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Psychology of Personality: Real and Virtual Context

DIGITAL SOCIALIZATION AND NEUROCOGNITIVE DEVELOPMENT OF ADOLESCENTS: THE ROLE OF DIGITAL COMPETENCE

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Abstract

According to digital socialization perspective all the developmental process should be studied taking into account it's digital "dimension" but different studies of the impact of Internet use on cognitive functions reveal different results. The aim of the study was to reveal relationship between neurocognitive development, digital competence and online self-appraisals in adolescents 11-13 years old and 14-17 years old. 54 adolescents 11-13 years old and 46 adolescents 14-17 years old participated in the study. Methods included neuropsychological examination**,** Information and Comprehension subscales from the Wechsler Intelligence Scale for Children, EU Kids items for user activity and excessive Internet use, Index of Digital Competency and visual scales for assessing general and online self-appraisals. User activity was not related to neuropsychological indexes but adolescents with high user activity demonstrated poorer scores on Information subtest. Excessive Internet use was related to poorer scores on neurodynamic component of mental activity and intelligence subtests (Information subtest in 11-13 years old and Comprehension subtest in 14-17 years old). In 11–13-year-old adolescents, digital competency skills are associated with better regulatory functions, while digital competency knowledge is associated with the intelligence. In adolescents 14-17 years old digital competence is associated with poorer tight hemisphere function.

Keywords: Adolescents, digital competence, digital socialization, excessive Internet use, neurocognitive development, self-appraisals online.

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1. Introduction

Contemporary adolescence spends long time online every day meeting their wide range of risks, demands, opportunities and other experiences (Livingstone et al., 2011) that should affect their psychological development. According to digital socialization perspective (Smith et al., 2015, Soldatova et al., 2017, Stornaiuolo, 2017), all the developmental process should be studied taking into account it's digital "dimension". However, empirical studies of the relationship between neurocongnitive functioning and user activity in children and adolescence are controversy and frequently reveal different results. Some researchers suggest that Internet use is associated with poorer characteristics of cognitive development (Agosto, 2002; Benkler, 2006; Wu et al., 2016) while others found positive relationship between time spent online or online games and cognitive development in adults and adolescents (Johnson, 2010; Greenfield, 2019; Fisher et al., 2015; Small et al., 2009).

2. Problem Statement

We suggest that these different results might be explained by different methodologies both in assessing cognitive functions and user activity. From the one hand, there are not many studies examining the whole neuropsychological functioning (for instance, implementing A. Luria syndrome analysis) and cognitive development that could lead to partial results if there are different relationships between user activity and different neurocognitive functions. From the other hand, user activity seems to be narrow construct that does not reflect content of online activity, interests, competency, risks etc.

3. Research Questions

The aim of the study was to reveal relationship between neurocognitive development, digital competence and online self-appraisals in adolescents 11-13 years old and 14-17 years old.

4. Purpose of the Study

We hypothesized that:

1.Relationship between neurocognitive developments and user activity would demonstrate some deficiency in adolescents with high level of user activity comparing to adolescents with medium or low level of user activity but these relationships would be weak.

2.Neurocognitive development would be related to better knowledge and skills of digital competence and better self-appraisals (the last effect would be stronger online than offline).

3.Excessive Internet use is related to poorer neurocognitive functions.

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5. Research Methods

5.1. Sample

100 adolescents 11-17 years old without mental or somatic disabilities participated in the study. The first group included 54 adolescents 11-13 years old (28 males and 26 females) and the second group included 46 adolescents 14-17 years old (25 males and 21 females).

5.2. Methods

All adolescents participated in neuropsychological examination in accordance with principles and methods of A. Luria syndrome analysis that was developed for children and adolescents (Akhutina, 2016). Neuropsychological examination included tasks for appraising dynamic praxis, auditory memory, counting skills, delayed reproduction of words (auditory-speech memory) and figures (visuospatial memory), visual and spatial memory, and the composition of the story from a series of pictures. 7 neuropsychological indexes were counted based on participants results in different tasks: Index of regulatory functions (programming and control functions), Index of serial organization functions, Index of auditory information processing functions, Index of visuospatial information processing functions, Index of left hemisphere functions, Index of right hemisphere functions, Index of neurodynamic component of mental activity.

To assess cognitive functions, we used two subtests from the Wechsler Intelligence Scale for Children (Wechsler, 1991) – Information subscale and Comprehension subscale.

Assessment of user activity was based EU Kids methodology (Livingstone et al., 2011) and included appraisals of the number of hours typically spent online (separately for weekdays and weekends). Then we differentiated three groups of adolescents with low (1-3 hours per day, n=33), medium (4-6 hours per day, n=31) and high user activity (7-8 and more hours per day, n=36). Excessive Internet use was measured using five items from EU Kids methodology (Livingstone et al., 2011) describing disturbance of some life spheres because of too much time spent online (e.g., “I didn’t eat or sleep because of the Internet).

Digital competency was measured by Index of Digital Competency (Soldatova & Rasskazova, 2014). Brief version of these measure includes 32 items assessing knowledge, skills, motivation for improving and responsibility in the Internet in four different spheres of online activities: content, consumption, communication, technosphere.

We assessed self-appraisals online and offline asking participants to point themselves (separately in general and online) on the visual scales (Dembo-Rubinstein scales) with some descriptions. In this study we used 6 scales: Healthy, Intelligent, Happy, Independent, Kind, Confident.

Data were processed in SPSS Statistics 23.0.

6. Findings

6.1. Age group and gender differences in neurocognitive development

Expectedly, younger children made more mistakes in the tasks related to auditory information processing functions ($F=6.73$, $p<.01$, $\eta^2=.07$) and functions of right hemisphere ($F=4.12$, $p<.05$, $\eta^2=.04$) but there were no other differences in neuropsychological indexes between two age groups. The only difference between boys and girls was in Information subscale of Wechsler’s test and girls scored lower on this subtest ($F=6.64$, $p<.01$, $\eta^2=.07$). The only interaction effect between age group and gender was related to functions

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of left hemisphere ($F=4.63$, $p<.05$, $\eta^2=.05$). In 11-13 years old girls did on these tasks better than boys and in 14-17 years old boys did better.

6.2. Neurocognitive development and user activity in adolescents 11-17 years

Adolescents with high user activity demonstrated poorer scores on Information subtest of WISC comparing to both adolescents with medium and low user activity ($F=4.32$, $p<.05$, $\eta^2=.08$). There were neither other differences in WISC and neuropsychological indexes nor interaction effects between user activity and age group.

6.3. Neurocognitive development and digital competence in adolescents 11-17 years

In adolescents 11-13 years old the only relationship between neuropsychological indices and digital competence was for regulatory functions (programming and control functions): better regulatory functions were associated with better digital competence skills (Table 01). Despite the fact that this relationship is meaningfully explainable and interesting, the fact that this if the only relationship and it was not revealed in adolescents 14-17 years old does not allow us to give a clear interpretation, i.e. this result needs to be clarified in further studies.

Knowledge and skills of digital competency in adolescents 11-13 years old are associated with the better intelligence (primarily, with Comprehension subtest).

In adolescents aged 14-17, digital competence (especially skills) was associated with worse indexes of the functions of the right hemisphere, while responsibility and knowledge were associated with better comprehension.

The motivation for improving digital competence was not associated with any indicator of neurocognitive development and therefore is not given in the table.

Table 01. Relationship between digital competence and neurocognitive development of adolescents 11-13 years old / 14-17 years old

Neurocognitive indexes and subtests	**IDC - Knowledge**	**IDC - Skills**	**IDC - Responsibility**	**IDC - Index**
Index of regulatory functions (programming and control functions)	-.18 /-.02	-.30* /.06	-.10 /.11	-.23 / .02
Index of serial organization functions	-.12 /.14	-.04 /.10	.00 /.16	-.08 /.16
Index of auditory information processing functions	-.22 /.07	-.13 /.28	.02 /.06	-.05 /.19
Index of visual-spatial information processing functions	-.15 /.02	-.15 /.01	.12 /.16	-.09 /.02
Index of left hemisphere functions	-.15 /.10	-.11 /-.09	.10 /.04	-.04 /-.01
Index of right hemisphere functions	-.09 /.37*	-.07 /.50**	.04 /.41**	-.07 /.50**
Index of neurodynamic component of mental activity	-.02 /.05	.04 /.25	.15 /.19	.06 /.13
Wechsler's test - Information subscale	.28* /.12	.26 /-.14	-.02 /.19	.19 /.13
Wechsler's test – Comprehension subscale	.28* /.32*	.29* /.11	.16 /.39**	.30* /.41**

Notes: * - $p<.05$, ** - $p<.01$.

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6.4. Neurocognitive development, online self-appraisals and excessive Internet use in adolescents 11-17 years

Self-appraisals (both online and offline) in adolescents were almost not associated with cognitive functioning (Table 02). The only exception was correlation of online self-appraisal with the poorer performance on tasks related to serial organization functions.

Indicators of excessive Internet use in adolescence was associated with poorer neurodynamic component of mental activity, as well as lower scores on Information subtest in adolescents 11-13 years old and lower scores on Comprehension subtest in adolescents 14-17 years old.

Table 02. Relationship between online self-appraisals, excessive Internet use and neurocognitive development in adolescents 11-13 years old / 14-17 years old

Neurocognitive indexes and subtests	General self-appraisals	Online self-appraisals	Excessive Internet use
Index of regulatory functions (programming and control functions)	.20 / -.06	.22 /-.04	.00 /.06
Index of serial organization functions	-.02 /.00	.30* /-.04	.06 /.23
Index of auditory information processing functions	-.11 /.03	.12 /-.03	.03 /.05
Index of visual-spatial information processing functions	.07 /.16	.00 /.09	.16 /.06
Index of left hemisphere functions	-.06 /.13	.24 /.05	.02 /.16
Index of right hemisphere functions	-.01 /-.01	-.08 /.10	.09 /.05
Index of neurodynamic component of mental activity	.03 /-.20	-.03 /-.08	.33* /.27
Wechsler's test - Information subscale	.03 /-.08	.03 /.05	-.30* /-.10
Wechsler's test – Comprehension subscale	-.02 /.21	-.26 /.25	-.13 /-.31*

Notes: * - p<.05, ** - p<.01.

7. Conclusion

Although comparisons of adolescents 11-13 and 14-17 years old revealed expectedly better neurocognitive functions in older children, there were only small differences in the two indexes – related to auditory information processing functions and functions of right hemisphere. We could suggest that these functions are more actively developing in these ages. Based on the interaction effect it could be also speculated that 11-17 years old left hemisphere functions are more actively developing in boys. In our sample boys demonstrated wider knowledge (Information) but not comprehension than girls.

As was hypothesized, user activity was not related to neuropsychological indexes but adolescents with high user activity demonstrated poorer scores on Information subtest. It seems reasonable that adolescents spending online most of their free time have less chances to get wide knowledge about the world.

Our second hypothesis was not confirmed although some relationships that were revealed in adolescents 11-13 years old and 14-17 years old are in line with this hypothesis. We could suggest that among 11–13-year-old adolescents, digital competency skills are associated with better regulatory functions, while digital competency knowledge is associated with the intelligence. It is possible that the

digital socialization of adolescents in 11-13 years old is changing towards more critical understanding and purposeful investigation than in younger children. Therefore, adolescents with better regulatory functions are more successful in training their digital skills, while adolescents with a higher level of intelligence are more successful in acquiring knowledge about the Internet. In addition, in accordance with the hypothesis of digital socialization, it should be assumed that cognitive development and the formation of digital competence go hand in hand: e.g., online skills can stimulate further online development and, accordingly, the development of regulatory functions, while teenagers who acquire new knowledge about the Internet "train" their awareness and understanding.

At the age of 14-17 years these effects are not revealed suggesting that the search for knowledge in the Internet is not as important activity as at the age of 11-13 years old. Moreover, adolescents 14-17 years old demonstrate relationship between functions of the right hemisphere and the worse digital competence.

Excessive use of the Internet in adolescence is associated with the worse index of neurodynamic component of mental activity and intellectual indicators. On the one hand, neurodynamic difficulties can lead to difficulties in quick "switches" between different information and activities so adolescent becomes more vulnerable to repetition of the same online activity too long. It also could be that neurodynamic difficulties are not so noticeable for adolescent himself and others online so the Internet become the "place" where he doesn't feel his difficulties. Poorer comprehension and less information can be associated with narrower interests, which also becomes a risk factor for excessive use of the Internet. On the other hand, excessive use of the Internet can increase or provoke neurodynamic difficulties, hindering the development of these functions in offline activities.

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