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DIFFERENTIAL AND STRUCTURAL ANALYSIS OF COGNITIVE RESERVE IN RUSSIAN SAMPLE

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Abstract

Structure and mechanisms of cognitive reserve can be considered as the psychological and behavioural resources for optimal cognitive functioning of older adults and thus increase their quality of life. We hypothesized that some activities that improve cognitive functioning in Western societies can have no effect in Russian sample, but the general structure was expected to be confirmed. Study aimed to investigate activities that are reported to form cognitive reserve in Western studies, to estimate their value for the overall cognitive reserve score, their frequencies and structure. We controlled for sex, gender and social and economic conditions to reveal most prominent activities that support optimal cognitive aging. Methods were Cognitive Reserve Index questionnaire (CRIq), MOCA test, demographic survey. Subjects: 215 older adults aged 60-89 (Mage=74; 70,4% - females). Results suggest that for Russian older adults' education and professional activities, consistently with Western studies, play significant role in the formation of cognitive reserve. We found that Leisure activities have some differences, particularly, Russian older adults dedicate less time to their private activities and more time to reading comparing to results reported in Western studies. Our study confirmed the overall structure of cognitive reserve suggested by Nucci. We found that all the activities in the model have significant effects for cognitive reserve score. We revealed that structure of cognitive reserve in Russian sample gave some differences in the effect sizes.

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1. Introduction

We live in a rapidly aging society. But changes occur not only to the demographic proportions of child, adult and aging populations, the ageing today is different. These transformations can be easily seen in the scientific publications on aging: in 1950-s and 1960-s researchers reported mostly negative aspects of aging, referring those results as normal due to aging decline; in 1980-s more data showed that while decline existed, not all older adults follow this pattern; today more researches acknowledge that there are many older adults who live active, happy and independent life that hardly fit into the deficit model of aging.

In such context more attention is given to mechanisms that can prevent declines and provide high levels of functioning in different domains. Within the domain of cognitive functioning one of such mechanisms is cognitive reserve.

1.1. Cognitive Reserve

Modern studies show that cognitive decline that recently was considered as a normal part of aging today is treated as a pathological process that needs intervention and treatment. Studies showed that older adults demonstrate high variability in the way they adjust to ageing processes (Katzman et.al., 1988), particularly, some patients who were expected to have mild or severe cognitive declines due to plaques revealed in their brain, demonstrated preserved cognitive functioning. These results suggested that there might be mechanisms that prevent cognitive decline and help one's adjustment to degenerative brain processes.

The concept of Cognitive Reserve (CR) was introduced by Stern (2009) and represents one of such mechanisms. The idea of CR broadens the concept of Brain reserve (Katzman, 1993) by giving greater sense to people's individual differences that provide different degree of resilience to cognitive declines, and refers such variability to one's involvement into different stimulating daily activities. These activities are supposed to support both functional and structural brain changes, creating a complicated and flexible networks with a stronger potential to adjust to age-related changes.

According to Stern (2009, 2012) there are factors that may affect CR. The most prominent factor to be called is education. Education (both formal higher education and life-long learning) appeared to be strong factor again cognitive decline in aging (Richards, & Sacker, 2003). Another factor somewhat related to education was bilingualism (Gold, 2015), particularly use of foreign languages substantially different from a native one. Some evidence was found for effects of emotions (Charles, Mather, & Carstensen, 2003; Bruno, Brown, Kapucu, Marmar, & Pomara, 2014), noradrenalin-related effects (Valenzuela, Sachdev, Wen, Chen, & Brodaty, 2008; Wilson et.al., 2013) on CR.

Aside from the global factors that can impact CR such as education, emotions etc., CR can be approached from the perspective of the activities that can to some extent stimulate brain activity and assist in development of the cognitive reserve (Nucci, Mapelli, & Mondini, 2012). As we mentioned, the most prominent of such activities is believed to be learning, the second and almost as significant are professional activities, the last and the most questionable – leisure activities. These three types of activities were taken as the core variables for development of the Cognitive Reserve Index questionnaire (CRIq).

2. Problem Statement

CR appears to be an important and promising protective mechanism in cognitive aging. Still the empirical study of CR leaves some room for discussion. While several European adaptations of CRIq showed similar results as original Italian version (Maiovis, Ioannidis, Nucci, Gotzamani-Psarrakou, & Karacostas, 2016), in country with a different lifestyle, for example, Russia, it may show somewhat different results. Since the development of CR might be an important resource for healthy aging we are interested in identifying if the activities identified in original version are universal or they are affected by cultural specifics.

3. Research Questions

In the present study we tried to address following research questions:

- Do three factors, identified by Nucci et.al. (education, working activity, leisure time) maintain their significant role in the model based on Russian sample?
- To what extent demographical factors, such as age and sex, impact cognitive reserve?
- Finally, we were interested if there could be specific cultural characteristics of cognitive reserve significant for Russian older adults?

4. Purpose of the Study

The aim of the study was to identify differential specifics of components of CRIq for Russian older adults and to empirically prove the structure of the cognitive reserve in Russian sample.

5. Research Methods

5.1. Participants

Subjects were 215 non-clinical older adults aged 60-89 (Mage=74; 70,4% - females) living in Saint-Petersburg and Nizhni Novgorod. Participants completed paper-based questionnaires. They were recruited from local community and University groups and participated in the study voluntarily.

5.2. Instruments and Procedures

To study *cognitive reserve* we used Cognitive Reserve Index questionnaire (CRIq, Nucci et.al., 2011; Russian adaptation by O. Strizhitskaya). CRIq comprises of three sections, education (years of formal and informal education), working activity (years and level of professional occupation) and leisure time (years of frequent attainment of various activities such as driving, reading books or travelling). For the purposes of differential and structural analysis we used both generalized scores and raw scores of the particular activities.

To prove that CRIq had positive effect on cognitive functioning we used MOCA test.

We also used data from demographic survey to control for age and sex effects.

6.   Findings

Analysis was conducted in three stages. First, we calculated descriptive statistics for raw data and ran preliminary correlation analysis. Second, we analysed raw data using regression analysis and identified variables most significant for education, professional and leisure components respectively. Finally, we analysed the effects of gender, sex and location on the CR scores.

6.1. Descriptive Statistics and Preliminary Correlation Analysis

Descriptive analysis of the CR variables - general score, Education, Working Activity and Leisure Time showed relatively high scores (Table 1).

Table 01. Descriptive statistics for CRIq scales

CRIq overall score	Mean	SD	Range
CRIq overall score	118,18	19,00	89-157
Education	123,64	12,63	100-142
Work Activity	121,21	24,01	85-178
Leisure Time	96,25	21,80	63-145

*In original questionnaire CRIq results were estimated using following scale: less than 70 points – low level of CR, 70-84 – medium low, 85–114 – medium, 115-130 – medium high, over 130 high scores.

Average scores has shown that overall CR score in our sample has been relatively high (according to original scale it has fallen into medium-high and high scores).

Preliminary regression analysis has revealed significant correlations between overall score and all CRIq subscales (Education r=0,639; Working Activity r=0,808; Leisure Time r=0,708), Education and Working Activity have been significantly correlated as well (r=0,415). Leisure Time score has not been associated with Education and Working Activity.

Further correlation analysis of CR variables within components has shown that variables "Years of education (including postgraduate studies and any specialization)" and "Vocational training" that comprise component Education have been significantly correlated (r=0,242). Correlation analysis of component Working Activity has shown significant negative associations of variable "Professional occupation (qualified specialist)" with variables "Low skilled manual work" (r=-0,435), "Skilled manual work" (r=-0,437), "Skilled non manual work" (r=-0,193). These results may be interpreted from the perspective of the sample specifics: in our sample most participants were at the same professional level for the most of their life, so if a person used to have experience as a low skilled manual worker he was unlikely to have experience as a qualified specialist.

Finally, correlation analysis of Leisure time component has revealed a complicated picture. This component consists of activities that one performs on a regular basis but with a different frequency – weekly, monthly, annually, or on a constant basis. Thus, in the analysis we have been analysing this component block by block.

Weekly activities included "Reading newspapers and magazines", "Domestic chores", "Driving", "Leisure activities (sports, dancing etc.)" and "Using new technologies". Data have shown that in our

sample most significant correlations have been found for variables "Reading newspapers and magazines" and "Using new technologies" (3 and 3 correlations respectively).

Monthly activities comprised such variables as "Social activities", "Cinema, theatre", "Gardening, DIY, small-scale operations such as knitting, etc.", "Looking after relatives", "Voluntary work", "Artistic activities (music, singing etc.)". All variables in this block have been positively significantly correlated (r ranged 0,173 to 0,470).

Annual activities have been represented by variables "Exhibitions, concerts, conferences", "Journeys lasting several days", "Reading books". All variables in this block have been positively intercorrelated with correlation coefficients ranging from 0,356 to 0,456.

Variables from constant block were represented by "Children", "Pets" and "Managing one's current account". All these variables have not been intercorrelated or correlated to overall score or variable "Leisure time".

Correlation analysis of CRIq scores and MOCA test scores have confirmed positive associations between CR and cognitive functioning. We have found significant positive correlations between CR general score (r=0,426) and Working Activity score (r=0,412). Correlation analysis of variables in the Working activity component have shown that years of "Skilled manual work" have had negative effect on cognitive functioning (r=-0,412) and "Qualified work" had positive effect (r=0,309). These results are consistent with the concept of CR and support the relevance of applied instruments.

These preliminary results from descriptive statistics and correlation analysis have suggested that the variables used in CRIq can be applied to Russian sample, but some culture specifics could be expected.

6.2. Regression Analysis of CR Components

At the second stage we have conducted regression analysis to identify if all the variables included in the components have been significant predictors of the Component score. We have found that both "Years of education" and "Vocational training" have been significant predictors for the Education score ($R^2 = 0,776$; $\beta_1=0,395$; $\beta_2=0,667$).

Regression analysis of variables comprised into "Working activity" component have shown that all five types of work have been significant predictors of the component score ($R^2=0,479$). Consistently with previous results, "Low skilled manual work", "Skilled manual work" and "Skilled non manual work" have had negative effects ($\beta_1= -0,498$; $\beta_2= -0,564$; $\beta_3= -0,385$) while "professional occupation" and "Highly responsible or intellectual occupation" ($\beta_4=0,375$; $\beta_5=0,597$) have had positive effects. This model suggests that low-skilled work do not help development of CR, but also may decrease it.

The "Leisure time" block included three sub-blocks – weekly activities, monthly activities, annual activities, so it have been decided to apply confirmative factor analysis to verify the structure and significance of variables within each block. As the results of preliminary analysis have shown no significant correlations with pet care, amount of children and managing one's account, they were excluded from the further analysis. Confirmative factor analysis conducted for Leisure time component have shown that all variables except "Driving" have been significant predictors of the "Weekly activities" block. All variables from monthly block have been significant predictors of the "Monthly" block.

Similarly, all variables from "Annual" block have been significant predictors in the model (Chi-square=2,536; df=3; p=0,207; CFI=0,954; RMSEA=0,041; PCLOSE=0,613).

Final structural analysis of all components of CRIq, adjusted to the results of preliminary correlation analysis, regression and confirmative factor analysis, has confirmed the three-factor structure of CRIq in Russian sample (Table 2).

Table 02. Fit indexes for hypothetical and empirical models of generativity

χ^2	df	CFI	RMSEA	PCLOSE
12,168	11	0,103	0,094	0,130

Note. df = degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; PCLOSE = p of close fit.

The patterns that have been obtained in the model were similar to those from the European studies; the excluded variables have been driving, pet care, amount of children and managing one's account.

6.3. Age, Gender and Location Effects on CR.

Differential analysis of the CR variables in our sample has revealed particular effects of subjects' age, gender and location.

In our sample the older were adults the more they were reading newspapers and magazines, they were doing more domestic chores than their younger counterparts, at the same time they used new technologies less. Age effects have also been found in the "working activity" variables: older representatives of the sample have had longer experiences of involvement into simple, low-skilled work.

Analysis of gender differences has shown that men had more years of education (M_{male}=13.91, M_{female}=12.31, p=0,030), spent more years doing qualified work (M_{male}=25.71, M_{female}=17.11, p=0,015), they were reading more newspapers (M_{male}=32.66, M_{female}=22.66, p=0,014), spent more time driving (M_{male}=27.77, M_{female}=2.14, p=0,000), and were more involved in use of new technologies (M_{male}=11.66, M_{female}=6.96, p=0,030) while women were more involved in domestic chores (M_{male}=29.00, M_{female}=40.23, p=0,002). These results to some extent have revealed quite traditional male and female roles in Russian society, particularly, for older adults who were raised in middle 20th century.

Comparative analysis of CRIq means of participants living in Saint-Petersburg and Nizhni Novgorod has shown that only one characteristic had significant differences – "Looking after relatives" (M_{SPb}=8.57, M_{NN}=16.81, p=0,013). During the study most of older adults reported that they were helping with grandchildren, about 23 % also reported they were taking care of their old parents at some moment of their life. While both Saint-Petersburg and Nizhni Novgorod are relatively big cities – population of Saint-Petersburg in 2017 was 5,2mln. people, in Nizhni Novgorod – 1,2mln. people. They are among the 5 biggest cities in the country. Both cities are regional centres with developed infrastructure. Still Saint-Petersburg historically had been closer to the Europe, for two centuries it had been the capital of the country and lifestyle of older adults in Saint-Petersburg comparatively different from smaller cities. Here, we have more opportunities for cultural and social involvement of older adults, thus more older adults devote their free time to their personal activities while in smaller cities majority of older adults, both male and female, are actively involved in grandparenting.

7. Conclusion

Our study has shown that levels of CR in our sample have been relatively high.

Descriptive, correlation and regression analysis has confirmed that three components of CR identified by Nucci have been stable in Russian sample. Still we found some differences. Particularly, three constant activities – "pet care", "amount of children" and "account management" were not significant in our sample. One's account management is not common for Russia in general, so we were initially predicting that this outcome is possible. Still we believe there might be alternative variable that might be more suitable for our sample, but it will take a new study to identify such variable. As for pet care and amount of children, we assume that this result might be associated with low variances of these variables. The results may reflect some cultural specifics of Russian older adults.

Results of differential analysis of CR variables reflect changes in the Soviet-Russian society that occurred in 20th century. During the 20th century higher education was gaining more and more importance. So, in the middle of the century, particularly right before and shortly after the Great Patriotic War (World War II) people had 8-10 years of education (7 years were obligatory for every Soviet Union citizen and 2-3 years of vocational training were offering some specific low-skilled specialization), in late 1960-s and 1970-s higher education became an indicator and guarantee of better life and more and more people were involved into college and university training, finally, by 2010 Russian ministry of education reported up to 80% of population with a college degree or higher. Education in most studies is reported as a strong preventive factor for reducing risk of cognitive decline. But from the idea of CR, activities that provide formation of CR need to be stimulating, in other words they require additional cognitive involvement to produce new physiological and functional networks in the brain. But what if the brain is used to high cognitive stimulation? Following the ideas of brain plasticity and adjustment we can assume that the brain that is used to active cognitive functioning might need a stronger stimulation to develop more complicated brain networks.

We have also reported gender differences in older adults. We have demonstrated that men in our sample were more progressive, they were reading more newspapers and magazines, having better jobs, using more technologies. When interpreting these results we need to keep in mind that most women in the sample still have higher education and could be capable to have the same level jobs, but their deep involvement into raising children and then grandchildren affects their resources and first of all – time resources. The results on the household chores also suggest that men involve into domestic duties on average 10 years later then women.

The question we need to address in our future studies is related to the ratio of internal and external factors that influence choice of lifestyle activities. For instance, if the society expects older adult to be significantly involved into granparenting, even the desire to have some time on your own for reading books, learning something new, traveling etc. might cause a feeling of guilt.

The main limitation of our study was the sample that originated from two big cities. There is still not enough data what happens to older adults living in small town and rural areas.

Acknowledgments

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