significantly influence an individual's developmental trajectory. Therefore, personality development is a multifaceted process influenced by the interplay of hereditary and environmental influences, with both playing a role in facilitating the construction of one's personality. The primary objective of this systematic review is to investigate the influence of genetic and environmental factors on the development of personality, encompassing both infancy and adulthood. This study addresses the abovementioned issue by analyzing the most up-to-date research findings from the past decade. This study's experimental procedures and techniques are described in the following section. This study presents a comprehensive overview of the existing literature investigating the impact of genetic and environmental factors on personality development. Fifteen scholarly research publications were chosen, focusing on individuals mostly in their youth and exploring the impact of genetic and environmental factors. The primary objective of this study is to address inquiries about the genetic impact, environmental role, and the combined contribution and interaction of these elements, as well as to elucidate the underlying causes of this connection and influence. The inclusion criteria for the papers encompassed several factors: language, relevance to the subject matter, age range of participants, publication time, journal of publication, study type, and methodological quality. In conclusion, while genetic factors and the environment play critical roles in shaping individuals, their complex interplay truly defines outcomes. Neither genes nor environment dictate destinies in isolation; their combined, intricate dance sculpts the vast diversity of human experiences. This interplay is fundamental to psychology, medicine, sociology, and even policymaking.

Keywords. Genetic Factors, Personality, Environment, Environmental Factors, Personality Development, Innovation

1. Introduction

The personality formation process commences with an embryo's inception and persists throughout an individual's lifespan. Hence, the developmental process is subject to the effect of several environmental elements, given its ongoing nature and the individual's consistent socialization within familial and societal contexts. Additionally, genetic factors stemming from

hereditary traits also contribute to this process. Numerous researchers have actively participated in analyzing and investigating this fundamental and intricate human phenomenon. Research in this area has experienced significant growth, particularly emphasizing various elements that impact personality formation (Antonopoulou et al., 2021c; Antonopoulou et al., 2023; Gkintoni & Dimakos, 2022; . These endeavors aim to examine, comprehend, and forecast human behavior comprehensively.

Genetic variables play a fundamental role in shaping human development and determining an individual's growth and maturation trajectory. DNA plays a pivotal role in orchestrating various biological processes, as the genetic sequences generated during pregnancy establish genetic pathways that govern several aspects of development, encompassing physical attributes, predisposition to specific ailments, and even facets of our individuality and disposition (Giannoulis et al., 2022a; Giannoulis et al., 2022b; Gkintoni et al., 2021c). Genetic variables, although significant, do not have an exclusive influence on the trajectory of development but rather interact with environmental influences.

Environmental variables encompass various environmental stressors that can activate or alter genetic potentials and dysfunctions. From birth, individuals are exposed to their surroundings, initially comprising the familial context and expanding to encompass educational institutions, peer associations, occupational settings, and other social collectives encountered throughout their lives. The prenatal environment plays a significant role in shaping human development, as it can impact the child even before birth. When a mother engages in unhealthy behaviors such as smoking cigarettes, consuming excessive amounts of alcohol, or using drugs, it risks the child's development (Gkintoni et al., 2022a). This increases the likelihood of encountering developmental issues during various stages of life or potentially contributing to the onset of such issues. The association between genetic factors and environmental influences is characterized by a multifaceted interplay rather than a straightforward correlation (Halkiopoulos et al., 2023a; Halkiopoulos et al., 2023b). Personality development is a dynamic interplay between genetic and environmental factors, wherein hereditary influences can amplify or decrease the impact of environmental factors (Sortwell et al., 2023).

Conversely, environmental factors can shape the manifestation and consequences of genetic predispositions. Furthermore, it is worth noting that an individual's genetic predisposition can impact the environments they create in their life, their exposure level to these situations, and the influences they are likely to receive (Gkintoni et al., 2017; Tzachrista et al., 2023). It is evident, therefore, that the process of human development is influenced not solely by genetic or environmental variables but rather by the interplay and interdependence of both.

2. Literature Review

Personality development is a multifaceted process shaped by hereditary and environmental influences. Previous studies have demonstrated a significant role played by genetic and environmental factors in accounting for the variations observed in personality traits among individuals (Bratko et al., 2013; Vernon et al., 2008). The long-term stability of personality is heavily influenced by genetic variables, as evidenced by research conducted by Kandler et al. (2010). On the other hand, changes in personality over time are primarily attributed to environmental circumstances. The development of personality traits is influenced by the interaction of genetic and environmental factors. According to Kandler et al. (2010), it has been determined that genetic variables play a significant role in maintaining long-term stability in personality traits throughout young and middle adulthood. The heritability of personality traits has been supported by twin studies, suggesting that a significant proportion of

individual personality differences can be attributed to genetic variables (Bratko et al., 2013; Vernon et al., 2008). For instance, research has indicated that impulsive purchase behavior is influenced by additive genetic factors, as demonstrated by studies conducted by Bratko et al. (2013).

Furthermore, Vernon et al. (2008) have discovered a correlation between genetic variables and the Big Five personality characteristics and traits of emotional intelligence. The significance of environmental influences in molding personality development is of paramount importance. Environmental effects include the familial milieu, peer dynamics, cultural elements, and significant life occurrences (Bleidorn et al., 2021). The expression of personality traits is influenced by the interaction between environmental circumstances and genetic factors. An example of this may be seen in the research conducted by Kandler et al. (2010), where they discovered that the combined impact of environmental factors has a role in the consistent and enduring nature of personality traits. Life events and experiences can influence personality development, as various environmental influences might have distinct effects during different life stages (Gkintoni et al., 2021b; Zheng et al., 2019). The intricate and ever-changing relationship between genetic and environmental elements in personality development is a subject of academic interest. The interplay between genetic and environmental influences has a significant role in both the maintenance and alteration of personality traits, as evidenced by the findings of Kandler et al. (2010). Developing and preserving identity is often attributed to the increased continuity of personality features with age. The interaction between genetic and environmental factors influences the expression of personality traits. Genetic factors have a role in determining the sensitivity of individuals to environmental effects and their subsequent responses to the environment (Briley & Tucker-Drob, 2012). The multidimensional nature of the interaction and influence between genetic components and environmental influences on personality development gives rise to several causes. Multiple processes, such as gene expression and epigenetic changes, influence genetic variables (Sanchez-Roige et al., 2017). The expression of genes and the influence of hereditary variables on personality traits can be modified by environmental influences. Ongoing research is dedicated to investigating the precise genetic mechanisms and environmental factors contributing to personality traits' stability and variability (Bleidorn et al., 2021).

Moreover, it should be noted that a combination of genetic and environmental factors influences the development of an individual's personality traits. Numerous studies have demonstrated that genetic and environmental influences influence personality (Antonopoulou et al., 2021a; Antonopoulou et al., 2021b; Gkintoni et al., 2023d). Research findings reveal that genetic variables are implicated in developing personality traits, including conscientiousness and openness to experience (Antonopoulou et al., 2022b; Antonopoulou et al., 2019). Moreover, specific research implies that heredity exerts a more substantial influence than environmental factors (Kraczla, 2021). According to Kawamoto and Endo (2015), longitudinal twin studies have provided evidence indicating that hereditary variables are predominant in influencing the stability of personality traits during adolescence. The heritability estimates for personality traits have been shown to range between 0.30 and 0.60, as documented by Kawamoto and Endo in 2015.

Moreover, scholarly investigations have explored the degree to which genetic elements underlying personality traits are associated with genetic influences on adolescent behavioral issues. Lewis et al. (2013) have reported the presence of shared genetic factors underlying both personality traits and behavior disorders, indicating a genetic underpinning for both phenomena. Moreover, extant research has provided evidence indicating that behavior issues throughout

adolescence and fundamental personality traits share an everyday genetic basis, therefore providing additional support for genetics's influence on personality development (Lewis et al., 2013). It is imperative to acknowledge that the interplay between hereditary and environmental influences is intricate. The interaction between genes and the environment is contingent upon the timing of exposure, whereby the influence of genetic and environmental factors is most pronounced in the early postnatal stages (Depue, 2009). Recent advancements in methodology have facilitated examining the interplay between many sources of influence, such as the dynamic interaction between nature and nurture in personality development (South & Krueger, 2008; Halkiopoulou et al., 2022; Halkiopoulou et al., 2021b).

Concerning the distinct contributions of genetic and environmental factors, scholarly investigations have revealed that personality traits exhibit a noteworthy degree of variance attributable to both additive and nonadditive genetic influences. The remaining variance is also influenced by environmental causes distinct to each individual and random measurement errors. The role of the home environment in socialization and development has been recognized as crucial, as it can moderate the effects of genetics and external factors on an individual's personality (Antonopoulou et al., 2022a; Gkintoni et al., 2016; Gkintoni et al., 2023a). The existing body of literature provides evidence that hereditary and environmental factors significantly shape an individual's personality development (Antonopoulou et al., 2020; Gkintoni et al., 2021a). Genetic variables exert a substantial influence on the development of personality traits, although it is imperative to acknowledge that the environment, encompassing the familial context, also exerts a discernible effect (Gkintoni et al., 2022b; Gkintoni et al., 2023c). The intricate interplay between genetic and environmental factors in the context of personality development necessitates additional research to elucidate the underlying mechanisms involved comprehensively. The primary objective of this systematic investigation is to analyze the potential influence of genetic and environmental factors on the formation of personality traits throughout childhood and maturity.

3. Methodology

Sample

The study sample comprises a selection of 15 research publications that have been published in reputable scientific journals. The chosen articles discuss the role of genetic and environmental factors in shaping an individual's personality development and, by extension, the broader population. Hence, the research objectives are likewise fulfilled, encompassing the task of addressing the subsequent inquiries: a) Do hereditary factors influence personality development? b) To what extent does the environment contribute to the formation and development of individual personalities? c) To what extent do genes and environment contribute to personality development, and if their influences differ, which element holds greater significance? d) What factors contribute to the interconnectedness and impact observed in this context? The forthcoming inquiries will be addressed utilizing the papers and associated investigations, mostly on twins and many preschool-aged children. References to adults are commonly seen in many sources and surveys, mainly employed to facilitate a constructive comparison between these demographic and other participants.

Materials

This study entails a comprehensive examination of existing literature, employing a methodical approach to identify relevant articles by utilizing specific keywords such as "personality, development, environmental, genetic, influences, nature, nurture, personality

disorders, twins, preschool children, adults, Big Five, behavior genericity," along with their synonyms and combinations.

- The inclusion criteria for articles in the study were determined.
- The composition must be composed in the English language.
- The text must possess relevance to the subject matter under investigation.
- The sample must primarily focus on young individuals with incomplete personalities.

- The publication period must span from 2001 to 2021.

In order to meet academic standards, the research findings should be published in a reputable scientific journal. Also, the article should focus on a clinical or descriptive study. Additionally, the research must be grounded in prior valid studies, even to a limited extent. It is necessary to establish a generalization of the findings from each research study. To ensure accuracy and validity, it is imperative to employ dependable methodologies and measurement techniques. After doing a thorough search of various databases and employing certain filters and websites to get relevant articles, a total of 30 articles were identified. Out of the options mentioned above, 15 were excluded following careful assessment. These particular options needed to be revised to meet the specific requirements of the current research. They did not satisfy the inclusion criteria established for publications in the context of this study.

Evaluation

Following the compilation of the bibliography, as previously stated, the articles were assessed using predetermined criteria. All the resultant articles underwent a thorough examination to identify any instances of duplication, and afterward, those duplicate articles were eliminated. Subsequently, a thorough examination of the article titles was conducted, and those that needed to align with the intended interpretation, significance, and objectives of the current study were excluded. The primary factor contributing to the rejection of nearly half of the publications was the inadequacy of their abstracts, which failed to satisfy the criteria for inclusion in the research. Articles that were found to have insufficient results or whose results could not be generalized were also excluded. Consequently, the full texts of the studies that surfaced after the final screening phase were examined, and those that needed to furnish the requisite information about the subject matter and objective of the review were excluded. Ultimately, the research's methodological rigor and qualitative excellence were evaluated, and only those that satisfied the eligibility requirements were chosen.

- Total articles that emerged after a search (n=30)
- Articles rejected after reading title (n=3)
- Articles rejected after abstract reading (n=9)
- Articles rejected after reading the article (n=3)
- Final set of study articles (n=15)

In order to derive results, each study employed specific methodologies for data collection. In order to address this concern, the researchers employed various questionnaires, namely "PETSS" and "CPTI," which were distributed to children, parents, teachers, and professionals closely associated with a kid exhibiting challenging traits. Additionally, a series of interviews were carried out with various individuals, including families, teachers, children, adults, and adolescents. These interviews specifically focused on adult antisocial behavior and its relationship to childhood conduct disorder, as explored in the study "Sex Differences in the Genetic and Environmental Influences on Childhood Conduct Disorder and Adult Antisocial

Behavior." Using specific methodologies reveals that families are the principal conduit for collecting information and data in this study.

4. Results

The findings of each publication were generally disseminated by researchers hailing from the United States, the Netherlands, Sweden, and Finland, with other investigations conducted in various other nations. The studies mentioned above were conducted throughout distinct time intervals. Two publications were released in 2002, followed by two in 2019. Furthermore, two more publications were released in 2023, which interestingly were published in 2008. These publications were preceded by a paper in 2009 and further papers in 2011, 2012, 2015, 2017, and 2018.

Additionally, all of them were published in the English language. Most of the research utilized randomized trials, employing both intervention and control groups. Numerous research studies have implemented therapies targeting children with diverse behavioral patterns along their developmental trajectory, encompassing those who encountered familial challenges and those who did not (Meier et al., 2011). Ultimately, a subset of these incidents occurred among individuals who had recently transitioned into early adulthood. Additional research was carried out on adult twin siblings, who, on average, were in their third decade of life. Most research, except for only two, included twin siblings. The two types of twins that can occur are either monozygotic or dizygotic. The study also examined all potential combinations of couples, including two males, two girls, and one boy and one female. The objective is to thoroughly explore all potential variables and exert influence on every conceivable factor that may impact an individual's personality.

The investigations aimed to ascertain the degree to which genetic and environmental influences independently influence an individual's personality and the role of heredity in shaping personality (Gkintoni & Ortiz, 2023b). For each study, relevant information such as the year of publication, country of origin of the researchers, year or duration of implementation, statistical data, purpose, sample size, interventions, tools used, results, and conclusions were extracted and utilized.

In 2016, Tuvblad conducted a study to examine the existing disparity in knowledge on the contributions of hereditary and environmental factors to psychopathic personality traits in both male and female individuals. The study employed many methodologies, including measurements, questionnaires, and data collection techniques. A study revealed notable disparities in psychopathic personality traits among male and female individuals. The study also revealed that genetic and environmental factors substantially influence personality dimensions, with hereditary factors being more influential in the development of psychopathic personality traits. At the same time, everyday environmental influences also play a considerable role.

In their study conducted in 2011, Martin et al. aimed to examine the potential influence of genetic and environmental factors on antisocial behavior, delinquency, and criminality, as well as explore any disparities between males and females in this regard. The study was conducted using interviews as the primary research method. Hence, it has been ascertained that hereditary variables have a substantial role in developing conduct disorder throughout childhood and the manifestation of antisocial behavior in adulthood. The research also examined twins, revealing that genetic factors influenced monozygotic twins more pronounced than dizygotic twins. The distinction between genders was exclusively qualitative rather than quantifiable. Genetic and environmental factors contributed to a comparable amount of variability observed in both males and females.

Trull (2008) and Distel et al. (2009) researched Borderline Personality Disorder (BPD), a condition characterized by impulsivity, emotional instability, difficulties in relationships, identity disturbances, and cognitive distortions associated with stress. The researchers aimed to investigate the potential impact of the heritability of personality traits and genetic variables on the development of the illness. Questionnaires were mainly employed in the study of twins to investigate these two articles. The mean cutoff score showed no significant variation between monozygotic and dizygotic twins within any country, as reported in the 2015 article. Gender differences were observed in the Netherlands, with women obtaining higher scores than men. The findings indicate a negative correlation between Borderline Personality Disorder (BPD) traits and advancing age.

Furthermore, the analysis reveals that hereditary factors account for 42% of the observed variation in BPD traits, while environmental variables contribute to the remaining 58%. The findings from the 2009 study indicate a negative correlation between extraversion, agreeableness, conscientiousness, and borderline personality disorder (BPD). This study also incorporates the Five Factor Model (FFM). It highlights the heightened phenotypic correlations between BPD and FFM observed in monozygotic twins instead of dizygotic twins, indicating the impact of hereditary variables. Lastly, it is essential to note that genetic factors and environmental effects account for around 50% of Borderline Personality Disorder (BPD).

Simultaneously, in their respective studies, K.M. Beaver (2008) and J.P. Wright endeavored to assess the durability of low self-control during adolescence. Their research aimed to explore the influential role of environmental and genetic factors in contributing to this stability. To achieve this, they utilized data from the Add Health study and a sample of twins. Both essays highlight the insufficiency of the explanations provided and advocate for further exploration of the reasons and stability of self-control by posing further questions. Nevertheless, it has been definitively demonstrated that the proportion of variability in self-control can be attributed to hereditary variables and shared and non-shared contextual influences.

In 2015, Vukasovic analyzed the subject of heredity and its associated characteristics, focusing on its influence on acquiring new knowledge. The individual extensively searched for relevant data, meticulously examined scholarly journals, initiated communication with the respective authors, and subsequently ascertained that genetic factors account for 39% of the observed variations across individuals. In comparison, environmental influences contribute to the remaining 61%. In conclusion, the individual contended that the personality model and gender are not crucial moderators in information acquisition. However, it was posited that genetic traits and certain contextual elements influence this process (Sameroff, 2010).

In 2018, South et al., expressed a desire to examine the genetic and environmental factors contributing to gender disparities within the framework of the Big Five Model. The study was conducted using interviews and questionnaires. The comparative analysis of the twins revealed congruent outcomes in terms of extroversion and neuroticism while exhibiting elevated levels of agreeableness and conscientiousness and less inclination towards novelty-seeking. In the domain of heredity, it has been documented that its impact varies from 27% for the inclination towards novel experiences to 36% for conscientiousness. Nevertheless, it was found that shared environmental factors accounted for a relatively small amount of variability (ranging from 2% to 15%) in these personality traits. However, non-shared environmental factors played a more substantial role (ranging from 53% to 67%) in explaining the variance observed in each personality component.

In 2011, Distel et al., conducted a study investigating the potential independent roles of environment and genes concerning Borderline Personality Disorder (BPD). Genetic

correlations between Borderline Personality Disorder (BPD) and divorce, sexual assault, and job loss were identified using questionnaires and self-report scales that incorporated inquiries about specific occurrences. Lastly, it is essential to note that both environmental and genetic factors influence these connections.

In 2019, Erbeli et al., conducted a study examining the role of genetic and environmental factors in the development of learning disabilities among children, comparing those with and without a familial history of such disabilities. The objective was to elucidate the underlying reasons for the differential manifestation of cognitive difficulties in children. Twins that possess a familial background of dyslexia exhibited notably inferior performance in reading and spelling assessments compared to twins lacking such a background. There was no significant difference in learning fluency between twins with a family history of impairment and those without. Lower academic accomplishment, particularly in reading and spelling, is linked to a familial background characterized by dyslexia and math difficulty. However, the underlying causes of these connections are relatively similar among the groupings based on family history.

In 2011, Thapar et al., conducted a study to investigate the potential influence of environmental and genetic factors on the etiology of Attention Deficit Hyperactivity Disorder (ADHD). The study revealed that genetic hazards are most likely attributable to numerous common gene variants, each exerting a minor influence on the overall risk, which remains unidentified. A comprehensive explanation and depiction of environmental influences necessitates a more profound comprehension. The factors under scrutiny, namely smoking and substance use during pregnancy, maternal stress, low birth weight, exposure to organic pollutants, and diet, have demonstrated a specific correlation with ADHD. Nevertheless, it is essential to note that these factors are not the primary causes.

According to Ayoub (2018), the development of children's personalities is influenced by parental upbringing and how children respond to and interpret their upbringing. Following a comprehensive investigation, it has been elucidated that genetic factors predominantly influence a kid's personality traits and responsiveness towards the environment in which they are raised.

In their respective investigations conducted in 2018, Zwir and Arnedo examined the impact of heredity and genetic factors on twins' development of personality traits. Questionnaires were employed as research instruments in both conducted investigations. The researchers demonstrated that genetic factors play a substantial role in various brain functions, including neurodevelopment, connection, reactivity, and stress response. According to the reports, heredity was found to impact 50% and 58% of the relevant investigations.

In a study by Jacobson (2002), an investigation was conducted to explore the impact of genetic and environmental factors on antisocial behavior. Based on the analysis of questionnaires and data, it was determined that assessments of antisocial behavior had a high level of reliability throughout time, with no significant impact observed concerning age. This study's findings indicate a notable degree of consistency in the intrapersonal relationships between childhood, teenage, and adult antisocial behavior. According to the paper, the twin research indicated the presence of hereditary and environmental factors and observed quantitative distinctions between genders. In the context of childhood antisocial behavior patterns, hereditary influences were more prevalent among women, whereas environmental factors primarily influenced men.

5. Discussion and Conclusion

This research paper concluded that human personality is fluid and influenced by environmental and genetic factors, as heredity and environment interact. This means that a person's genetic predispositions (such as the manifestation of a mental illness or dysfunction due to heredity) can be determined by how he has structured his cycle and manifests accordingly (Gousteris et al., 2023). Therefore, when analyzing people's personalities and studying their development, it is necessary to consider these two essential factors through which any dire situations can be prevented or limited both for the individual and for society.

The included research and articles, as well as what we studied in general, offer much information about the development and evolution of personality and the extent to which genetic and environmental factors influence it. Some published articles still needed to provide comprehensive research or were still in progress; therefore, they were not included (Halkiopoulos et al., 2023c). In general, the study of personality is a complex issue, and researchers have yet to conclude which factor is most responsible for its development. The investigations, however, continue, and we are optimistic about the findings and developments that will be published.

Some areas for improvement were found while selecting and investigating the specific topic. First, as mentioned above, the research results concerning the influence of genes and the environment on personality development are often different. Due to this, the opinions and ideas formed today and related to this subject are quite different. Thus, others support the decisive role of heredity, while others support the decisive importance of the environment in personality development (Halkiopoulos et al., 2023a). However, some equally support both influences, which are closer to the truth of the research. Also, the difficulty of generalizing many results was observed, as the selected research involved specific types of people, such as twins ("Psychopathic personality traits in 5-year-old twins the importance of genetic and shared environmental influences"). Finally, a zero range of measurement tools and methods was noted.

According to what we have read, the range of published studies and articles is sufficient to understand and analyze the complex personality issue. However, if we as a group were to suggest an idea for further research, it would be to emphasize how genetic and environmental factors influence the emergence of mental disorders or dysfunctions during adolescence and adulthood and how these prevent or limit individuals' smooth social integration and socialization. In conclusion, personality development is influenced by a combination of genetic factors and environmental influences. Genetic factors contribute to the long-term stability of personality traits, while environmental factors play a role in shaping changes in personality over time. The interplay between genetic and environmental factors contributes to individual differences in personality traits. Understanding the complex interrelationship and influence between genetic factors and environmental influences is crucial for gaining insights into the development of personality traits.

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