

Original

Personality Changes as an early marker of Mild Cognitive Impairment

Cambios de personalidad como predictor temprano de Deterioro Cognitive Leve

Adriana Leis¹

Mónica Iturry²

Galeno Rojas³

Emilia Gatto⁴

How to cite this article:

Leis, A., Iturry, M., Rojas, G. & Gatto, E. (2024). Personality Changes as an early marker of Mild Cognitive Impairment. *Journal of Applied Cognitive Neuroscience*, 5(2), e6011. <https://doi.org/10.17981/JACN.5.2.2024.6011>

Received: 20-09-2024

Accepted: 29-11-2024

Abstract

The high incidence of personality changes in Dementia of Alzheimer type and mild cognitive impairment (MCI) makes these changes a potential early marker of these conditions. There is recent evidence that premorbid personality style could predict the likelihood of certain behavioral and psychological symptoms of dementia. Objectives: The present study aims to detect personality traits of patients with MCI, to describe and compare personality traits with normal healthy subjects, and to describe and identify relationships between personality factors, mood, and behavioral symptoms. Methods: 38 patients with mild cognitive impairment and 40 healthy control subjects matched by age and educational level were assessed with a personality inventory (NEO-FI), and an extensive neuropsychological battery. Results & Conclusions: The values of agreeableness were significantly higher in patients with MCI than in healthy control subjects; this trait increased in patients with MCI over time, being a change from the expected development for the general population. On the other hand, the relationship between the neuroticism trait and the rest of the personality traits is altered in patients with MCI already before the onset of the disease, which is a finding to be considered and could help identify subjects at risk of cognitive impairment.

Keywords: mild cognitive impairment; MCI; AD; personality; five-factor model; dementia; risk factors.

Resumen

La alta incidencia de cambios de personalidad en la demencia de tipo Alzheimer y el deterioro cognitivo leve (DCL) hace que estos cambios sean un posible marcador temprano de estas afecciones. Existe evidencia reciente de que el estilo de personalidad premórbido podría predecir la probabilidad de ciertos síntomas conductuales y psicológicos de la demencia. Objetivos: El objetivo del presente estudio es detectar los rasgos de personalidad de los pacientes con DCL, describir y comparar los rasgos de personalidad con sujetos sanos normales, y describir e identificar las relaciones entre los factores de personalidad, el estado de ánimo y los síntomas conductuales. Métodos: Se evaluaron 38 pacientes con deterioro cognitivo leve y 40 sujetos controles sanos emparejados por edad y nivel educativo con un inventario de personalidad (NEO-FI) y una batería neuropsicológica extensa. Resultados y conclusiones: Los valores de amabilidad fueron significativamente mayores en los pacientes con DCL que en los sujetos controles sanos, este rasgo aumentó en los pacientes con DCL con el tiempo siendo un cambio con respecto al desarrollo esperado para la población general. Por otro lado, la relación entre el rasgo de neuroticismo y el resto de rasgos de personalidad se encuentra alterada en los pacientes con DCL ya antes del inicio de la enfermedad, lo que supone un hallazgo a tener en cuenta y que podría ayudar a identificar a los sujetos en riesgo de deterioro cognitivo.

Palabras clave: deterioro cognitivo leve; DCL; EA; personalidad; modelo de cinco factores; demencia; factores de riesgo.

1 Corresponding author. Departamento de Neurología, Sanatorio de la Trinidad Mitre. Buenos Aires, Argentina. licadrianaleis@gmail.com <https://orcid.org/0000-0002-8463-4697>

2 Hospital de Agudos Dr. Abel Zubizarreta. Buenos Aires, Argentina <https://orcid.org/0000-0001-8899-5812>

3 Fundación Favalaro. Buenos Aires, Argentina. <https://orcid.org/0000-0002-3912-9421>

4 Facultad de Medicina. Buenos Aires, Argentina. <https://orcid.org/0000-0002-1346-5443>

INTRODUCTION

Aging is a generally homogeneous natural process that can vary in duration but is undoubtedly associated over time. The variation will depend on the living conditions and the quality of aging; the cessation of life may be anticipated or delayed but never suspended. Life expectancy has increased significantly in recent years due to the development of sewage networks and drinkable water; in addition, there has been the advancement of diagnostic methods, the development of pharmacological treatments, and advances in surgical techniques. The annual incidence of all-cause dementia is approximately 1 per 100 in individuals aged 65–70 years and 4 per 100 per year in those aged 80–90 years (Niu, H, 2017). A meta-analysis of twenty studies from Europe and North America revealed that the prevalence of clinically diagnosed amnesic dementia increased from less than 1% in individuals aged 65–69 years to 7–8% in those aged 80–84 years to 27% in those aged 90–94 years (Hy, 2000)

Latin American countries have a high rate of elderly population. In Argentina, the prevalence of dementia, in general, is estimated at 12.18% in subjects over 65 years of age (Larraya, Grasso & Mari, 2004), and, in a pilot study conducted in Cañuelas cognitive impairment was found in 23% of subjects over 60 years of age (Arizaga et al., 2005).

In recent years, there has been a growing focus on the milder spectrum of cognitive decline. Individuals who ultimately manifest degenerative dementia, including Alzheimer's disease (AD), are prone to undergoing a transition during a period of cognitive impairment. This transition stage has been described by various authors using a variety of terms, including mild cognitive impairment (MCI), pre-dementia syndrome, incipient dementia, and isolated memory impairment, among others (Petersen et al., 2001).

MCI is then a transitional stage between normal aging and dementia, in which the patient has cognitive disorders that do not generate a significant functional alteration to meet dementia criteria. The importance of this syndrome lies in the fact that each year, between 10% and 15% of those subjects who suffer from it turn into dementia, while the general population, only 1% or 2% (Iqbal, Sisodia & Winblad, 2001; Petersen, 2007).

Classically, the concept of MCI has implied only disorders in “cognitive” functions. However, behavioral symptoms associated with this syndrome have been found (Lyketsos et al., 2002; Serrano et al., 2007). Individuals experiencing significant challenges with memory also demonstrate mild impairments in other cognitive domains, including language function, attention, visuospatial skills, and cognitive flexibility.

In 2013, the American Psychiatric Association published new criteria for dementia in the fifth edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-5). This edition recognizes the pre-dementia stage of cognitive decline. This condition, which exhibits many of the hallmarks of MCI, is designated as mild

neurocognitive disorder (Mild NCD). Mild NCD acknowledges the presence of subtle cognitive decline, distinguishable from the effects of aging, yet not equivalent to a diagnosis of dementia. Furthermore, Mild NCD is characterized as the initial phases of cognitive disorders and precedes the diagnosis of Major NCD, which is analogous to the previous diagnosis of dementia. The criteria for mild NCD closely resemble the basic MCI criteria, which include the following characteristics: (i) clinical concern raised by the patient or a respondent or observations made by the physician, (ii) cognitive impairment in one or more cognitive domains, preferably relative to normative data appropriate to that individual, (iii) preservation of functional independence, and (iv) absence of dementia. These criteria align with the MCI criteria previously described, and while defined neuropsychological scores are not recommended, there is an implication that neuropsychological testing can be very useful in making the diagnosis ([American Psychiatric Association, 2013](#)).

However, it should be noted that not all individuals who experience cognitive decline, particularly in advanced age, will ultimately develop Alzheimer's disease (AD). Additionally, some individuals who are diagnosed with mild cognitive impairment (MCI) may not progress to clinically defined dementia. A considerable proportion of these individuals may exhibit cognitive impairment due to factors other than neurodegeneration, including depression, anxiety, drug use, medical comorbidities, and other treatable conditions. The advent of novel diagnostic criteria and promising biomarkers in various clinical settings has facilitated the identification of distinct types of MCI and their etiological pathways ([Petersen et al., 2014](#)).

According to various studies, between 35% and 85% of patients with MCI also have neuropsychiatric disorders ([Baquero et al., 2004](#); [Demey, Allegri & Taragano, 2007](#); [Lyketsos et al., 2002](#)). Depression has been extensively studied as a possible risk factor or predictor of MCI ([Enache, Winblad & Aarsland, 2011](#); [Monastero, Mangialasche, Camarda, Ercolani & Camarda, 2009](#); [van der Linde et al., 2013](#)). Other studies reported that irritability, depression, and anxiety are also frequent ([Serrano et al., 2007, 2014](#); [Serrano, Dillon, Taragano & Allegri, 2013](#)), and delusions, hallucinations, and sleep disturbances ([Taragano et al., 2009](#)).

Personality is a unique and enduring set of characteristics that can change in response to different situations. For which enduring personal traits, changing aspects, and the constant interaction between them are simultaneously considered ([Schultz, & Schultz, 2010](#)).

Several models of personality have been proposed throughout history; however, in this study, we focus on the five-factor theory proposed by Robert McCrae and Paul Costa, who argue that personality traits can be described in relation to five basic dimensions called Neuroticism (N), Extraversion (E), Openness to experience (O), Agreeableness (A) and Conscientiousness (C) ([McCrae & Costa, 1997](#)).

The latest lines of dementia research focus on being able to detect the disease in its initial stages, trying to establish those factors or variables that can act as predictors of cognitive impairment and evolution to dementia. In this way, advanced

age, low levels of education, physical inactivity, social isolation, lack of work activity, and vascular risk factors such as high blood pressure, diabetes, and smoking, among others, have emerged as risk factors.

However, there are few papers on personality changes throughout the cognitive impairment process from MCI and whether any personality trait present in a healthy adult could be considered a predictor of a particular subtype of cognitive impairment.

A 2011 review of extant literature posits that people with Alzheimer's disease frequently exhibit lower scores in the domains of Openness to Experience, Extraversion, and Conscientiousness when compared to age-matched controls (Robins Wahlin, & Byrne, 2011). It seems that subjects change negatively concerning their own style but still retain the distinctive personality that differentiates them from other subjects, which would go against the idea of a universal Alzheimer's personality (Balsis, Carpenter & Storandt, 2005).

The high incidence of personality changes in Alzheimer's disease (AD) and mild cognitive impairment (MCI) suggests that these changes may serve as early markers for these conditions. Additionally, research has indicated a correlation between heightened neuroticism and an elevated risk of cognitive decline. Furthermore, recent evidence suggests that premorbid personality traits may serve as a predictor of specific behavioral and psychological symptoms of dementia (Robins Wahlin, & Byrne, 2011). Follow-up studies in healthy control subjects and patients with MCI allow us to understand the risk factors for cognitive impairment associated with personality, and the association between cognitive and non-cognitive signs and the symptoms of different types of cognitive disorders in the elderly. When studying patients with MCI and healthy normal control groups, the MCI group scored significantly lower on Openness to experience, agreeableness, and conscientiousness. Subjects diagnosed with MCI exhibited notable shifts in personality, characterized by an increase in neuroticism and a decrease in extraversion and conscientiousness, over a period of five years. Conversely, openness to experience and agreeableness demonstrate stability. In contrast, the control group exhibited no significant alterations in personality traits over the course of the study (Mendez Rubio, Antonietti, Donati, Rossier & von Gunten, 2013).

In 2005, Seiffer studied the relationship between levels of conscientiousness and disease awareness in subjects with dementia. Their results concluded that higher levels of conscientiousness, understood as the ability to organize, persist, and control tasks, and motivation in goal-directed behavior, were associated with a lower awareness of their level of functioning, following certain authors who propose that subjects with high rates of conscientiousness, efficient and well organized, have a tendency to experience the pathology with large amounts of distress and this would lead to launch a defense and thereby decrease their awareness of the disease (Seiffer, Clare & Harvey, 2005).

However, other researchers studied patients with MCI and dementia, and they found a protective association between the conscientiousness facet and cognitive

status in both groups. In elderly populations, for instance, conscientiousness has been linked to reduced cognitive impairment and function as a protective factor against Alzheimer's disease (AD) and other dementias. In diverse populations, taking into account a range of personality metrics and variations in follow-up periods, conscientiousness has been shown to be a consistent protective factor against dementia. The findings indicate that individuals who perceive themselves as adept at regulating their behaviors and exert considerable effort in their endeavors demonstrate a reduced likelihood of developing dementia and MCI. These associations persist even when controlling for sociodemographic characteristics, clinical and behavioral risk factors, and a shared genetic risk factor, specifically the APOE genotype. This research suggests that, in addition to genetic, clinical, and behavioral risk factors, specific aspects of an individual's personality traits can predict the risk of mild and severe cognitive impairment in advanced adulthood (Sutin, Stephan & Terracciano, 2018).

Terracciano and his team have worked on several studies on the role of personality in AD (Stephan, Sutin & Terracciano, 2014). In 2014, they published a study in which they found that for each increase in standard deviation in neuroticism, the risk of Alzheimer's disease (AD) increased by more than 30%. The researchers then compared the groups with high and low scores in neuroticism and found that the risk of incident AD was three times higher for the group in the highest quartile compared to the lowest quartile for neuroticism. A similar effect for liability was observed, with the risk of incident AD being three times higher for the group in the lowest quartile than for the highest quartile (Terracciano et al., 2014). In 2018, the researchers performed group and individual longitudinal analyses of the five principal dimensions of personality, evaluated on two occasions over a period of four years. These analyses suggested that personality stability decreased progressively with advancing age. This decline in stability among the older age groups was accompanied by a pattern of increasing prevalence of cognitive impairment within these same age groups. Among individuals without cognitive impairment or dementia, no association was observed between age and stability. These findings imply that the diminished personality stability observed in older adults is not merely a consequence of aging but rather is attributable to cognitive decline and dementia (Terracciano, Stephan, Luchetti & Sutin, 2018). This team of researchers investigated the relationship variables between sensory function, personality, and older adulthood over a period of four years. Their findings indicated that sensory functioning was a more significant predictor of personality change than the burden of disease or depressive symptoms. The study's findings, substantiated by evidence that declining sensory function and worsening sensory function compromise individuals' interactions with the social and physical environment, indicate that deficits in hearing and vision are associated with maladaptive personality trajectories in older adults (Stephan, Sutin, Bosselut & Terracciano, 2017).

In 2019, the Terracciano team published an article about the five-factor model of personality and its relationship with five cognitive domains. The present study sought to ascertain the relationship between neuroticism and cognitive performance. The findings indicated that individuals with a higher degree of neuroticism demonstrated poorer performance on all cognitive tasks. Conversely, conscientiousness was associated with superior performance in all five cognitive domains, although not uniformly across all tasks. Conversely, openness to experience and agreeableness were associated with superior performance in all domains except numerical reasoning. Extraversion was associated with enhanced processing speed, attention, executive functioning, and fluency. The study found no substantial evidence that the association between personality and cognition was influenced by sociodemographic characteristics or global cognitive function. Extraversion was the only trait with specific domain associations (Sutin, Stephan, Luchetti, & Terracciano, 2019).

Objectives: To describe and compare the relationship between personality traits in healthy control subjects and subjects with MCI, detect personality traits in subjects with cognitive impairment, identify relationships between personality traits in the three subgroups studied (healthy control subjects, subjects with MCI prior to the onset of the disease and diagnosed MCI), describe and identify relationships between personality factors, mood, behavioral symptoms, and functionality of the normal population and subjects with cognitive impairment.

MATERIAL AND METHODS

This is a cross-sectional, descriptive, observational, correlational study without therapeutic intervention. Seventy-eight subjects between fifty-three and ninety-three years of age were evaluated. Among them, thirty-eight subjects presented a diagnosis of MCI and attended the Memory Center of the Hospital Abel Zubizarreta, Buenos Aires, and the Cognitive Neurosciences Unit of the Trinidad Mitre Clinic for evaluation. A total of forty healthy control subjects were also evaluated. These subjects were randomly selected and were cognitively and psychiatrically asymptomatic. The tests were administered by a specialized neuropsychologist trained for the administration of the chosen neurocognitive and neuropsychiatric battery.

The sample consisted of thirty-four men (43.59%) and forty-four women (56.41%). They were matched by age and educational level. The exclusion criteria were age <21 years; Beck >15; history of major psychiatric disease; drug or alcohol abuse; head trauma with loss of consciousness; or systemic diseases that may affect intellectual performance.

Inclusion criteria for the sample subjects with MCI

- Subjects \geq 21 years of age
- Patients with mild cognitive impairment are diagnosed by neurologists and objectified by neuropsychological evaluation.

- Have a complete neuropsychological evaluation. If it does not have it, a battery is administered at the time of the consultation.

Measuring Instruments

A semi-structured interview was conducted to collect sociodemographic data and medical history. Scales were applied to patients and informants (family members/caregivers) to know the subject's behavioral, mood, and functionality characteristics at the time of the interview.

Family member/Caregiver

- Neuropsychiatric Inventory (NPI) (Cummings et al., 1994)
- Instrumental Activities of Daily Living (Lawton & Brody, 1969)
- NEO Five-Factor Inventory (NEO-FFI) (Costa & McCrae, 1999) (relatives of patients only)

Patient and Healthy controls

- Beck Depression Inventory (BDI) (Beck, Ward, Mendelson, Mock & Erbaugh, 1961)
- NEO Five-Factor Inventory (NEO-FFI) (Costa & McCrae, 1999)

Assessment of personality traits

Personality characteristics and dimensions were assessed during evaluation using the reduced version of neo-PI R (NEO – FFI). Participants (healthy control subjects and subjects with MCI) were asked to complete the 60-item self-report version of the NEO-FFI questionnaire using a five-point Likert scale (Costa & McCrae, 1999). Informants were asked to think of the participants as they were before the onset of cognitive decline. The NEO-FFI is a self-reported, self-report-based measure of personality. Scores range from 25 to 75 for each domain. Higher scores indicate higher ranks in the domain.

- Neuroticism: Values adjustment vs. emotional mismatch (anxiety, hostility, depression, shyness, impulsivity, vulnerability).
- Extraversion: Measures the amount and intensity of interpersonal relationships, the tendency to cordiality, gregariousness, assertiveness, activity, search for excitement, and positive emotions.
- Openness to experience: Measures the breadth and variety of interests, as well as the intensity of emotional life (fantasy, aesthetics, feelings, actions, ideas, and values).
- Agreeableness: Measures the quality of interpersonal relationships (trust, openness to experience, altruism, conciliatory attitude, modesty, and sensitivity).
- Conscientiousness: Associated with self-regulation, planning and execution of tasks (competence, order, sense of duty, need for achievement, self-discipline, and deliberation).

Evaluation of behavioral symptoms: Neuropsychiatric Inventory (Cummings et al., 1994), Self-administered depression scale (Beck et al., 1961).

Functional assessment: Instrumental Activities of Daily Living (Lawton & Brody, 1969).

Neuropsychological Evaluation: Mini-Mental State Examination (Folstein, Folstein & McHugh, 1975), Direct and Inverse Digit Span (WASI III) (Wechsler, 1988), Boston Naming Test (Kaplan, Goodglass & Weintraub, 1986), Verbal Fluency Test (Benton, 1968), Clock Test (Freedman et al., 1994), Subtest of the Signoret Mnesic Efficiency Battery (Signoret & Whiteley, 1979) adaptation in Buenos Aires (Leis et al., 2018), Trail Making Tests: Part A (Reitan, 1958).

Ethical Collections: All clinical work was subject to the ICH Rules of Good Clinical Practice, the review of the Helsinki declarations (World Medical Association, 2013), and the regulations of the GCBA Health Authorities. The researchers involved knew and carried out the safeguards provided for in all the ethical, legal, and legal requirements established in the national bioethics standards – ANMAT Provision 5330/97 – and international – Nuremberg Code, Helsinki Declaration and its modifications (last modified – Fortaleza, 2013); as well as the Universal Declaration on the human genome and human rights adopted by the General Conference of UNESCO on 11/11/1997.

Informed Consent: All subjects who participated in this study were provided with an informative text, which was explained by the evaluator. It answered all the questions that were asked by the study subjects. After this step, the signature of the patient and family member was requested, accepting the conditions of the study. (See annex)

Statistical analysis: The data obtained from the control cases and patients with MCI were uploaded to an Excel spreadsheet. The IBM SPSS Statistics V.17.0 statistical package was then used to perform the statistical examination, and the R Project for Statistical Computing for the graphs of relationships between personality traits. Descriptive data from the control group and group of patients with MCI were analyzed. Mixed linear models were applied to study differences in the five personality factors between healthy controls, patients with MCI before the onset of the disease, and patients with current MCI. The normality of the errors was studied with the Shapiro-Wilks test, and the homoscedasticity with the Levene test. The comparison between the three groups was made using the Tukey test. Pearson's correlation coefficient was used to know the relationship between the variables of neurocognitive evaluation, neuropsychiatric scale, functional scales, and NEO-FFI personality scale with its sub-components of neuroticism, extraversion, Openness

to experience, agreeableness, and conscientiousness current and prior to the development of cognitive impairment. The association between personality traits and performance variables was estimated using Pearson's correlation coefficient, stratified according to condition (healthy or pathological). SC (Behavioral Symptoms) was created as the number of pathological behavioral events (score ≥ 1) on the NPI scale.

RESULTS

Sociodemographic data, neuropsychological variables, and mood at the time of the intervention are presented in Table 1. Concerning demographic factors, there were no significant differences in age ($p = 0.745$) or educational level ($p = 0.159$). The same number of men were in the healthy control group and subjects with MCI ($n = 17$). Subjects with MCI had depression scores higher than healthy controls in the Beck Depression Inventory, although all were below 15 points on the total scale ($p = 0.005$). There were no significant differences in the cognitive performance of direct Span ($p = 0.321$) or inverse Span ($p = 0.202$) between healthy controls and subjects with MCI. However, significant differences were evidenced in verbal memory (immediate and delayed free verbal logical memory recall, serial learning, serial recall, memory recall with semantic keys and recognition of a list of words, $p < 0.01$), language (Boston Vocabulary Test and Semantic Fluency, $p < 0.01$), visuo-constructive skills (Clock Test, $p < 0.01$), executive functions (TMTb and Phonological Fluency, $p < 0.01$) and TMTa ($p = 0.045$) between both groups. Unsurprisingly, significant differences were found in tests that assessed global mental state (MMSE, $p < 0.01$). Although significant differences are evidenced in the total scores obtained on the scale of instrumental activities of daily living ($p < 0.01$), they indicate independence in both groups.

Table 1. Sociodemographic Data and Neuropsychological Variables

	Healthy Controls (n = 40)		MCI (n = 38)		p*
	Media	(ds)	Media	(ds)	
Age	74,78	9,13	75,42	8,34	0,745
Men %	42,50%		44,73%		
Education	10,55	3,94	9,26	4,04	0,159
MMSE	28,85	1,08	24,39	3,59	$p < 0,01$
AIVD	0,10	0,30	1,68	1,93	$p < 0,01$
Beck Depression Inventory	5,60	3,87	9,74	8,06	$p < 0,01$
Immediate VLM recall	7,16	2,63	3,46	2,20	$p < 0,01$
Delayed VLM recall	6,88	2,52	2,56	2,58	$p < 0,01$
Serial Learning	7,65	1,87	5,68	1,81	$p < 0,01$
Serial Memory recall	5,97	2,15	2,20	2,67	$p < 0,01$
Recall with Semantic Keys	9,17	2,14	5,04	3,76	$p < 0,01$
Recognition	10,70	1,81	8,56	2,70	$p < 0,01$
Direct Digits	4,98	1,29	4,69	1,14	0,321

TMTa	68,33	39,02	93,54	66,91	0,045
TMTb	171,50	90,54	297,56	131,48	p < 0,01
Inverse Digits	3,70	1,15	3,37	1,03	0,202
Phonological Fluency	14,25	5,30	9,97	4,10	p < 0,01
Semantic Fluency	17,78	5,16	11,70	4,99	p < 0,01
Boston Vocabulary Test	51,53	5,39	37,24	11,03	p < 0,01
Clock Test	6,53	0,96	4,89	2,39	p < 0,01

* p is significant at the level < 0.050. ds: standard detour. MCI: mild cognitive impairment.

MMSE: Mini Mental State Examination. VLM: Verbal Logic Memory. TMT: Trail making test. AIVD: Instrumental activities of daily living

The differences in the five personality factors between healthy controls, patients with MCI before the onset of pathology, and patients with current MCI are described below. Patients were included as a random factor to consider the lack of independence between previous and current observations. Models including age and gender were run as covariates. Since these variables were not significant in any case and the results did not vary in significance, only models without covariates are presented. The results showed marginal differences in the neuroticism variable between healthy controls and subjects with current MCI, the latter being the ones who scored the lowest in this trait and the healthy controls who scored higher in neuroticism (p=0.05).

On the other hand, the extraversion variable presents significant statistical differences between the previous and current scores of the MCI with a decrease in the trait over time (p=0.025) and leaving the subjects healthy controls with intermediate values between both groups with MCI. Finally, the three groups studied present differences between themselves in the trait of agreeableness, with the highest values in the current MCI group and the lowest in the group of healthy controls (p < 0.01). The rest of the domains showed no significant differences in the previous and current instances of the subjects with MCI or concerning the group of healthy controls (Table 2).

Table 2. Mixed linear models of the NEO - FFI Scale between Healthy Control Subjects Vs. previous MCI Vs. Current MCI

Five-Factors of the NEO Scale - FFI	Healthy Controls (n = 40)		MCI previous (n = 38)		MCI current (n = 38)		p*
	Media	Ds	Media	Ds	Media	Ds	
	Neuroticism	22,10	A 1,17	20,20	AB 1,20	17,90	
Extroversion	28,50	AB 1,08	30,90	A 1,11	27,50	B 1,11	0,025
Openness to experience	25,53	A 1,08	22,80	A 1,10	24,00	A 1,10	0,217
Agreeableness	24,10	A 1,10	30,10	B 1,13	34,90	C 1,13	p < 0,01
Conscientiousness	31,30	A 1,06	32,80	A 1,09	33,9	A 1,09	0,245

* p is significant at the level < 0.05. The equal letters indicate no differences between the subgroups (p>0.05). ds: standard detour. MCI: mild cognitive impairment.

When the correlations obtained between the neuropsychological variables and the five personality factors evaluated using the NEO – FFI scale administered to subjects with MCI were investigated, it was found that the current neuroticism scores positively and significantly correlated clock test ($p < 0.05$) and Boston naming test ($p < 0.05$); the current Openness to experience scores correlated significantly and positively with key recall ($p < 0.05$); the values of current extraversion with deferred recall of a list of words ($p < 0.05$); finally, the values of current conscientiousness correlated negatively with the TMTa ($p < 0.01$) measured by the number of seconds used to run the test.

By correlating the scores obtained on the NEO-FFI scale answered by relatives of patients who later developed MCI, it was found that the agreeableness scores reported by an informant correlated negatively with the performance in the delayed recall of the CVLT ($p < 0.01$) (Table 3).

Table 3. Correlation between neuropsychological variables and the Five Factors of previous and current personality of patients with MCI

NPS's Variables	Neuroticism a		Neuroticism p		Extroversion a		Extroversion p		Openness a		Openness p		Agreeableness a		Agreeableness p		Conscientiousness a		Conscientiousness p	
	Corr. Pearson	p	Corr. Pearson	p	Corr. Pearson	p	Corr. Pearson	p	Corr. Pearson	p	Corr. Pearson	p	Corr. Pearson	p	Corr. Pearson	p	Corr. Pearson	p	Corr. Pearson	p
MMSE	0,316	0,054	0,086	0,609	-0,144	0,390	0,103	0,538	0,199	0,232	-0,011	0,950	-0,135	0,419	0,021	0,898	0,209	0,207	0,177	0,289
Immediate Verbal Logic Memory	0,008	0,965	0,159	0,401	-0,096	0,614	0,048	0,802	0,052	0,786	-0,139	0,464	-0,257	0,171	-0,185	0,329	0,159	0,402	0,136	0,464
Deferred Verbal Logic Memory	0,108	0,569	0,220	0,243	-0,134	0,481	-0,144	0,449	0,103	0,588	-0,161	0,396	-0,059	0,757	-0,185	0,328	0,015	0,939	0,134	0,474
Learning (Z score)	0,005	0,978	-0,089	0,627	0,107	0,559	0,077	0,674	0,303	0,092	0,233	0,199	-0,089	0,626	0,015	0,936	0,331	0,064	0,130	0,480
Immediate Recall (Z score)	0,204	0,263	-0,054	0,767	0,140	0,445	0,102	0,580	0,176	0,335	0,077	0,677	-0,280	0,121	-0,136	0,459	0,282	0,118	-0,034	0,852
CVLT Deferred Memory	-0,229	0,622	0,361	0,426	0,864*	0,012	0,285	0,536	0,706	0,076	0,316	0,490	0,551	0,200	-0,895**	0,0064	0,220	0,635	-0,119	0,799
Signoret Semantic Keys	0,239	0,250	-0,044	0,834	0,123	0,557	0,049	0,817	0,412*	0,041	0,087	0,680	-0,060	0,777	0,227	0,276	0,385	0,058	-0,007	0,974
Signoret Recognition	0,371	0,068	-0,054	0,797	-0,038	0,857	-0,031	0,884	0,315	0,125	0,056	0,792	-0,083	0,694	0,297	0,150	0,361	0,076	0,238	0,252
Naming	0,399*	0,014	0,092	0,587	-0,092	0,587	0,239	0,154	0,150	0,376	-0,113	0,506	-0,186	0,270	0,039	0,818	0,238	0,157	0,245	0,144
Semantic Fluency	0,265	0,112	0,229	0,174	-0,048	0,777	0,012	0,946	0,194	0,250	0,041	0,809	-0,214	0,203	-0,166	0,325	0,282	0,091	0,047	0,781
Phonological Fluency	0,260	0,119	0,009	0,958	0,111	0,515	0,268	0,109	0,286	0,087	0,130	0,444	0,081	0,634	-0,059	0,728	0,111	0,513	0,165	0,330
Clock test	0,342*	0,041	0,144	0,403	-0,069	0,687	0,063	0,715	0,326	0,052	0,188	0,271	-0,178	0,299	-0,004	0,980	0,092	0,595	-0,046	0,788
Direct Span	0,077	0,654	-0,151	0,380	0,180	0,294	0,276	0,104	0,304	0,071	0,068	0,692	-0,117	0,495	-0,030	0,863	0,161	0,350	0,156	0,364
Reverse Span	0,204	0,240	0,019	0,915	-0,266	0,123	0,020	0,907	0,030	0,865	-0,109	0,532	-0,024	0,889	-0,084	0,631	0,067	0,703	0,212	0,220
Trail making A	-0,082	0,628	-0,107	0,528	-0,140	0,407	-0,105	0,535	-0,094	0,581	0,132	0,437	0,082	0,629	0,284	0,088	-0,431**	0,008	-0,104	0,539
Trail making B	-0,081	0,688	-0,050	0,805	0,077	0,704	-0,140	0,486	0,117	0,561	-0,074	0,713	0,058	0,775	0,325	0,099	-0,175	0,383	-0,106	0,597

MCI: Mild Cognitive Impairment; MMSE: Mini Mental State Examination; * p<0,05; **p<0,01; Pearson's correlation. the p-value is significant at level < 0,05 ; (p): previous; (a): current

Personality trait a: current y p: previous

Finally, the results of the previous and current NEO – FFI scales were correlated to know if there was a relationship between the scores obtained in the different periods. They showed significant positive correlations between the previous and current extraversion scores ($r = 0.430$, $p < 0.01$) and between previous and current opening ($r = 0.347$, $p = 0.033$). (Table 4).

Table 4. Correlation between previous and current scores of the 5 factors of the NEO-FFI Scale in patients with MCI

	N (p)	N (a)	E (p)	E (a)	O(p)	O (a)	A (p)	A (a)	C (p)	C (a)										
N (p)	1,000	--	0,196	0,238	-0,206	0,214	0,125	0,456	0,144	0,390	-0,056	0,737	-0,144	0,389	0,055	0,745	-0,209	0,208	0,011	0,949
N (a)	0,196	0,238	1,000	--	-0,035	0,834	-0,152	0,362	-0,027	0,870	-0,136	0,416	-0,038	0,821	-0,517	0,001	-0,120	0,472	-0,324	0,048
E (p)	-0,206	0,214	-0,035	0,834	1,000	--	0,430	0,007	0,465	0,003	0,178	0,285	0,373	0,021	-0,079	0,636	0,209	0,208	-0,256	0,120
E (a)	0,125	0,456	-0,152	0,362	0,430	0,007	1,000	--	0,278	0,091	0,311	0,057	0,065	0,700	0,255	0,122	-0,151	0,364	0,203	0,223
O (p)	0,144	0,390	-0,027	0,870	0,465	0,003	0,278	0,091	1,000	--	0,347	0,033	0,024	0,888	0,107	0,521	0,243	0,142	-0,103	0,537
O (a)	-0,056	0,737	-0,136	0,416	0,178	0,285	0,311	0,057	0,347	0,033	1,000	--	0,010	0,951	0,107	0,523	0,030	0,857	0,106	0,527
A (p)	-0,144	0,389	-0,038	0,821	0,373	0,021	0,065	0,700	0,024	0,888	0,010	0,951	1,000	--	0,127	0,447	0,047	0,777	-0,028	0,869
A (a)	0,055	0,745	-0,517	0,001	-0,079	0,636	0,255	0,122	0,107	0,521	0,107	0,523	0,127	0,447	1,000	--	0,001	0,996	0,278	0,091
C (p)	-0,209	0,208	-0,120	0,472	0,209	0,208	-0,151	0,364	0,243	0,142	0,030	0,857	0,047	0,777	0,001	0,996	1,000	--	0,097	0,564
C (a)	0,011	0,949	-0,324	0,048	-0,256	0,120	0,203	0,223	-0,103	0,537	0,106	0,527	-0,028	0,869	0,278	0,091	0,097	0,564	1,000	--

N: neuroticism, E: extraversion, O: openness to experience, A: agreeableness, C: conscientiousness; MCI: Mild Cognitive Impairment; MMSE: Mini Mental State Examination; r: Spearman's correlation; * the p-value is significant at level $< 0,05$; (p): previous; (a): current

We investigated the relationship between the personality traits of the healthy controls and the scores obtained by the subjects with previous MCI to know if there was a differential pattern between the healthy control subjects and those who evolved to MCI and found that the healthy control subjects presented a positive relationship between pairs of variables (neuroticism and the rest of the aspects of personality, and between agreeableness and conscientiousness). However, the previous MCI group showed no relationship between such traits. (Figure 1)

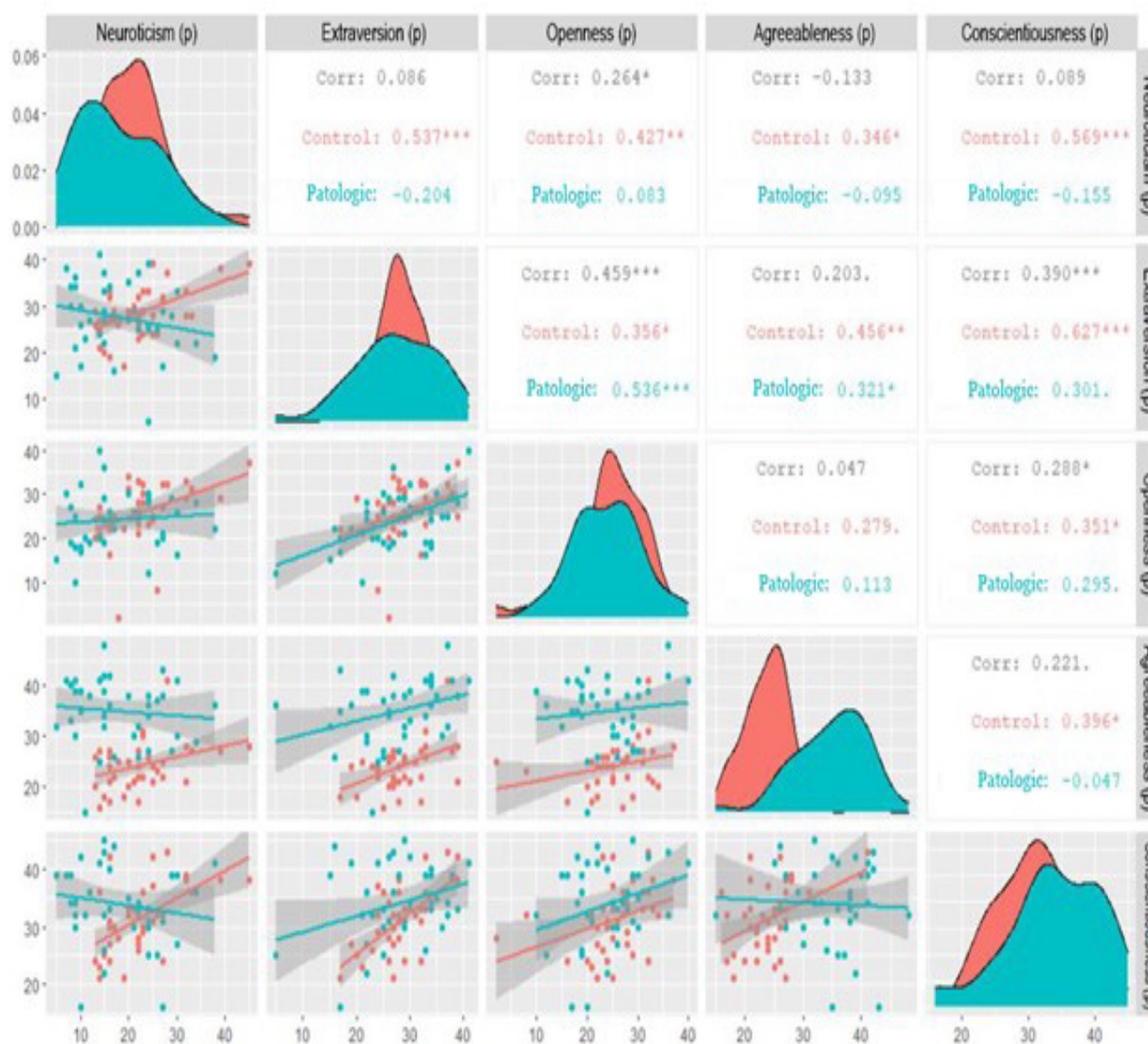


Figure 1. Relationship between the personality traits of healthy control subjects and MCI prior to the manifestation of cognitive pathology

The relationship between personality traits prior to cognitive decline and current behavioral variables was investigated. BS (Behavioral Symptoms) was created as the number of pathological behavioral events in the NPI inventory (score ≥ 1) and shows that neuroticism is directly associated with current depression and activities of total daily living (AIVD Lawton Scale). On the other hand, extraversion is inversely associated with depression (Beck Depression Inventory). These findings indicate a relationship between previous levels of personality, when neurocognitive pathology was not yet manifest, and current behavioral symptomatology. (Figure 2 and Table 5)

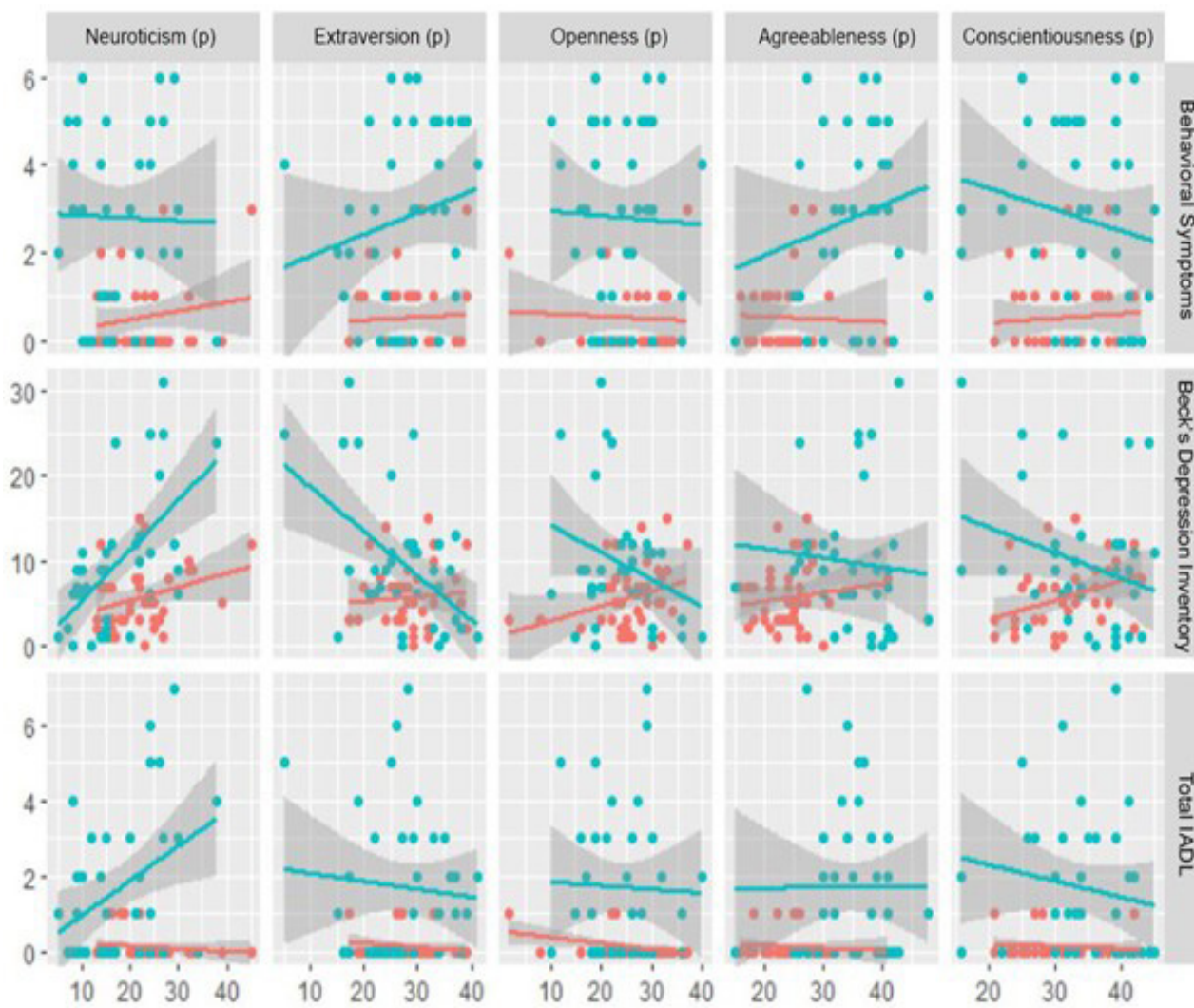


Figure 2. Relationship between the personality traits of MCI prior to the manifestation of cognitive pathology and current behavioral variables.

Neuroticism (p)	Extraversion (p)	Openness (p)	Agreeableness (p)	Conscientiousness (p)	
Corr: -0.153	Corr: 0.082	Corr: -0.059	Corr: 0.490***	Corr: 0.033	Behavioral Symptoms
Control: 0.174	Control: 0.043	Control: -0.046	Control: -0.035	Control: 0.076	
Pathologic: -0.023	Pathologic: 0.185	Pathologic: -0.033	Pathologic: 0.173	Pathologic: -0.169	
Corr: 0.338**	Corr: -0.364**	Corr: -0.111	Corr: 0.204	Corr: -0.020	Beck's Depression Inventory
Control: 0.293	Control: 0.069	Control: 0.297	Control: 0.120	Control: 0.352*	
Pathologic: 0.597***	Pathologic: -0.505**	Pathologic: -0.273	Pathologic: -0.097	Pathologic: -0.278	
Corr: 0.101	Corr: -0.114	Corr: -0.112	Corr: 0.353**	Corr: -0.013	Total IADL
Control: -0.169	Control: -0.183	Control: -0.350*	Control: -0.101	Control: -0.106	
Pathologic: 0.399*	Pathologic: -0.085	Pathologic: -0.033	Pathologic: 0.006	Pathologic: -0.161	

Table 5. Correlation values between the personality traits of MCI prior to the manifestation of cognitive pathology and current behavioral variables

A Pearson correlation was performed to know if there was a relationship between the difference in personality traits (current - previous) and behavioral symptoms and functionality. Agreeableness was found to increase in MCI, although it was already higher than the values of healthy controls, and this difference in trait is inversely related to behavioral symptoms. Thus, a decrease in agreeableness (current - previous) is associated with more behavioral symptoms. A similar association, though milder, lies in the trait of conscientiousness. On the other hand, the more significant the increase in neuroticism is, the more behavioral symptoms are observed. (Figure 3 and Table 6).

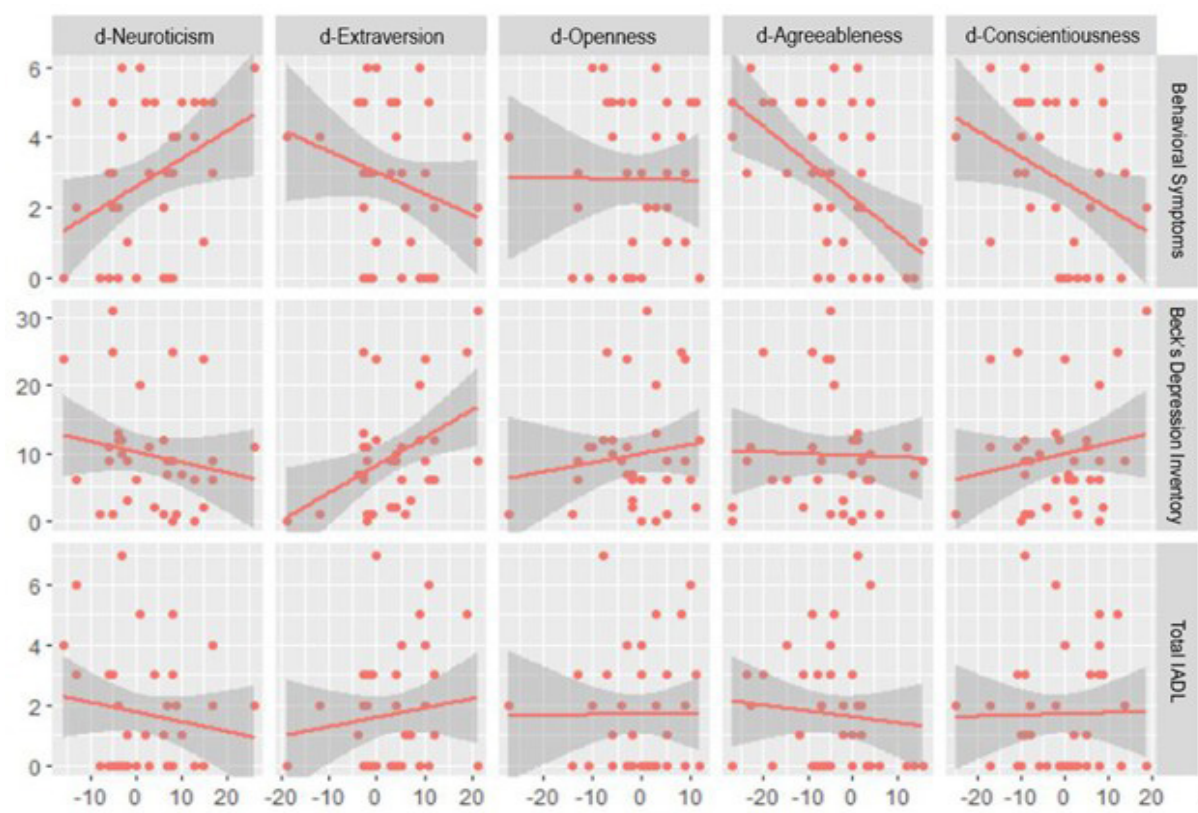


Figure 3. Relationship between the difference in personality traits (current - previous) and behavioral symptoms and functionality

Table 6. Pearson correlation coefficients between the existing difference in personality traits (current - previous) and behavioral symptoms and functionality.

Personality Traits	BS	BDI	AIVD Total
d-Neuroticism	0,36*	-0,18	-0,16
d-Extroversion	-0,24	0,43*	0,13
d-Openness to experience	-0,01	0,14	0,00
d-Agreeableness	-0,51*	-0,03	-0,10
d-Conscientiousness	-0,34*	0,18	0,02

d: difference, BS: behavioral symptoms, BDI: Beck Depression Inventory, AIVD: instrumental activities of daily living. *p<0.05

A canonical correlation analysis was performed to observe what happened when multivariate combinations were correlated. On the one hand, the differences obtained between previous and current personality traits were combined. On the other hand, behavioral variables, depressive symptoms, functional autonomy, and amnesic performance were combined, finding a marginally significant correlation ($r = 0.75$ and $p = 0.06$) in which an increase in the differences of the neuroticism trait, combined with a decrease in the differences in the traits of extraversion and agreeableness, are associated with an increase in behavioral symptoms and decreased recognition scores from a list of words. (Table 7). We can infer that this combination of personality traits would be characteristic of subjects with more significant behavioral and cognitive impairment.

Table 7. Canonical correlation between NEO-FFI and behavioral and performance variables

		Correlation coefficient	0,753
		Significance value p	0,064
Predictor variables	d_Neuroticism		0,555
	d_Extraversion		-0,444
	d_Openness to experience		-0,073
	d_Agreeableness		-0,597
	d_Conscientiousness		-0,296
	Behavioral symptoms		0,696
	Beck Depression Inventory		-0,227
Response variables	Functional autonomy		-0,069
	Immediate logical memory		-0,066
	Deferred logical memory		0,195
	Learning		-0,053
	Immediate memory		-0,144
	Recognition		-0,468

d: difference between current and previous values of personality traits.

Finally, a comparison was made between the gender of the study subjects and the values of the NEO FFI. There were no significant differences between men and women in the different traits; however, if we compared intragroup, we found that women had a significant decrease in extraversion ($p < 0.01$) and an increase in agreeableness over time ($p < 0.01$). (Table 8).

Table 8. Comparison over time of personality traits by gender

NEO FEE	Women			Men		
	Media	Ds	P*	Media	Ds	P*
Previous neuroticism	22,25	7,586	0,128	19,74	5,770	0,752
Current neuroticism	20,61	8,497		19,38	7,220	
Previous extraversion	30,75	6,613	0,008	28,29	6,206	0,595
Current extraversion	28,18	7,121		27,76	5,784	

Previous openness	24,14	7,258	0,525	24,29	6,762	0,521
Current openness	24,64	7,160		25,00	5,841	
Previous agreeableness	26,18	7,650	0,005	28,06	7,843	0,601
Current agreeableness	29,89	7,662		28,65	7,831	
Previous conscientiousness	32,09	5,953	0,782	31,91	7,213	0,189
Current conscientiousness	31,82	6,402		33,50	6,783	

ds: standard deviation; *the p is significant at the <0.05 level

DISCUSSION AND CONCLUSIONS

Longitudinal studies indicate that personality undergoes general patterns of change with the progression of age. Neuroticism, Openness to Experience, and Extraversion have been shown to decline over the course of life, with some studies indicating that Extraversion remains relatively stable. Conversely, agreeableness and conscientiousness exhibit an upward trend during the course of development. Specifically, conscientiousness levels tend to rise, particularly during early adulthood, presumably in response to new roles and demands (Leszko, Elleman, Bastarache, Graham & Mroczek, 2016). Although these patterns are expected in healthy control subjects, another type of performance is found in subjects with MCI, with lower values in Openness to experience, agreeableness, and conscientiousness concerning healthy control subjects (Mendez Rubio, Antonietti, Donati, Rossier, & von Gunten, 2013).

In our study, agreeableness values were significantly higher in MCI patients than in healthy control subjects, increasing slightly in patients with mild cognitive impairment over time. Although neuroticism tends to decrease in healthy control subjects over time, we have found significant differences concerning subjects with MCI, the latter being those who present lower values in this trait. On the other hand, it seems that subjects with a posteriori develop cognitive pathology already present previous alterations in the relationships between personality traits that differ from those found in healthy control subjects. We have found that subjects with MCI do not present in stages prior to the manifestation of neurocognitive pathology relationship between neuroticism and other personality traits, while healthy controls present a relationship between neuroticism and all the rest of the traits described.

Rebecca Hock et al. studied a group of 561 young adults with an average age of 45. They found that each 10-point increase in neuroticism T scores was associated with a 0.15-point decrease in MMSE scores. In contrast, each 10-point increase in conscientiousness T scores was associated with a 0.18-point increase in MMSE and a 0.21 increase in immediate recall between initiation and patient follow-up in Baltimore. The findings suggest that increased neuroticism is associated with decreased overall cognitive function, while greater conscientiousness is associated with improved immediate recall and overall cognition. On the other hand, higher scores on agreeableness were associated with improved deferred recall. While they had no other significant findings, they suggest that neuroticism predicts cognitive decline

while extraversion, Openness to experience, agreeableness, and conscientiousness would predict stability or cognitive improvements (Hock et al., 2014). About these results, we observed that in our study, the findings are dissimilar, finding a positive correlation between the scores of current neuroticism and a naming test by visual confrontation and a visuo-construction test; on the other hand, high values in current aperture correlated positively and significantly with better performance in memory recall with semantic facilitation; high values in extraversion correlates positively with delayed recall of a word list and current conscientiousness with an attentional sustainability test. These results would indicate that subjects with a personal inclination to experience and appreciate new situations and thoughts with a curious, imaginative, and creative attitude, proactive behaviors, and actions to explore and experiment beyond habits and routines would be associated with better cognitive performance. As in Hock's study, extraversion, openness to experience, and conscientiousness indicate some stability of neuropsychological variables. However, the high values in neuroticism would indicate in our study a better performance of language and visual construction in contrast to this and other studies.

Srivastava studied the changes of the five major personality factors, differentiating the changes in men and women. The findings indicated that individuals' conscientiousness levels remained relatively stable after the age of 30, exhibiting minimal change in comparison to their younger years. However, it should be noted that this stability does not imply stagnation, as the study revealed a continuous process of change. Conversely, agreeableness exhibited a substantial increase from age 31 to 60, a development that was observed across both male and female subjects. Conversely, neuroticism exhibited divergent patterns across genders, yielding distinct results for both men and women. The men did not show a significant age effect at any age period. Women, however, consistently declined in neuroticism. The analysis revealed a marked negative trend in the opening slopes of both men and women after the age of 30. For men, the decline after age 30 exhibited a greater magnitude than the increase until age 30. Conversely, for women, the decline after age 30 did not differ significantly from the magnitude of the increase until age 30. A significant decrease in extraversion was observed from age 31 to 60 for women, while the increase for men from age 31 to 60 was weak and barely significant.

In summary, conscientiousness exhibited an increase across the age range studied, with the most pronounced growth occurring during the 20s; agreeableness demonstrated its most significant increase during the 30s, while neuroticism exhibited a decline with age for women but not for men. Openness to experience demonstrated modest declines with age, while extraversion exhibited a decrease among women but not among men (Srivastava, John, Gosling & Potter, 2003). We can observe that following this group of healthy controls studied over time, the women evaluated in our sample presented a decrease in extraversion values and an increase in agreeableness over time. Likewise, patients with MCI presented

increasing values of agreeableness, a common denominator concerning the expected development for the general population.

Extraversion is comprised of two components: social domination and social vitality. These components demonstrate distinctly different maturation patterns. Social domination reflects traits such as dominance, independence, and self-confidence, especially in social contexts. Conversely, social vitality is associated with traits such as sociability, positive affect, gregariousness, and energy level. According to Helson and Kwan's comprehensive review, individuals typically exhibit an increase in social dominance, while measures of social vitality demonstrate a decline with advancing age (Roberts et al., 2006). About this finding in our study, we found that subjects who, prior to the onset of the pathology, had higher scores in extraversion; after the development of MCI, the scores in depressive traits were lower.

Although the present study was the creation of several years of work, we found a series of limitations concerning sample size, considering that a greater number of subjects could provide us with more significant statistical values.

On the other hand, a long-term follow-up of our subjects with MCI would allow us to separate those subjects who evolved into a demented picture from those who maintain mild cognitive impairment.

Regarding the planning of the work, it should be noted that it occurred within the framework of care practice and was born as a curiosity and wanting to know the behavior of personality variables in subjects with MCI who attended the neurology service without having had a well-defined state of the art at the beginning of data collection. Therefore, we consider that the methodology and how the evaluation instruments were administered were not rigorous. By this, we refer mainly to the data collection of the NEO-FFI scale in the previous and current instances, having been a better choice if both instances were evaluated by the same operator (family) to reduce the subjective differences in the appreciation of the personality characteristics of the subjects with MCI.

Something similar happened with the data collected from the neurocognitive evaluation; some patients attended a previous neurocognitive evaluation of other health centers with some differences in the tests administered. We tried to compare the results but could not do so in all of them. Above all, we found some difficulties in homologating the instances of immediate and deferred memory and instances of recognition of the verbal memory tests that could have been corrected if these subtests had been administered to all the subjects studied.

Some other limitations of the present study are the inclusion of people with uncompleted primary school (less than 7 years of formal education) and patients with high school diplomas (equal or more than 12 years of formal education). Although there is not a significant difference between education measures, it could be a variable to consider concerning cognitive status and personality traits.

CONCLUSIONS

This research evaluated the relationship between personality factors and cognitive impairment in older adult subjects. While we do not have a large amount of data differentiating the personality traits of healthy control subjects and patients with MCI, the lack of relationship between the traits presented by patients who developed MCI could be a finding to be considered and could help identify subjects at risk of having decline in their neurocognitive performance. Likewise, combining the traits' differences over time, the presence of behavioral symptoms, and poor performance in memory tests could be helpful in clinical care practice to recognize patients with suspected neuropathological symptoms.

Suppose we can obtain a profile of the existing relationship of these traits to each other and their association with other behavioral and performance symptoms. In that case, we can get closer to discovering a characteristic pattern of subjects converting to MCI.

CONFLICTS OF INTEREST

The authors report there are no conflicts of interest in relation to this study.

ACKNOWLEDGEMENTS

We thank the work team of the Memory Research Center of the Dr. Abel Zubizarreta Hospital and the Department of Neurology of the Trinidad Mitre Sanatorium for the space provided to collect the necessary data to carry out this research and for the access to the patients who are treated in the service.

CONTRIBUTOR ROLES

Adriana Leis, Conceptualization; Formal analysis; Investigation; Methodology; Project administration; Supervision; Validation; Visualization – Preparation; Writing – original draft.

Mónica Iturry, Conceptualization; Investigation; Project administration; Resources; Writing – review & editing.

Galeno Rojas, Conceptualization; Formal analysis; Methodology; Writing – review & editing.

Emilia Gatto, Conceptualization; Methodology; Project administration; Writing – review & editing.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Publishing. <https://doi.org/10.1176/appi.books.9780890425596>
- Arizaga, R. L., Gogorza, R. E., Allegri, R. F., Baumann, D., Morales, M. C., Harris, P., & Pallo, V. (2005). Cognitive impairment in people over 60 years of age in Cañuelas (Argentina): Results of the pilot of the CEIBO study (Population epidemiological study of dementia). *Revista Neurológica Argentina*, 30, 83–90.
- Balsis, S., Carpenter, B. D., & Storandt, M. (2005). Personality change precedes clinical diagnosis of dementia of the Alzheimer type. *The Journals of Gerontology: Series B, Psychological Sciences and Social Sciences*, 60(2), P98–P101. <http://www.ncbi.nlm.nih.gov/pubmed/15746024>
- Baquero, M., Blasco, R., Campos-García, A., Garcés, M., Fages, E. M., & Andreu-Català, M. (2004). Descriptive study of behavioral disorders in mild cognitive impairment. *Journal of Neurology*, 38(4), 323–326.
- Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry*, 4, 561–571.
- Benton, A. L. (1968). Differential behavioral effects in frontal lobe disease. *Neuropsychologia*, 6(1), 53–60. [https://doi.org/10.1016/0028-3932\(68\)90038-9](https://doi.org/10.1016/0028-3932(68)90038-9)
- Costa, P. T., & McCrae, R. R. (1999). Revised NEO Personality Inventory (NEO PI-R) and NEO Five-Factor Inventory (NEO-FFI). TEA Ediciones.
- Cummings, J. L., Mega, M., Gray, K., Rosenberg-Thompson, S., Carusi, D. A., & Gornbein, J. (1994). The Neuropsychiatric Inventory: Comprehensive assessment of psychopathology in dementia. *Neurology*, 44(12), 2308–2314. <http://www.ncbi.nlm.nih.gov/pubmed/7991117>
- Demey, I., Allegri, R. F., & Taragano, F. E. (2007). Behavioral disorders in mild cognitive impairment. *Revista Neurológica Argentina*, 18, 252–257.
- Enache, D., Winblad, B., & Aarsland, D. (2011). Depression in dementia. *Current Opinion in Psychiatry*, 24(6), 461–472. <https://doi.org/10.1097/YCO.0b013e32834bb9d4>
- Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). “Mini-mental state.” A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, 12(3), 189–198. [https://doi.org/10.1016/0022-3956\(75\)90026-6](https://doi.org/10.1016/0022-3956(75)90026-6)
- Freedman, M., Leach, L., Kaplan, E., Winocur, G., Shulman, K., & Delis, D. (1994). *Clock drawing: A neuropsychological analysis*. Oxford University Press.

- Hock, R. S., Lee, H. B., Bienvenu, O. J., Nestadt, G., Samuels, J. F., Parisi, J. M., ... Spira, A. P. (2014). Personality and cognitive decline in the Baltimore Epidemiologic Catchment Area follow-up study. *The American Journal of Geriatric Psychiatry*, *22*(9), 917–925. <https://doi.org/10.1016/j.jagp.2012.12.217>
- Hy, L. X., & Keller, D. M. (2000). Prevalence of AD among whites: A summary by levels of severity. *Neurology*, *55*, 198–204.
- Iqbal, K., Sisodia, S., & Winblad, B. (Eds.). (2001). Alzheimer's disease: Advances in etiology, pathogenesis and therapeutics. John Wiley & Sons. <https://doi.org/10.1007/978-94-007-5416-4>
- Kaplan, E., Goodglass, H., & Weintraub, S. (1986). Boston Vocabulary Test. Panamericana.
- Larraya, F., Grasso, L., & Mari, G. (2004). Prevalence of Alzheimer's dementias, vascular dementias and other DSM-IV and ICD-10 dementias in Argentina. *Revista Neurológica Argentina*, *29*, 148–153.
- Lawton, M. P., & Brody, E. M. (1969). Assessment of older people: Self-maintaining and instrumental activities of daily living. *The Gerontologist*, *9*(3), 179–186. <http://www.ncbi.nlm.nih.gov/pubmed/5349366>
- Leis, A., Allegri, R. F., Roman, F., Iturry, M. L., Crotti, B., Gatto, E., & Rojas, G. (2018). Normative data of the Argentine version of the Signoret Mnestic Efficacy Battery (BEM 144) to be applied in the neurocognitive evaluation. *Neurología Argentina*, *10*(3), 127–136. <https://doi.org/10.1016/j.neuarg.2018.04.002>
- Leszko, M., Elleman, L. G., Bastarache, E. D., Graham, E. K., & Mroczek, D. K. (2016). Future directions in the study of personality in adulthood and older age. *Gerontology*, *62*(2), 210–215. <https://doi.org/10.1159/000434720>
- Lyketsos, C. G., Lopez, O., Jones, B., Fitzpatrick, A. L., Breitner, J., & DeKosky, S. (2002). Prevalence of neuropsychiatric symptoms in dementia and mild cognitive impairment. *JAMA*, *288*(12), 1475–1483. <https://doi.org/10.1001/jama.288.12.1475>
- McCrae, R. R., & Costa, P. T. (1997). Personality trait structure as a human universal. *The American Psychologist*, *52*(5), 509–516. <http://www.ncbi.nlm.nih.gov/pubmed/9145021>
- Mendez Rubio, M., Antonietti, J. P., Donati, A., Rossier, J., & von Gunten, A. (2013). Personality traits and behavioural and psychological symptoms in patients with mild cognitive impairment. *Dementia and Geriatric Cognitive Disorders*, *35*(1–2), 87–97. <https://doi.org/10.1159/000346129>
- Monastero, R., Mangialasche, F., Camarda, C., Ercolani, S., & Camarda, R. (2009). A systematic review of neuropsychiatric symptoms in mild cognitive impairment. *Journal of Alzheimer's Disease*, *18*(1), 11–30. <https://doi.org/10.3233/JAD-2009-1120>

- Niu, H., Álvarez-Álvarez, I., Guillén-Grima, F., & Aguinaga-Ontoso, I. (2017). Prevalence and incidence of Alzheimer's disease in Europe: A meta-analysis. *Neurología*, *32*(8), 523–532.
- Petersen, R. C. (2007). Mild cognitive impairment: Current research and clinical implications. *Seminars in Neurology*, *27*(1), 22–31. <https://doi.org/10.1055/s-2006-956752>
- Petersen, R. C., Caracciolo, B., Brayne, C., Gauthier, S., Jelic, V., & Fratiglioni, L. (2014). Mild cognitive impairment: A concept in evolution. *Journal of Internal Medicine*, *275*(3), 214–228. <https://doi.org/10.1111/joim.12190>
- Petersen, R. C., Doody, R., Kurz, A., Mohs, R. C., Morris, J. C., Rabins, P. V., ... Winblad, B. (2001). Current concepts in mild cognitive impairment. *Archives of Neurology*, *58*(12), 1985–1992. <https://doi.org/10.1001/archneur.58.12.1985>
- Petersen, R. C., Smith, G. E., Waring, S. C., Ivnik, R. J., Tangalos, E. G., & Kokmen, E. (1999). Mild cognitive impairment: Clinical characterization and outcome. *Archives of Neurology*, *56*(3), 303–308. <https://doi.org/10.1001/archneur.56.3.303>
- Petersen, R., Stevens, J., & Ganguli, M. (2001). Practice parameter: Early detection of dementia: Mild cognitive impairment (an evidence-based review). *Neurology*, *56*(9), 1133–1142. <http://www.neurology.org/content/56/9/1133.short>
- Reitan, R. M. (1958). Validity of the Trail Making Test as an indicator of organic brain damage. *Perceptual and Motor Skills*, *8*(3), 271–276. <https://doi.org/10.2466/pms.8.3.271-276>
- Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological Bulletin*, *132*(1), 1–25. <https://doi.org/10.1037/0033-2909.132.1.1>
- Robins Wahlin, T.-B., & Byrne, G. J. (2011). Personality changes in Alzheimer's disease: A systematic review. *International Journal of Geriatric Psychiatry*, *26*(10), 1019–1029. <https://doi.org/10.1002/gps.2655>
- Schultz, D. P., & Schultz, S. E. (2010). *Personality theories* (9th ed.). Cengage Learning Editores SA.
- Seiffer, A., Clare, L., & Harvey, R. (2005). The role of personality and coping style in relation to awareness of current functioning in early-stage dementia. *Aging & Mental Health*, *9*(6), 535–541. <https://doi.org/10.1080/13607860500193245>
- Serrano, C., Dillon, C., Heisecke, S., Castro, D., Perez Leguizamon, P., Allegri, R., & Taragano, F. (2014). Onset age and clinical heterogeneity of dementias: A diagnostic and therapeutic approach. *Current Psychopharmacology*, *3*(1), 2–17. <http://benthamsience.com/cpsp/index.htm>

- Serrano, C. M., Dillon, C., Leis, A., Taragano, F. E., & Allegri, R. F. (2013). Mild cognitive impairment: Risk of dementia according to subtypes. *Actas Españolas de Psiquiatría*, 41(6), 328–337.
- Serrano, C., Taragano, F., Allegri, R., Krupitzki, H., Martelli, M., Feldman, M., ... Tamaroff, L. (2007). Predictors of conversion into mild cognitive impairment. *Revista Neurológica Argentina*, 32(2), 75–93.
- Signoret, J., & Whiteley, A. (1979). Memory battery scale. *International Neuropsychological Society Bulletin*, 2, 2–26.
- Srivastava, S., John, O. P., Gosling, S. D., & Potter, J. (2003). Development of personality in early and middle adulthood: Set like plaster or persistent change? *Journal of Personality and Social Psychology*, 84(5), 1041–1053. <https://doi.org/10.1037/0022-3514.84.5.1041>
- Stephan, Y., Sutin, A. R., Bosselut, G., & Terracciano, A. (2017). Sensory functioning and personality development among older adults. *Psychology and Aging*, 32(2), 139–147. <https://doi.org/10.1037/pag0000159>
- Stephan, Y., Sutin, A. R., & Terracciano, A. (2014). Physical activity and personality development across adulthood and old age: Evidence from two longitudinal studies. *Journal of Research in Personality*, 49, 1–7. <https://doi.org/10.1016/j.jrp.2013.12.003>
- Sutin, A. R., Stephan, Y., & Terracciano, A. (2018). Facets of conscientiousness and risk of dementia. *Psychological Medicine*, 48(6), 974–982. <https://doi.org/10.1017/S0033291717002306>
- Taragano, F. E., Allegri, R. F., Krupitzki, H., Sarasola, D. R., Serrano, C. M., Loñ, L., & Lyketsos, C. G. (2009). Mild behavioral impairment and risk of dementia: A prospective cohort study of 358 patients. *The Journal of Clinical Psychiatry*, 70(4), 584–592. <https://doi.org/10.4088/JCP.08m04181>
- Terracciano, A., Stephan, Y., Luchetti, M., & Sutin, A. R. (2018). Cognitive impairment, dementia, and personality stability among older adults. *Assessment*, 25(3), 336–347. <https://doi.org/10.1177/1073191117691844>
- Terracciano, A., Sutin, A. R., An, Y., O'Brien, R. J., Ferrucci, L., Zonderman, A. B., & Resnick, S. M. (2014). Personality and risk of Alzheimer's disease: New data and meta-analysis. *Alzheimer's & Dementia*, 10(2), 179–186. <https://doi.org/10.1016/j.jalz.2013.03.002>
- van der Linde, R. M., Stephan, B. C. M., Matthews, F. E., Brayne, C., Savva, G. M., & Medical Research Council Cognitive Function and Ageing Study. (2013). The presence of behavioral and psychological symptoms and progression to dementia in the cognitively impaired older population. *International Journal of Geriatric Psychiatry*, 28(7), 700–709. <https://doi.org/10.1002/gps.3873>
- Wechsler, D. (1988). WAIS: Adult Intelligence Test. Paidos.