ABSTRACT

of the dissertation submitted for the degree of Doctor of Philosophy (PhD) in the educational program "8D03107-Psychology"

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“Psychogenetic markers of cognitive abilities in children and adolescence”

Relevance of the research topic. The relevance of this dissertation stems from the growing interest within contemporary psychology in the interdisciplinary analysis of the nature of cognitive abilities. In the context of the rapid development of neuroscience and psychogenetics, there is an increasing need for a deeper understanding of the mechanisms underlying individual differences in cognition, particularly in childhood and adolescence periods of intensive development of intelligence, personality, and emotional regulation.

The aim of the research is to identify the relationship between cognitive abilities, executive control, and personality characteristics, and their association with genetic markers in childhood and adolescence.

To achieve this aim, the following objectives were formulated:

1. to conduct a theoretical analysis of domestic and international studies on cognitive abilities, executive control, emotional intelligence, and their associations with personality and genetic factors in childhood and adolescence;
2. to adapt a scientifically grounded methodological complex for psychometric assessment;
3. to determine the relationship between cognitive abilities, emotional intelligence, executive control, and personality traits using a systems-based approach;
4. to examine age and gender differences in psychometric indicators of cognitive and emotional intelligence and behavioral indicators of executive control;
5. to identify associations between the investigated genes linked to cognitive abilities and the psychometric and behavioral characteristics of the participants.

The **general hypothesis** assumes that cognitive abilities are associated with specific genetic markers.

The general hypothesis was elaborated into several **specific hypotheses**:

– the level of cognitive abilities is determined by emotional intelligence, executive control, and personality traits within a systems framework;

– psychometric and behavioral indicators exhibit age- and gender-specific differences;

– psychogenetic markers predict the level of cognitive abilities and are associated with emotional intelligence, executive control characteristics, and personality traits.

Theoretical and methodological framework

The dissertation is devoted to identifying genetic determinants of cognitive development in children and adolescents, as well as analyzing relationships between cognitive abilities, emotional intelligence, executive control, and personality characteristics. The study substantiates the polygenic nature of intelligence, whereby hundreds of genes, each with a small effect size, collectively contribute to individual differences in cognitive functioning. The theoretical section includes a review of classical and contemporary theories of intelligence, models of individual differences, frameworks of executive control, and theories of emotional intelligence and emotional regulation. A systems approach to the psychogenetics of cognitive abilities is examined, emphasizing the unity of affective and cognitive processes and integrating theories of cognitive control with models of individual differences.

The dissertation draws upon contemporary international and domestic psychogenetic research, which has identified the influence of genes on cognitive abilities, executive control, emotional intelligence, and individual differences among children and adolescents.

The research methods and techniques were selected based on the subject, hypothesis and objectives of the research:

theoretical methods: analysis and systematization of scientific literature concerning the relationships between genetic, cognitive, behavioral, and personality characteristics.

methods of collecting empirical data:

1) Psychometric assessment. Wechsler Intelligence Scale for Children (WISC, ages 6–15 years 11 months); Wechsler Adult Intelligence Scale (WAIS, from age 16); Trait Meta-Mood Scale (TMMS) for emotional intelligence; Emotion Regulation Questionnaire (ERQ); Personality inventories (Big Five);

2) ***Behavioral assessment.*** The task was an adapted and modified version of Attentional Networks Test (ANT), programmed in E-Prime. The ANT allowed measurement of behavioral indicators (reaction time) across target categories: a) executive control network; b) orienting network; c) alerting network. Primary behavioral analyses were conducted in E-Prime, followed by calculation of network indices through subtraction procedures.

3) ***Genetic analysis***. Genetic samples were obtained via a non-invasive buccal epithelial cell collection method. DNA extraction and genotyping were conducted at the University of Sharjah (UAE), in the laboratory of Professor R. Hamoudi, using real-time PCR.

4) ***Statistical analysis***. Statistical analysis of the study was carried out using the *SPSS for Windows, Version 16.0 (SPSS Inc., Chicago)*. Pearson correlations were used for cognitive and personality variables; Spearman correlations for ordinal genetic data. One-way ANOVA with Post Hoc tests assessed group differences. Multiple regression analysis evaluated the effects of genetic

polymorphisms on cognitive abilities. Reliability of questionnaires was assessed using Cronbach's alpha.

5*)* ***Participants*****.** The study sample consisted of 223 participants aged 7-20 years, including 180 school and lyceum students (91 boys, 89 girls) who completed all three stages: psychometric, behavioral, and genetic assessment.

Groups were balanced by age, gender, and language: 50.5% male, 49.5% female; 90 participants assessed in Kazakh, 90 in Russian.

The study complied with the Declaration of Helsinki and was approved by the Local Ethics Committee of al-Farabi Kazakh National University, with annual protocol updates throughout the research period.

The study systematizes theoretical significance regarding psychogenetic markers of cognitive abilities, executive control, and individual differences. It expands current theoretical understanding of the influence of genetic factors on cognitive abilities in childhood and adolescence; to determine the relationship between behavioral, psychometric results and genetic markers of cognitive abilities and personality characteristics of children. The data obtained on the identified genetic associations can be taken into account in the development of individualized educational programs and cognitive skill-development interventions, thereby making a theoretical contribution to the advancement of cognitive psychology within the Kazakhstani scientific community.

The practical significance lies in developing a methodological framework for psychogenetic research, adapting psychometric tools for the Kazakhstani population, and creating a genetic database that can be utilized for individualized educational programs.

The scientific novelty of the study is that for the first time in Kazakhstan, an analysis of psychogenetic markers of cognitive abilities in children and adolescents was conducted at the Brain Institute of Al-Farabi Kazakh National University. This represents a new scientific and socially significant direction with potential implications for personalized psychodiagnostics:

– for the first time within a single study, a systematic integrative analysis of key theoretical approaches to the investigation of cognitive abilities was conducted, combining perspectives from cognitive psychology, psychogenetics, and neuropsychology. Genes exerting the greatest influence on individuals' cognitive abilities during childhood and adolescence were identified;

– adaptation of a psychometric assessment battery (WISC, WAIS, TMMS, ERQ, Big Five) into a unified protocol validated on the Kazakhstani population;

– identification of relationships between cognitive intelligence, emotional intelligence, executive control, and personality traits, demonstrating the multifaceted nature of cognitive development;

– age- and gender-related differences were identified in the psychometric indicators of cognitive and emotional intelligence, as well as in the behavioral measures of executive control;

– for the first time in Kazakhstan, a comprehensive psychogenetic study of cognitive abilities, emotional intelligence, executive control, and personality traits in children and adolescents was conducted, incorporating DNA genotyping data. Empirical analysis revealed associations between genetic and psychometric indicators of cognitive abilities, as well as relationships between phenotypes and genetic markers influencing cognitive functioning in childhood and adolescence. A polygenic analysis was performed, confirming the cumulative impact of cognition-relevant alleles on IQ, EQ, and personality traits, thereby making a unique contribution to the national knowledge base on psychological development.

The provisions submitted for defense that contain elements of scientific novelty:

A comprehensive psychogenetic approach was implemented for the first time in a Kazakhstani sample of children and adolescents (N = 180), incorporating psychometric methods (WISC/WAIS, TMMS, ERQ, the Big Five), a behavioral method (the Attention Neural Networks Test), and DNA genotyping of 100 cognition-associated genes. This represents the first interdisciplinary study of such scale conducted at the Brain Institute of Al-Farabi Kazakh National University.

1. Cognitive abilities are defined as an integrative outcome of the interaction among attention, memory, thinking, perception, executive functions, emotional intelligence, personality traits, and genetic factors. Based on the conducted study, the concept has been refined as follows: cognitive abilities constitute a multilevel psychological phenomenon that encompasses basic mental processes and regulatory-emotional components, determined by the interplay of genetic, personality, and environmental factors, and manifested in individual differences in intellectual performance.

2. A comprehensive methodological framework for psychogenetic research was developed in Kazakh and Russian, incorporating psychometric, behavioral, and genetic methods. The reliability of the instruments was confirmed by Cronbach's alpha coefficients (α = 0.6-0.9), which supports their further use in psychological assessment.

3. Associations were identified between cognitive intelligence indicators and emotional intelligence, executive control, and personality traits, confirming the phenotypic multidimensionality and complexity of the processes underlying the development of cognitive abilities.

4. Age- and gender-related differences were identified in the psychometric indicators of cognitive and emotional intelligence, as well as in the behavioral indicators of executive control.

5. As a result of the experimental studies conducted, associations were established between psychogenetic markers of cognitive abilities and psychometric as well as behavioral indicators. Regression analysis accounting for age and gender revealed specific associations between individual

polymorphisms and cognitive abilities in the Kazakhstani population, which align with existing literature. Additionally, new predicted associations with phenotypes were identified, which were previously unreported in the literature. Polygenic analysis confirmed a positive association between the cumulative alleles enhancing cognitive abilities and IQ, EQ, and personality traits:

Description of the doctoral candidate's contribution to the preparation of each publication.

The main findings of the study were presented to the scientific community through the author's reports and presentations at international and regional academic conferences, where they received positive evaluations. A total of nine articles have been published on the research topic, including four in journals recommended by the Committee for Quality Assurance in the Sphere of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan; three in the proceedings of international scientific and practical conferences; and two in foreign journals indexed in the international Scopus database:

1. "Psychogenetic and psycho-physiological markers of cognitive abilities" // Bulletin of Al-Farabi Kazakh National University. Series: Psychology and Sociology, Almaty, No. 2(69), 2019, pp. 35–43 (SHEQAC).

2. "Relationship of personal qualities with genetic markers" // Bulletin of KazNU. Series of Psychology and Sociology, Almaty, No. 2 (73), 2020, pp. 65–79 (SHEQAC).

3. "Emotional intelligence and preference in emotion regulation strategy in adolescents" // Bulletin of KazNU. Series of Psychology and Sociology, Almaty, No. 4 (87), 2023, pp. 14–24 (SHEQAC).

4. "Cognitive abilities: features of development and interconnection with executive control" // Bulletin of KazNU. Series of Psychology and Sociology, Almaty, No. 3 (94), 2025, pp. 38–50 (SHEQAC).

5. "Professional Choice in the Context of Modern Psychogenetic Research." // Proceedings of the International Scientific and Methodological Conference "Modern Trends in the Development of Ethnopsychology: History, Current State, and Prospects," dedicated to the birthday of Doctor of Psychological Sciences, Academician of KazNAEN, Professor S.M. Dzhakupov, May 15, 2019, pp. 158–165.

6. "Association of the rs6265 polymorphism of the *BDNF* gene and the rs1800497 polymorphism of the *ANKK1* gene with the cognitive abilities of lyceum students" // Abstracts of the III International school-conference of students, postgraduates, and young scientists materials and technologies of the 21st century, Kazan, October 29–31, 2018, p. 19.

7. "Age-related characteristics of children's intellectual abilities." // Proceedings of the international scientific conference of students and young scientists *'Farabi Alemi',* April 6–9, 2020, Vol. 2, pp. 86–90.

8. “*KIBRA* Gene Variant Is Associated with Ability in Chess and Science.” Genes, 14(1), 204. https://doi.org/10.3390/genes14010204 (Scopus);

9. “Association Between Genetically Predicted Memory and Self-Reported Foreign Language Proficiency.” Genes 2025, 16(5), 589. P. 1-11 https://doi.org/10.3390/genes16050589 (Scopus).

Compliance with national scientific priorities and state programs.

The dissertation aligns with priority areas of scientific development, including the “State Program for the Development of Education and Science of the Republic of Kazakhstan for 2020–2025”, approved by the Resolution of the Government of the Republic of Kazakhstan dated December 27, 2019; the strategic development plan of the Republic of Kazakhstan until 2025 within the framework of “New Human Capital,” approved by the Decree of the President of the Republic of Kazakhstan dated February 15, 2018; and the national program “Rukhani Zhangyru.”