Title

The Role of Education in Executive Functions, Behavioral Problems and Functional Performance in People with Schizophrenia.

Running title

Education, Cognitive Reserve & Schizophrenia

Authors

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1   **Title**

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1 **Abstract**

2 **Objective:** This cross-sectional study examined the influence of education on executive

3 functions, behavioral problems and functional performance in people with chronic

4 schizophrenia. **Method**: Our sample was composed of 116 subjects with a schizophrenia

5 diagnosis (evolution time = 17.5±9.5 years) from consecutive referrals to the

6 Rehabilitation Unit of Benito Menni Hospital (Valladolid, Spain). All participants

7 completed an extensive standardized protocol including a neuropsychological testing of

8 executive functions (processing speed, working memory, inhibition, interference control,

9 mental flexibility), the assessment of behavioral symptoms, and functional performance.

10 Hierarchical regression models (HRMs) were carried out to determine whether education

11 (in years) relates to executive functions after controlling for the effect of demographics,

12 IQ, and clinical factors. **Results**: Both IQ and years of education were associated with a

13 later onset of the illness. Specifically, high education (in years) significantly correlated with

14 fewer behavioral problems and better functional performance in daily life. Further, HRMs

15 showed that education was associated with digit span and sematic verbal fluency tasks after

16 controlling for the effect of age, sex, and IQ as covariates. **Conclusions:** Higher education

17 may ameliorate executive deficits in patients with chronic schizophrenia and, in turn,

18 diminish the behavioral and functional problems of the illness.

19 **Key Words:** Education, Cognitive Reserve, Schizophrenia, Executive Functions;

20 Psychological and Behavioral Symptoms.

21

Key points

1) Question: This research addresses the role of education, as cognitive reserve proxy, on cognitive, functional and behavioral outcomes in people with chronic schizophrenia.

2) Findings: Higher education is associated with less executive dysfunction, behavioral problems and better daily life functioning in individuals with chronic schizophrenia.

3) Importance: The engagement in cognitive stimulating activities may help people with chronic schizophrenia to cope better with manifestations of the illness.

4) Next Steps: Longitudinal studies combining behavioral and neuroimaging data are required to determine specific weights of different cognitive reserve proxies on the clinical course of schizophrenia.

1   **Introduction**

2   The concept of cognitive reserve (CR) originally refers to the ability to

3   optimize task performance through recruitment of alternative neural networks (i.e.,

4   implying a more flexible and efficient use), and/or the use of different cognitive

5   processes, which may help individuals actively offset the consequences of

6   neuropathology (Stern, 2002). CR is primarily influenced by genetic and

7   neurodevelopmental factors, but it may vary depending on certain variables such as

8   education, lifestyle, and mental activities (Bora, 2015). This is possible due to brain

9   plasticity, a term that refers to the brain's ability to adapt functionally and structurally

10   in response to a constantly changing environment (Burke & Barnes, 2006). Thus,

11   individuals with higher CR are less likely to develop dementia (Contador, Bermejo-

12   Pareja, Puertas-Martín, & Benito-León, 2015; Stern et al., 1994), because they cope

13   better with the clinical symptoms and manifestations of neuropathology (Scarmeas &

14   Stern, 2004; Stern, 2013). Accordingly, some authors underline that CR may also

15   explain individual differences in the expression of psychiatric disorders such as

16   schizophrenia (Barnett, Salmond, Jones, & Sahakian, 2006). In this sense, CR may be

17   important not only for reducing the risk of schizophrenia (Khandaker et al., 2011), but

18   also to better understand the expression of symptoms and patients' functioning

19   (Herrero, Contador, Stern, Fernández-Calvo, Sánchez, & Ramos, 2020).

20   It is known that schizophrenia is a complex and heterogeneous broad-spectrum

21   disorder characterized by neurocognitive deficits (Heinrichs & Zakzanis, 1998; Rund

22   et al., 2007). In particular, cognitive deficits can be moderate to severe across several

23   domains, including attention, working memory, verbal learning, and memory, and

24   executive functions (Bowie & Harvey, 2006). Most importantly, the presence of such

25   deficits in patients with schizophrenia has been linked to worse worse functioning in

1   everyday-life activities (Bowie, Reichenberg, Patterson, Heaton, & Harvey, 2006;

2   Leeson, Barnes, Hutton, Ron, & Joyce, 2009; Robinson, Woerner, McMeniman,

3   Mendelowitz, & Bilder, 2004) and severity of the symptoms (Lam, Raine, & Lee,

4   2014), even in phases of clinical remission (Bowie et al., 2006; Galderisi et al., 2014;

5   Green, Kern, Braff, & Mintz, 2000). Further, it seems that cognition and, more

6   specifically, executive functioning can influence the benefits of treatments due to the

7   fact that impairments in the executive domains are usually associated with less

8   engagement in therapy and medication compliance (Bowie & Harvey, 2006).

9   According to a recent systematic review, the effect of socio-behavioral CR

10   proxies (i.e, IQ, education) in people with schizophrenia has usually been analyzed

11   through cognitive outcomes, whereas studies on social or functional consequences are

12   inexistent (Herrero et al., 2020). Robust scientific evidence has demonstrated the

13   importance of education in preventing cognitive decline and dementia incidence in

14   older populations (Meng & D'Arcy, 2012; Matyas et al 2019). However, the role of

15   education in schizophrenic patients has mostly been analyzed in combination with other

16   proxies such as premorbid IQ (Amoretti et al., 2018; de la Serna et al., 2013; Holthausen

17   et al., 2002), so its specific effect on different schizophrenia outcomes has not been

18   thoroughly investigated, and the current studies present difficulties in terms of

19   methodology and data interpretation. For instance, Kanchanatawan et al. (2018) found

20   that high education, taken as covariate (secondary analysis), was more common in

21   simple forms of neurocognitive psychosis (a less well- developed phenotype), whereas

22   Herold et al. (2019) described a negative association between education and

23   neurological signs in chronic patients with schizophrenia. Finally, Ward et al. (2017)

24   suggested that high and moderate levels of education (vs. low levels) may be protective

25   factors against cognitive impairment in patients with schizophrenia, but this effect was

restricted to individuals who were carriers of cardiovascular risk alleles (i.e., ACE D and APOE ε4).

It should also be considered that most of the studies on CR have been carried out after the first schizophrenic episode because cognitive and functional decline occur mainly before or during the onset of the disease (Kelly, Sharkey, Morrison, Allardyce, & McCreadie, 2000; Rabinowitz et al., 2000). However, Herold et al. (2019) reported that neurological signs and psychopathological symptoms (e.g., thought disturbances) of schizophrenia may also be associated with its chronicity. To support this observation, longitudinal MRI studies have shown an accelerated loss of gray matter over time in schizophrenia (Dietsche, Kircher & Falkenberg, 2017), which seems particularly pronounced in poor outcome patients (Mitelman et al., 2009ab). Consequently, it would be relevant to investigate the role of CR in moderating the impact of pathophysiological processes underlying brain changes in chronic stages of schizophrenia.

This research aimed to assess the specific effect of education on standardized cognitive, clinical, and functional variables in a large sample of chronic patients with schizophrenia. To our knowledge, this study provides new insights on the effect of CR in behavioral and functional outcomes of chronic schizophrenia, extending the traditional approach focused on cognitive outcomes (Herrero et al. 2020; Roldán-Tapia, Cánovas, León, & García-Garcia, 2012). According to CR expectations, a higher educational level should be associated with better cognitive-functional performance and fewer behavioral problems in chronic patients with schizophrenia. A hierarchical regression framework was used to control the influence of IQ, sociodemographic factors, and clinical variables on the mentioned associations. The current work could shed light on the specific impact of education, as a CR proxy, on different outcomes (cognitive, functional, and behavioral) in the chronic phase of schizophrenia.

1   **2. Methods**

2   *2.1. Participants*

3   A total of 116 patients who met diagnostic criteria for schizophrenia were

4   recruited from consecutive referrals to the Rehabilitation Center of the Benito Menni

5   Hospital (Valladolid, Northwest of Spain). Schizophrenia diagnosis was carried out

6   according to the International Statistical Classification of Diseases, 10th Revision

7   (World Health Organization, 1992). Each patient was diagnosed by a specialist in

8   psychiatry based on a clinical interview (history and assessment of the mental state)

9   with the patient and his or her family. All patients included in this study presented a

10   clinical progression of symptoms of at least two years and were suffering from

11   significant functional and social impairment. Subjects with concomitant organic

12   illnesses or another psychiatric disease different from schizophrenia, history of substance

13   abuse, presence of serious behavioral disorders (e.g., aggressive behavior), or an IQ

14   lower than 70 were excluded from the study. All participants were volunteers and

15   signed written informed consent, with the assistance of their legal tutor if necessary,

16   before enrolment in the study. This research was approved by the hospital's ethics

17   committee.

18   *2.2. Measures*

19   The comprehensive standardized protocol included the collection

20   of sociodemographic variables (age and sex), CR proxies (years of education and

21   occupation), clinical information (age at onset, duration, number of relapses, days of

22   hospitalization), a measure of general intelligence, executive function testing, and

23   evaluation of behavioral and functional problems. Occupation was evaluated based on

24   the work type and complexity level, but this variable was not analyzed because many of the subjects

25   evaluated had not performed any work. If they have done so, it was for very short periods

of time before abandoning it. The evaluation tests of the standard

protocol are described in detail below.

The Positive and Negative Syndrome Scale (Kay, Fiszbein, & Opler, 1987). The

scale assesses the severity of symptomatology (positive and negative) and general

psychopathology. It consists of 30 items; 7 for the positive scale, 7 for the negative

scale, and 16 for the general psychopathology scale. All items are rated on a 7-point scale of severity (1 = absent; 7 = extreme)

The Global Assessment of Functioning (GAF; APA, 2001). This scale assesses the

severity of the patient's mental illness on a scale ranging from 0 to 100. The lower the

scores on this scale, the more difficulties in performing daily life activities.

The Kaufman Brief Intelligence Test (K-BIT; Kaufman, 2000). It measures the

level of intelligence for ages between 4 and 90 years. The Vocabulary subtest assesses

verbal skills related to school learning (crystallized intelligence), whereas the Matrices

subtest assesses nonverbal skills and the ability to solve new problems (fluid

intelligence). Overall (composite) IQ scores range from 40 to 160, with higher scores

indicating a higher level of intelligence.

Perceptual-motor speed processing. This domain was assessed by the Digit

Symbol-Coding and Symbol Searching subtasks of the Wechsler Adult Intelligence

Scale-fourth edition (WAIS-IV; Wechsler et al., 2014). Symbol searching requires

the examinee within 120 s whether a target symbol appears (yes vs. no) among the 5

symbols shown in a search group. Digit Symbol-Coding consists of transcribing numbers

to symbols according to the legend provided. Each item is presented sequentially in a

row, and the examinee has 120 s to pair specific numbers with given geometric figures.

Attention and working memory. This factor was assessed by the Digits Forward

and Backwards subtasks of the WAIS-IV (Wechsler et al., 2014). It requires subjects

1   to repeat a series of increasing numbers, which are presented orally. Starting with two,

2   at a rate of one per second, numbers must be repeated in the forward or backward

3   conditions. The test ends when two consecutive mistakes are made on each condition.

4   *Verbal fluency test* (Delis, Kramer, Kaplan, & Holdnack, 2004). Both conditions,

5   semantic and phonological fluency, were applied. In the semantic task, participants

6   were asked to name as many elements as they could in two semantic categories, animals

7   and fruits. In the phonological condition, subjects were asked to say as many words as

8   possible that begin with a particular letter (F, A, S). Time limit for both tasks was 60

9   seconds. Scores were based on the number of responses given for each condition.

10   *Mental Flexibility and Inhibition. This components were tested y the Stroop Test (Golden, 1978) and the Trail Making Test (TMT; Reitan & Wolfson, 1985).*

11   *The Stroop Test* (Golden, 1978) consists of three conditions: 1) list of words (black ink)

12   that name colors (red, green, and blue), b) list of stimuli in the form of "x" (red, green, and

13   blue); c) the interference condition in which the subject should name the color of the ink of

14   the words that name colors (red, blue, and green). The stimuli are organized in columns

15   and should be named as quickly as possible within 45 seconds. An interference measure was

16   calculated based on the time needed to complete the first two subtasks in comparison

17   with the time needed to complete the third subtask (Scarpina & Tagini, 2017).

18   *The* TMT consists of two parts (A and B).

19   Part A is the simplest and consists of connecting series of randomly arranged,

20   numbered circles, in order, whereas part B requires alternating numbers and letters. For

21   parts A and B, scoring is expressed in terms of the time required to complete the tasks.

22   *The Health of the Nation Outcome Scale* (HONOS; Wing, Curtis, & Beevor, 1996).

23   This instrument was designed to measure physical, personal, and social problems in

24   patients with mental illnesses using secondary or tertiary mental health services (Casas,

25   Escandell, Ribas, & Ochoa, 2010). The scale is composed of 12 items divided into 4

subscales: Behavioral Problems (disruptive behavior, self-harm, and substance use), Impairment (cognitive problems and physical impairment), Clinical/Symptomatic Problems (depression, hallucinations and delusions, and other mental or behavioral problems), and Social Problems (problems with relationships, activities of daily living, living conditions, and occupation). Each item is scored on a five-point scale ranging from 0 to 4. The maximum score is 48, with higher scores indicating greater severity.

2.3. Procedure

Before enrollment, the aims of the study were explained, and each patient signed an informed consent form. All participants underwent a standardized evaluation protocol at the time of admission to the rehabilitation center. The protocol was applied by a clinical psychologist specialized in the management of patients with mental disorders. During the first interview, a preliminary talk was carried out with the patients and accompanying relatives to record basic sociodemographic information. Then, an exhaustive socio-medical history, with the help of reliable informants (relatives or legal tutors), was collected in order to gather information about diagnosis, age at onset, number of relapses, evolution, treatments, stays in other mental units, and socio-economic status. Finally, different standardized instruments were applied to assess participants' neuropsychological performance, behavioral and functional problems.

2.4. Data analysis

All data analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 21 for Mac. The descriptive analysis was conducted for the total sample, including mean and standard deviations ($M \pm SD$) for the quantitative variables. Frequencies and percentages were used for the nominal variables. Taking into account that atypical antipsychotics may have benefits on cognitive performance (see Guilera, Pino, Gómez-Benito, & Rojo, 2009), patients were stratified by antipsychotic

1 medication (atypical/combined antipsychotics vs. typical antipsychotics)

2 to explore potential differences between these groups on each measure.

3   Normality was tested in dependent variables using skewness and kurtosis statistics

4 (Hair, Black, Babin, & Anderson, 2010). All outcomes were adjusted to a normal

5 distribution except for symbol search, phonological fluency, and TMT-B, which did not

6 conform to normality even after logarithmic transformation (x+1). As a general

7 approach, Pearson's correlations were performed between education (in years) and

8 different outcomes, whereas t-tests were used to compare mean differences for

9 independent groups (typical vs. atypical antipsychotics). In addition, non-parametric

10 test (Spearman's correlation test and the Mann–Whitney U-test) were applied to confirm

11 the statistical significance for exceptional variables which did not comply with the

12 assumption of normality. Alternatively, chi-squared was applied to compare differences

13 in frequencies between categorical variables.

14   Finally, hierarchical multiple regression (HMRs) analyses were performed to

15 examine the effect of education on executive tasks after controlling for age, sex, IQ,

16 and main clinical factors such as age (onset), illness duration, and number of relapses.

17 The coefficient of multiple determination for multiple regression (R^2) was evaluated in

18 conjunction with residual plots (x = regression standardized predicted value, and y =

19 regression standardized residual) in order to assess the goodness of fit of the regression

20 model to the data and rule out potential biases. Detection of multicollinearity was

21 performed using the Variance Inflation Factor (VIF), with VIF > 5 as cut-off point for

22 the diagnosis of collinearity (Sheather, 2009). The significance threshold (alpha)

23 adopted in all statistical analyses was set to 0.05.

24
25   **3. Results**

26 *Characteristics of the sample.*

1   Table 1 summarizes the sociodemographic and clinical characteristics of the

2   sample, stratified by type of antipsychotic medication. Participants were middle-aged,

3   men in a higher proportion (62%), with a medium level of education. Negative

4   symptoms were more common than positive symptoms, and most of the patients were

5   under treatment with atypical antipsychotics. As shown in Table 1, no differences

6   emerged between typical/combined antipsychotics and atypical antipsychotics subgroups in clinical and

7   sociodemographic factors. These groups were matched in terms of cognitive,

8   functional, and behavioral measures, except for performance on the Digit Span task.

9   [INSERT TABLE 1]

10   *Associations between education, IQ and target outcomes*

11   Education (years) and IQ showed a moderate correlation ($r = .499^{**}$, $p < .001$).

12   Table 2 shows the correlations between education or IQ with different

13   outcomes, including the clinical characteristics of the sample.

14   [INSERT TABLE 2]

15   Education and IQ were positively associated with age at onset, whereas both

16   variables correlated negatively with the presence of positive psychotic symptoms.

17   Furthermore, education and IQ showed significant positive correlations with working

18   memory (Digit Span) and verbal fluency tasks (semantic and phonological), whereas IQ

19   was associated with a wider range of cognitive outcomes, including inhibitory control

20   (Stroop) and TMT-B. Finally, education, but not IQ, was negatively correlated with global

21   functioning scores (GAF) and the Clinical Problems subscale (HONOS).

22   *Influence of education and IQ on cognitive performance*

23   Finally, hierarchical multiple linear regression (MLR) analyses were performed to

24   calculate the amount of variance explained by IQ, after entering demographic variables

(age, sex, and education), in the Digit Span and verbal fluency tasks —semantic and phonological.

In the first step, education was a significant predictor of Digit Span (b = .018, 95% CI [.012, .002], p = 0.01] and semantic verbal fluency performance (b = .024, 95% CI [.009, .038], p =0.01) after controlling the effect of age and sex. This effect did not reach statistical significance, but a marked tendency was also found in phonological fluency tasks (b = .018, 95% CI [-.001, .038], p =0.06). After the inclusion of IQ (second step), the effect of education remained significant for Digit Span and showed a marked trend toward significance on Semantic Fluency. Finally, when clinical covariates (age at onset, illness duration, and number of relapses) were included, the effect of education remained significant for semantic fluency (b = .021, 95% CI [003, .039], p = .02), but it was no longer significant for Digit Span (b = .003, 95% CI [-.013, .018], p = .73).

[INSERT TABLE 3]

4. Discussion

The main aim of this study was to analyze the specific influence of education, as CR proxy, on executive functions, behavioral symptomatology, and functional performance in chronic patients with schizophrenia. Our findings showed that higher education was specifically associated with better cognitive and functional performance and fewer clinical problems, including positive symptoms. In fact, previous observations suggest that education can potentially alleviate the cognitive manifestations in patients with chronic schizophrenia (Kanchanatawan et al., 2018; Ward et al., 2017). In this regard, education is a well-known CR proxy associated with the prevention of cognitive and functional decline (Matyas et al 2019; Meng & D'Arcy, 2012), although current evidence in people with schizophrenia is still scarce (see Herrero et al., 2020). Moreover, using HRMs, this study shows that higher education

was associated with better performance on Digit Span and Semantic Verbal Fluency after controlling for the effects of sociodemographics and IQ. Consistently, de la Serna et al. (2013) showed that education improves the ability of IQ to predict cognitive performance in attention and working memory in people with schizophrenia.

Further, this study provides new insights on the effect of education on behavioral and functional outcomes of chronic schizophrenia. Other studies found that CR was also related to lower negative symptoms in patients with schizophrenia (Amoretti et al., 2016; Mäkinen et al., 2010), but such association was non-significant in our study. This heterogeneity might be due to CR's operationalization. For instance, Mäkinen et al. (2010) used school performance as a proxy of CR in their study, whereas Amoretti et al. (2016) applied a complex index of CR based on premorbid IQ, education, and leisure activities. In addition, it should be considered that only the effect of semantic fluency remained significant when clinical factors were included in the model and different interpretations may coexist in this regard. Firstly, education may have a higher effect on reducing the severity of cognitive problems after the first schizophrenic episode but, as the severity of the grey matter damage increases in chronic patients (Dietsche et al., 2007), the protective role of education decreases. Thus, CR—and specifically, education—may slow down cognitive and clinical deterioration, but its protective role gradually diminishes at long-term. Secondly, years of education may have a limited capacity to estimate CR in schizophrenic individuals with limited access to education, as occurs in other populations (Contador et al., 2015; Dotson, Kitner-Triolo, Evans & Zonderman, 2009). In fact, people with schizophrenia often leave school early.

Finally, HRMs are focused on the independent effect of education on the executive tasks eafter controlling for a wide range of covariates (IQ, demographics, and clinical characteristics).

The differential effect of education on executive tasks might illustrate the existence of complex relationships between them when different covariates are taken into account (e.g., age or severity of the illness).

This study has some limitations that should be pointed out. First, we presented herein a correlational cross-sectional study, which does not allow discriminating whether education is truly an indicator of CR or whether simply related to better cognitive performance. Indeed, education shows a robust association with the level of cognitive performance, but whether education is consistently associated with cognitive changes remains controversial (Seblova, Berggren & Lövdén, 2020). Further, the interpretation of these findings in terms of causality should be avoided. Schizophrenia is a multicausal entity of unknown etiology, possibly epigenetic, in which the interaction of genes and the environment promote disruptions in brain networks (Akbarian, 2014; Smigielski, Jagannath, Rössler, Walitza, & Grünblatt, 2020). In this context, our results suggest that CR may ameliorate cognitive-functional deterioration and behavioral symptoms, but direct causality between CR and schizophrenia emergence should not be inferred. Second, CR was estimated with education, as a single proxy of CR, so it is important to understand the specific weight of CR indicators (see Grotz, Seron, Van Wissen, & Adam, 2017), whose effects are usually overshadowed in complex CR indexes (see Amoretti et al., 2018; de la Serna et al., 2013). Finally, this study is focused on executive functions, so the results are not generalizable to other cognitive domains such as memory. One of the main strengths of this study is the diverse characteristics and the broad size of the sample. However, the generalization of these findings to the whole population of people with schizophrenia, a broad heterogeneous condition, should be done cautiously.

1   To sum up, our findings highlight that patients with a superior educational level

2   would cope better with cognitive-functional problems and the severity of the clinical

3   manifestations of the illness. Therefore, education might be an

4   important factor for tailored interventions in people with schizophrenia,

5   considering different evidences which suggest that effectiveness of cognitive intervention

6   programs may be mediated by the influence of CR (Amoretti et al., 2018; Buonocore

7   et al., 2019; Fiszdon, Choi, Bryson, & Bell, 2006). Otherwise, education may be

8   associated with greater awareness of the disease (trans-diagnostic factor), increasing

9   treatment adherence (Buckley, Wirshing, Bhushan, Pierre, Resnick, & Wirshing,

10 2007), which may result in less chronicity and severity of the symptoms. Future

11 research should address the role of education and other CR proxies to optimize the

12 benefits of intervention programs carried out in patients with schizophrenia at different

13 levels of chronicity.

14

<div align="center">**References**</div>

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Table 1. Characteristics of the sample: comparisons between patients with typical versus atypical antipsychotic drugs.

Variables	Total sample ($n = 116$)	Typical or combined (typical plus atypical) intervention ($n = 33$)	Atypical antipsychotics only ($n = 83$)	p
Age	40.66 (9.62)	42.64 (9.03)	39.98 (9.78)	.151
Sex (n, % male)	73 (62.90)	24 (72.7)	49 (59)	
Education (years)	13.84 (3.93)	13.97 (3.44)	13.80 (4.12)	.817
K-BIT (IQ)	90.16 (11.64)	89.36 (11.26)	90.47 (11.85)	.640
Age at onset (years)	23.03 (5.95)	23.94 (5.23)	22.67 (6.21)	.270
Duration (years)	17.54 (9.58)	18.09 (10.69)	17.33 (9.16)	.719
Hospital admittance (days)	493.11(284.6)	533 (236.6)	477.01(301.4)	.289
Relapses (n)	2.93 (3.42)	2.64 (3.73)	3.05 (3.13)	.582
Positive symptoms (PANSS)	14.84 (5.09)	14.85 (4.65)	14.84 (5.29)	.996
Negative symptoms (PANSS)	22.74 (9.10)	23.48(10.80)	22.45 (8.40)	.622
Other Medications				
Anxiolytics (n, %)	70 (60.3)	54 (48.5)	54 (65.1)	.227
Antidepressants (n, %)	34 (29.3)	12 (26.4)	22 (26.5)	.154
Mood stabilizers (n, %)	16 (13.8)	3 (9.1)	13 (15.7)	.367
Anti-Parkinsonism (n, %)	102 (12.1)	6 (17.7)	8 (9.6)	.234
Cognitive Testing				
Digit Symbol Coding	50.25 (14.36)	50.06(16.74)	50.32 (13.41)	.936
Symbol Search	23.50 (6.32)	23.48 (7.23)	23.50 (5.97)	.988
Digit Span^T	12.30 (3.71)	13.82 (5.32)	11.70 (2.65)	.035*
Phonological Fluency	9.80 (3.21)	9.27 (3.28)	10.01 (3.18)	.274
Semantic Fluency	14.68 (4.30)	14.88 (4.40)	14.60 (4.29)	.760
Stroop (interference)	-1.65 (10.43)	-3.84(11.49)	-.77 (10.27)	.163
TMT B (seconds)	142.48 (66.0)	147.85(76.1)	140.35 (61.9)	.617
GAF	52.73 (10.32)	53.21(11.29)	52.14 (9.92)	.362
HoNOS	13.12 (13.00)	12.85 (4.65)	13.23 (4.19)	.684
Behavioral problems	1.24 (1.42)	.97 (1.35)	1.35 (1.44)	.187
Impairment	1.88 (1.42)	1.67 (1.38)	1.96 (1.43)	.306
Clinical Problems	3.89 (1.95)	5.06 (2.26)	3.82 (1.83)	.588
Social Problems	6.08 (2.61)	5.94 (2.67)	6.13 (2.60)	.725

Numbers represent means and standard deviations (between parentheses) for quantitative variables. PANSS. Positive and Negative Symptoms Scale; HONOS. Health of the Nation Outcome Scale; GAF. Global Assessment Functioning; K-BIT = The Kaufman Brief Intelligence test; IQ = Intelligence quotient; T = sum of forward and backward condition; *$p < .05$.

Table 2. Correlations between education and IQ with cognitive, behavioral, and functional outcomes.

	Education (years)	IQ
Clinical Factors		
Age at onset (years)	.352**	.252**
Duration (years)	-.123	.026
Hospitalization (days)	.158	-.096
Relapses (n)	-.059	-.119
Positive symptoms (PANSS)	-.304**	-.262**
Negative symptoms (PANSS)	.051	-.045
Neuropsychological Testing		
Digit Symbol Coding	.081	.013
Symbol Search[¥]	.176	-.032
Digit Span	.211*	.297**
Semantic Verbal Fluency	.327**	.295**
Phonological Verbal Fluency[¥]	.224*	394**
Stroop Word-Color (interference)	-.162	-.215*
TMT-B (seconds)[¥]	-.156	-.254**
Global Assessment Functioning (GAF)	.201*	.162
HONOS	-.122	-.069
Behavioral problems	-.081	-.189
Impairment	.143	-.043
Clinical problems	-.208*	-.060
Social problems	-.006	-.097

*p < .05. **p < .01.

[¥] Pearson correlations were non-significant for these variables. Non-parametric correlations are shown.

Table 3. Hierarchical regression models examining the effect of education and intelligence quotient (IQ) on cognitive measures.

	Intercept	b	95% CI	p
Digit Span				
Model. $R^2 = .187$, $F = 6.384$, $p < .001$	2,953			
Age		-.008	-.014, -.003	-.008
Sex		-.011	-.119, .096	-.011
Education		.005	-.010, .020	.005
IQ		.009	.004, .014	.009
Semantic Verbal Fluency				
Model. $R^2 = .142$, $F = 4.608$, $p = .002$	2,879			
Age		002	-.004, .008	.445
Sex		.060	-.059, .180	.318
Education		.017	.000, .034	.054
IQ		.005	-.001, .010	.101
Phonological Fluency				
Model. $R^2 = .154$, $F = 5.053$, $p = .001$	2,229			
Age		-.006	-.013, .001	.117
Sex		.024	-.126, .175	.748
Education		-.002	-.024, .019	.834
IQ		.014	.007, .021	.001

Note. b = unstandardized Beta Coefficient. Residual plots were randomly dispersed around the horizontal axis, supporting the appropriateness of the linear regression model to the data. All VIF values fell below the cut-off point of 5.

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RESOLUCIÓN 624/2019, de 9 de abril, del Rector de la Universidad Pública de Navarra, por la que se ordena publicar el "Acuerdo de Consejo de Gobierno por el que se aprueba la política institucional de acceso abierto de la Universidad Pública de Navarra" adoptado por acuerdo del Consejo de Gobierno de 9 de abril de 2019.

E uso d as comp   cias qu m a sido co f ridas por   ar ícu o 40 d os Es a u os d a U iv rsidad aprobados por D cr o Fora 110/ 003 d 1 d mayo, s ord a a pub icació d acu rdo d Co sjo d Gobi r o d 9 d abril d   019 por   qu s apru ba a po í ica s iucio a d acc so abi r o d a U iv rsidad Púb ica d Navarra.

La U iv rsidad Púb ica d Navarra, como i s iució púb ica d dicada a a doc cia, a a i v s igació y a a ra sf r cia d co ocimi o, d s a apoyar a difusió d os r su ados d a i v s igació y acu rda i iciar u a po í ica i s iucio a d acc so abi r o qu favor zca a mayor difusió , acc sibi idad, visibi idad impac o d a producció ci   ífica d os mi mbros d a Comu idad U iv rsi aria.

Es a po í ica s sus a   cump imi o d ar ícu o 37 d a L y d a Ci cia (14/ 011),   R a D cr o qu r gu a as s ña zas oficia s d Doc orado (99/ 011), y   a r ci   Asamb a G ra d a Co f r cia d R c or s d as U iv rsidad s Españo as (CRUE) qu ,   19 d f br ro d   019, suscribió u docum o d compromisos d as u i v rsidad s a   a Op Sci c qu r cog u a d c aració d di z accio s d dicadas a impu sar a imp a ació d a Ci cia Abi r a. E   co x o uro o, por ac rr fr cia a io más r ci , d b   d s acars as co c usio s ma adas d a Comisió Europ a, co f c a d abri d   016, qu i cid   a vo u ad d   ac ru a a sició   acia u sis ma d Ci cia Abi r a; por su par ,   ju io d   017, a Europ a U iv rsi i s Associa io (EUA) pub icó u docum   o d r com dacio s Towards Fu Op   Acc ss i 0.

Co form , por a o, a as r com dacio s d apoyo a acc so abi r o a a i formació ci   ífica d a Comisió Europ a, d a gis ació   s a a y d a Co f r cia d R c or s d as U iv rsidad s Españo as

A propu s a d Vic rr c or d I v s igació , Co s jo d Gobi r o, s sió d 9 d abri d   019, pr via d ib ració d sus mi mbros, adop a a sigui

ACUERDO:

Prim ro.–Aprobar a Po í ica I s iucio a d Acc so Abi r o d a U iv rsidad Púb ica d Navarra   os érmi os d docum   o qu s a xa.

S gu do.–Comu icar pr s   Acu rdo a Vic rr c or d I v s igació y a a Dir c ora d S rvicio d Bib io ca.

T rc ro.–Ord ar a pub icació d sigui   Acu rdo   Bo í Oficia d   Navarra.

Cuar o.–Fr a pr s   Acu rdo podrá i rpo rs r curso co   cioso admi is ra ivo   p azo d dos m s s co ados a par ir d día sigui   a su pub icació   Bo í Oficia d   Navarra, co form a as disposicio s   s ab cidas   a L y 9/1998, d 13 d ju io, r gu adora d a Jurisdicció Co   cioso-admi is ra iva."

Pamp o a, 9 d abri d   019.–E R c or, A fo so Car os   a.

Las dos prim ras i icia ivas a favor d acc so abi r o, a Budap s Op   Acc ss I i ia iv ,   00 , firmada por u grupo d ci   íficos d r i v mu dia y a B r i D cara io o Op   Acc ss o K ow dg i   Sci c s a d Huma i is, qu ac suya a i icia iva y d fi ició d a BOAI,   003, suscri a   a co f r cia orga izada por a soci dad Max P a ck,   su 10.º a iv rsario r sp c ivo, r ovaro su compromiso   a apu s a por   acc so abi r o a a ci cia.

E   01 , a BOAI r afirma a d fi ició d "acc so abi r o" como:

"[a i ra ura ci ífica r visada por par s], os r f rimos a su dispo ibi idad gra ui a   a r púb ica, qu p rmi a cua qui r usuario   r, d scargar, copiar, dis ribuir, imprimir, buscar o añadir u   ac a   x o comp o d sos

artículos, raster o vectoriales para su digitalización, incorporarlos como datos en un software, o utilizarlos para cualquier otro propósito que sea legal, sin barreras financieras, legales o técnicas, aparte de las que son inseparables del acceso mismo a Internet. La única limitación en cuanto a la reproducción y distribución, y el único papel del copyright (los derechos patrimoniales) en este ámbito, debería ser el dar a los autores el control sobre la integridad de sus trabajos y el derecho a ser adecuadamente reconocidos y citados."

Asimismo, en el décimo aniversario de la BDOA, en 2013, se urge a los "organismos e instituciones de investigación a trabajar internacionalmente para formular una estrategia viable, coordinada y transparente que posibilite la transición a un sistema en que el modelo de publicación en acceso abierto sea la norma".

Mientras tanto, en Europa, la Comisión Europea, ya en agosto de 2008, lanzó un programa piloto de Acceso Abierto, si bien dentro del VII Programa Marco, que duró hasta su finalización. No es puede dejar sin citar el inicio de la puesta en marcha de la iniciativa europea OpenAIRE (Open Access Infrastructure for Research in Europe). En el posterior programa marco HORIZON 2020, en su artículo 29., el acceso abierto a los resultados de la investigación científica será requisito en todas las áreas.

También en España, en la Ley de la Ciencia, la Tecnología y la Innovación, Ley 14/2011 recoge en su artículo 37, qué y cómo difundir en acceso abierto los resultados de la investigación financiada con fondos públicos.

En el mismo sentido, el Real Decreto de Doctorado 99/2011, que regula las enseñanzas de doctorado, lo recoge también en su artículo 14, en materia de depósito de las tesis doctorales, y a la cual la Normas reguladoras del Doctorado en la UPNA (2017), se adhieren.

Más recientemente, se ha puesto de manifiesto en las conclusiones de la Comisión Europea, en abril de 2016, la voluntad de dar la acelerar la transición hacia un sistema de Ciencia Abierta. En este sentido, la European University Association (EUA) publicó, en junio de 2017, un documento de recomendaciones Towards Full Open Access in 2020, profundizando en las políticas de acceso abierto.

Y por último, las universidades españolas, reunidas en la Asamblea General de la Conferencia de Rectores de las Universidades Españolas (CRUE) han suscrito un documento de Compromisos de las universidades ante la Open Science, el 19 de febrero de 2019, que recoge una declaración de diez acciones decididas a impulsar e implementar la Open Science o Ciencia abierta.

La Universidad Pública de Navarra, al igual que ya lo ha hecho con otras iniciativas y dos universidades españolas en las años momento, y con las citadas más arriba mencionadas,

DECLARA su adhesión a los principios contenidos en la Budapest Open Access Initiative y en la Berlin Declaration on Open Access to Knowledge in Sciences and Humanities y aprueba la siguiente política:

POLÍTICA INSTITUCIONAL DE ACCESO ABIERTO DE LA UNIVERSIDAD PÚBLICA DE NAVARRA

I.–Alcance de la política institucional de acceso abierto.

La Universidad Pública de Navarra incluirá en el ámbito de acceso abierto:

1. Publicaciones científicas (artículos científicos, libros o capítulos de libros, etc.) resultados de la investigación científica de sus miembros docentes e investigadores.

2. Tesis doctorales leídas en la UPNA.

3. Trabajos fin de grado y máster realizados en las situaciones de la UPNA.

4. Patrimonio bibliográfico de la UPNA digitalizado.

5. Publicaciones de la Universidad Pública de Navarra, editadas en acceso abierto.

6. Congresos y otros eventos científicos organizados por la UPNA.

7. Otra documentación institucional académica que la Universidad acuerde incluir en este ámbito.

II.–Condiciones para promover la difusión en acceso abierto de la producción académica y científica.

1. El personal docente e investigador, el de la PDI, depositará sus publicaciones digitales en el repositorio institucional Academica-e.

2. Las tesis doctorales leídas en la UPNA se depositarán en Academica-e, al amparo del Real Decreto 99/2011 y de la reglamentación y normativas que la Universidad establezca.

3. Los trabajos académicos de fin de grado y máster se depositarán en Academica-e, siguiendo la normativa que la Universidad establezca.

4. El depósito de todo documento en Academica-e respetará los derechos de autor y propiedad intelectual, en cuanto implicará una concesión no exclusiva a la UPNA de los derechos de explotación del documento (reproducción, distribución, comunicación pública, transformación) necesarios para aquel fin.

5. El depósito de los documentos del PDI de la UPNA tendrá en cuenta as políticas editoriales en r ación con depósito de documentos en repositorios abier os (versiones, plazos de embargo,..) estab ecidos para ofrecer su acceso. Igualmente, se garantizará la confide cialidad o el embargo tempora susceptibles de explotación comercial, acuerdo con empresa o similar, según las norma ivas y r glamentos vigentes n la UPNA.

6. El depósito de las publicaciones en Academica-e será obligatorio cua do sean produc o de proyectos financiados e convocatorias públicas, sean del ámbito local, nacional, europeo u otros, en cuyas bas s reguladoras se establezca este requisito.

7. El PDI, individual o en unidades de investigación, que soliciten ayudas de investigación a la UPNA deberán facilitar a publicación de sus resultados de dicha i vestigación generados por esa ayuda e Academica-e, mediante copia digita de la publicación y teniendo en cuenta las políticas editoriales en relación con el archivo en repositorios institucionales.

8. Se deberá facilitar el acceso abierto a las patentes concedidas al personal investigador de la UPNA, una vez cumplidos todos los trámites para su publicación.

9. La UPNA podrá tener en cuenta en sus procesos internos de evaluación de la producción cien ífica el hecho de que las publicaciones estén registradas y depositadas en Academica-e. Para ello las citadas publicacion s deberán ser, como mínimo, referenciadas en el repositorio y facilitar el acceso abi rto a su tex o comp eto tan pro to como sea posible en función de las limitaciones que pudiesen haber establecido sus editores.

10. La UPNA recomienda a los investigadores que en materia de propiedad intel c ual mantenga e su poder los derechos de explotación de sus trabajos no c diéndolos en exclusiva a otros agent s.

11. Con el fin de depositar los artículos de inv s igación, la UPNA recomienda el depósito del post-print de editor si éste lo autoriza o, tan pronto como el documento sea aceptado para su publicación, los autores deposite la versión final revisada (post-print de autor).

12. Se recomienda, así pues, conservar el post-print de autor en todos los casos.

III.–Compromisos de la Universidad Pública de Navarra con la producción científica y académica depositada en el repositorio Academica-e.

1. Velar por el respeto a los derechos de autor y propiedad intelectua d los documentos depositados e Academica-e.

2. Establecer procedimientos adecuados para e depósito de los diferen es tipos de documentos en Academica-e.

3. Asesorar, dar apoyo técnico y facilitar las tareas de depósito de documentos, a través de los medios de os que la Biblioteca disponga, a la comunidad universitaria.

4. Asesorar sobre el depósito de datos de inv s igación a los investigadores de la UPNA.

5. Formar e informar a los investigadores y docentes en el acceso abier o y la ciencia abi rta, a través d los medios de los que la Biblioteca disponga.

6. Recolectar y recuperar documentos publicados por los investigadores de la UPNA para su inclusión e l repositorio Academica-e.

7. Poner a disposición de los autores datos sobr visitas, uso y citas de su obra depositada en el repositorio Academica-e.

8. Velar por la integridad de los datos introducidos.

9. Preservar, asegurar y mantener el acceso perpetuo a las publicaciones de la producción académica y ci ntífica alojadas en el repositorio Academica-e.

10. Seguir normas y criterios internacionales en la elaboración y desarrollo de Academica-e.

11. Utilizar protocolos y estándares de intercambio de metadatos que incrementen a interoperabilidad y visibilidad de os contenidos y someterse a sus test de evaluación de calidad.

12. Incorporar el repositorio a buscadores académicos, portales, directorios o recol ctores, nacionales e internacionales que aseguren el incremento de la visibilidad y el impacto de la investigación de la UPNA.

13. Promover la interoperabilidad entre el reposi orio Academica-e y otros sistemas de gestión de la investigación de la Universidad Pública de Navarra.

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