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Personality traits in women with Alzheimer's disease: Comparisons with control groups with the NEO-FFI

Joana Henriques-Calado *, Maria Eugénia Duarte-Silva, Ana Sousa Ferreira

Universidade de Lisboa, Faculdade de Psicologia, Alameda da Universidade, 1649-013 Lisboa, Portugal
CICPSI, Research Center for Psychological Science, Faculdade de Psicologia, Universidade de Lisboa, Portugal

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ABSTRACT

This research is geared towards the evaluation of current and pre-morbid personality traits in Alzheimer's Disease (AD), as well as personality changes. The study was conducted with four groups to whom were administered the NEO-FFI, mainly in the form of individual interviews. Two groups for the current personality measurement: AD Group, consisting of 44 female participants ($M = 81.36$ years of age); and Control Group, consisting of 80 female participants from the population at large ($M = 75.84$ years of age). Two groups for the pre-morbid personality measurement: AD Group Informants, relatives of the AD participants ($n = 40$); and Control Group Informants, relatives of the other participants ($n = 42$). Results are in line with the literature review and provide new research data. Current and pre-morbid personality traits are identified and some are analyzed as accentuations of previously existing characteristics, reflecting a possible continuum. An increase in the Neuroticism and a decrease in the Conscientiousness were confirmed as personality changes. This study suggests that there is stability across the life cycle in the negative expression of Openness to Experience and Agreeableness traits. Interpretation of the data and their implications for Dementia personality research are the object of the discussion.

1. Introduction

Personality changes in Alzheimer's disease (AD) have been documented in the literature (e.g., Caselli, 2015; Cipriani, Borin, Del Debbio, & Di Fiorino, 2015; Osborne, Simpson, & Stokes, 2010; Pocnet, Rossier, Antonietti, & von Gunten, 2011; Pocnet, Rossier, Antonietti, & von Gunten, 2012, Pocnet, Rossier, Antonietti, & von Gunten, 2013; von Gunten, Pocnet, & Rossier, 2009; Wahlin & Byrne, 2011). Some researchers argue that personality changes precede the cognitive changes which typically point to the diagnosis of AD, therefore taking on great importance. In the future, personality evaluation may be included in the diagnosis, since the results have implications for the research of the prevention, treatment of symptoms and for the etiological knowledge of Dementia (e.g., Balsis, Carpenter, & Storandt, 2005; Duberstein et al., 2010; Duchek, Balota, Storandt, & Larsen, 2007; Terracciano et al., 2013, 2014; Jackson, Balota, & Head, 2011).

Personality changes are evident at the onset of AD and may be a useful early clinical marker (e.g., Duberstein et al., 2010; Duchek et al., 2007; Helmes, Norton, & Ostbye, 2013; Pocnet et al., 2011, 2012, 2013; Wahlin & Byrne, 2011). Some researchers suggest that the pre-morbid characteristics of personality may represent a risk factor for AD and, thus, pre-morbid personality should differ between patients and controls (e.g., Balsis et al., 2005; Duberstein et al., 2010; von Gunten et al., 2009; Wang et al., 2009).

Within this field, the most robust and validated personality evaluation measure is based on the Five-Factor Personality Model. The overall common objective is to understand personality changes in Dementia through comparing the pre-morbid and current measurement, using the NEO-PI (or NEO-FFI) instrument, in retrospective and current evaluation, normally by means of Informants. Evidence of an increase in the Neuroticism dimension and a decrease in the Conscientiousness in Dementia dimension is seemingly transversal and unanimous across the research (e.g., Balsis et al., 2005; Chatterjee, Strauss, Smyth, & Whitehouse, 1992; Cipriani et al., 2015; Dawson, Welsh-Bohmer, & Siegler, 2000; Duchek et al., 2007; Low, Harrison, & Lackersteen, 2013; Pocnet et al., 2011, 2012, 2013; Siegler, Dawson, & Welsh, 1994; Strauss & Pasupathi, 1994; Strauss, Pasupathi, & Chatterjee, 1993; Terracciano et al., 2014; Wahlin & Byrne, 2011; Wilson et al., 2003). However, one of these studies biggest limitations is considered to be the lack of control groups.

Some researchers have begun to question whether such data reflects personality changes due to the disease itself or if these *changes* indicate

* Corresponding author.
E-mail addresses: joanahenriquescalado@gmail.com (J. Henriques-Calado), meduartesilva@psicologia.ulisboa.pt (M.E. Duarte-Silva), asferreira@psicologia.ulisboa.pt (A.S. Ferreira).

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an accentuation of pre-morbid personality traits (e.g., Balsis et al., 2005; Duberstein et al., 2010; Duchek et al., 2007; Pocnet et al., 2012, 2013).

1.1. Aim of the study

This study sets out to understand the impact of personality on AD, through the NEO-FFI, by investigating whether personality traits remain stable or undergo changes, by studying pre-morbidity and the present time. The personality changes will be considered resulting from the difference between current personality traits and premorbid.

The following considerations should be noted: firstly, this study was developed in response to an argued limitation, and included control groups in the research design. Secondly, it was defined that the etiology of Dementia to be studied would be AD. Hence, this study sets out to overcome one of the limitations of a number of previous studies in which the etiologies of Dementia are mixed in the composition of the samples, despite a higher prevalence of AD, which may render incorrect results. The third consideration is related to the evaluation format of self-reporting (in interview form), on current personality in individuals with Dementia, thus following more recent studies on this subject, such as those of Duchek et al. (2007); Duberstein et al. (2010); Pocnet et al. (2011) and Terracciano et al. (2013, 2014). Lastly, it should be clarified that the option was taken to study a sample of women (≥65 years), since this pathology is more prevalent in females, and it is also easier to gain access to female participants owing to their greater life expectancy. By doing so, it was also the aim to avoid the risk of obtaining a rather detached sample in terms of gender percentage and to reduce a potential source of skewed results.

The following hypotheses are studied:

Hypothesis 1. Regarding current personality: a significantly higher mean result in the Neuroticism dimension and a significantly lower mean result in the Conscientiousness dimension are expected to be found in the Alzheimer's disease Group in relation to the Control Group.

Hypothesis 2. Regarding pre-morbid personality: a significantly higher mean result in the Neuroticism dimension and a significantly lower mean result in the Conscientiousness dimension are expected to be found in the Alzheimer's disease Group Informants in relation to the Control Group Informants.

Hypothesis 3. Regarding personality changes: a significantly higher mean result in the Neuroticism dimension and a significantly lower mean result in the Conscientiousness dimension are expected to be found in the Alzheimer's disease Group in comparison with the information collected from the Alzheimer's disease Group Informants and the Control Groups.

2. Method

2.1. Participants

The Alzheimer's disease Group (AD Group) is composed of 44 female, Caucasian participants of Portuguese nationality, resident in an urban environment with a clinical diagnosis of AD (onset), aged 65 years or above (see Table 1).

The Control Group is composed of 80 female, Caucasian participants, from the general population, of Portuguese nationality, resident in an urban environment, aged 65 years or above (see Table 1).

The Alzheimer's disease Group Informants (AD Group Informants) is composed of 40 participants who are the respective relatives of the AD Group participants, namely daughter/son 80.00%, niece/nephew 10.00%, husband 5.00%, sister 2.50% and daughter-in-law 2.50%. The Informants provide assessments of the pre-morbid personality characteristics of the respective AD Group participant.

The Control Group Informants is composed of 42 participants who are the respective relatives of the Control Group participants, namely daughter/son 83.00% and husband 17.00%. The Informants provide assessments of the pre-morbid personality characteristics of the respective Control Group participant.

2.2. Materials and procedure

2.2.1. Socio-demographic questionnaire

2.2.1.1. Mini mental state examination (MMSE). A 30-point questionnaire with a total score used extensively in clinical and research settings to measure cognitive impairment.

2.2.1.2. The NEO-Five Factor Inventory (NEO-FFI). The NEO-FFI (Costa & McCrae, 1992) is a short-form of the NEO Personality Inventory (NEO PI-R), which operationalizes the FFM. The NEO-FFI contains 60 items, and participants are asked to respond on a 5-point Likert scale ranging from 0 (strongly disagree) to 4 (strongly agree). The NEO-FFI scales yield scores for the following personality domains (traits): Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness. Each scale consists of 12 items which are scaled in a way that higher scores reflect the presence of the assessed traits.

An Informant version was introduced in this study, adapted from the NEO-FFI, and created for empirical research purposes. This methodology follows the procedure adopted in other works (e.g., Osborne et al., 2010; Pocnet et al., 2011; von Gunten et al., 2009; Wahlin & Byrne, 2011). With a view to retrospectively evaluating the relative of the Informant, the initial instruction is as follows: "Think of your relative before the age of 60 years. Remember what she was like in the past, throughout her whole life, and answer the following questions".

In the present study, Cronbach's alphas have an average value of: 0.71 in the AD Group; 0.67 in the Control Group; 0.79 in the AD Group Informants; 0.82 in the Control Group Informants.

2.2.2. Procedure

It should be noted that the present research study was approved and authorized by the Administrative and Clinical Boards of the Institutions. Participants were clarified as to the aims of the study and provided their informed consent. No compensation was given. It complies with Portuguese Psychologists Board ethical standards and the specific research on Dementia recommendations stipulated by Alzheimer Europe (2011).

2.2.2.1. AD Group and AD Group Informants. The AD Group sample was mainly collected (±69%) at a Psychiatric Hospital Center (Psychiatry and Neurology Outpatients) and (±31%) at Geriatric Centers.

Inclusion criteria were as follows: female; 65 years or above; clinical diagnosis of AD (onset); absence of psychiatric or neurological co-morbidity, other than that possibly related to the clinical diagnosis at issue; with intelligibility and understanding capacities and a minimally stable emotional state to collaborate in psychological evaluation tasks and interpersonal relations.

It is important to note that the AD clinical diagnosis (onset) always considered the medical evaluation provided by Psychiatrists (89%) and Neurologists (20%) as a criterion. This investigation yielded a diagnosis of AD according to the International Classification of Diseases, 10th edition (WHO, 1993) and the National Institute of Neurological and Communicative Disorders and Stroke, and the Alzheimer's Disease and Related Disorders Association (NINCS-ADRDS) criteria (McKhann et al., 1984).

Application of the protocol (MMSE and NEO-FFI) was conducted in two face-to-face individual sessions, by a psychologist trained for such purpose, corresponding to a total period of approximately one hour and fifteen minutes.

As regards collection from the AD Group Informants, each member was a relative of one of the participants and had to share a significant

Table 1
Demographics and descriptive statistics, MMSE Total.

Variables	AD Group, $n = 44$								Control Group, $n = 80$							
	n	%	*M*	*SD*	*Me*	*Mo*	Min	Max	*n*	%	*M*	*SD*	*Me*	*Mo*	Min	Max
Age, years			81.36	6.47	82.00	80.00	65.00	92.00			75.84	6.12	75.00	74.00	65.00	91.00
65–80	16	36.40	74.56	4.84	73.50	80.00	65.00	80.00	63	78.80	73.52	4.42	74.00	74.00	65.00	80.00
>80	28	63.60	85.27	3.35	84.50	81.00	81.00	92.00	17	21.30	84.41	3.16	83.00	81.00	81.00	91.00
Schooling, years			7.61	4.00	4.00	8.00	0.00	17.00			8.94	2.75	8.00	8.00	0.00	17.00
0	6	13.60	–	–	–	–	–	–	2	2.50	–	–	–	0.00	–	–
1–4	0	0.00	–	–	–	–	–	–	1	1.30	–	–	–	4.00	–	–
5–12	35	79.50	8.11	1.37	8.00	8.00	5.00	12.00	73	91.30	8.88	1.76	8.00	8.00	6.00	12.00
≥Licentiate degree	3	6.80	17.00	0.00	17.00	17.00	17.00	17.00	4	5.00	18.00	2.31	18.00	17.00	17.00	20.00
Marital status																
Single	4	9.10							6	7.50						
Married	10	22.70							35	43.80						
Widowed	28	63.60							34	42.50						
Divorced	2	4.50							5	6.30						
N° children			1.48	1.01	1.00	1.00	0.00	5.00			1.86	1.40	2.00	2.00	0.00	8.00
With whom she lives																
Alone	7	15.90							40	50.00						
Husband	7	15.90							35	43.75						
Children	10	22.70							5	6.25						
Family/friends	2	4.50							0	0						
Geriatric center	18	40.90							0	0						
MMSE (Total score)			17.59	4.44	16.00	15.00			0	0	27.81	2.08	28.00	29.00		

and close relationship with the participant, and have a considerable amount of knowledge about her (namely daughter/son 80.00%, niece/nephew 10.00%, husband 5.00%, sister 2.50% and daughter-in-law 2.50%). The protocol was applied in a face-to-face individual session, by a psychologist trained for such purpose, with a duration of approximately forty five minutes.

2.2.2.2. Control Group and Control Group Informants. Collection of the Control Group sample was carried out at a Day Center (19 participants) and by means of a "snowball" procedure (61 participants).

Inclusion criteria were as follows: female; 65 years or above; from the general population; absence of diagnosed or evident psychiatric or neurological disorder; with intelligibility and understanding capacities and a minimally stable emotional state to collaborate in psychological evaluation tasks and interpersonal relations.

As regards collection from the Control Group, each member was a relative of one of the participants and had to share a significant and close relationship with the participant, and have a considerable amount of knowledge about her (namely daughter/son 83.00% and husband 17.00%). The research protocol and its application were conducted as the previously described situation.

2.3. Data analysis

Verification of the assumptions that the variables were normally distributed was always carried out by means of the following global analysis: 1) Kolmogorov-Smirnov/Shapiro-Wilk tests (according to the sample *n*), 2) form measurements (asymmetry and flattening) and 3) Q-Q plots.

Effects for *p-values* ≤ 0.05 were considered statistically significant.

The statistical analyses were conducted with the Software PASW Statistics (v. 19, 20, SPSS Inc., Chicago, IL).

2.3.1. Analysis of clinical variable and socio-demographic variables

Possible relations between the MMSE Total clinical variable and the Age and Schooling socio-demographic variables were evaluated for the AD Group and the Control Group through correlations. The Pearson correlation coefficient (r) was used, except when analyzed with the Schooling variable (given that normal distribution of this variable was not observed for either sample) in which case the Spearman correlation coefficient (r_s) was used. It should be noted that in the AD Group, the mean score of the MMSE Total was neither observed to be related to Age ($r = -0.07$, $p = 0.67$) nor Schooling ($r_s = 0.16$, $p = 0.29$). Similarly, in the Control Group the mean score of the MMSE Total was neither found to be related to Age ($r = -0.32$, $p = 0.11$) nor Schooling ($r_s = 0.35$, $p = 0.08$).

2.3.2. Comparison of the AD Group with the Control Group

In order to evaluate whether there was a significant influence of the groups on the five personality dimensions of the NEO-FFI, a multivariate covariance analysis, MANCOVA, was carried out, with Age, Schooling and MMSE Total variables controlled as covariates. The MANCOVA application assumptions were validated - Multivariate Normality, Homoscedasticity, Homogeneity of variances-co-variances in the factor levels and Homogeneity of slopes.

2.3.3. Comparison of the AD Group Informants with the Control Group Informants

In order to evaluate whether there was a significant influence of the groups on the five personality dimensions of the NEO-FFI, an one factor analysis of variance was carried out - ANOVA. The assumptions of this statistical method were validated - Normality, with the exception of the Conscientiousness dimension, and Homogeneity of variances. With regard to the Conscientiousness dimension, the Wilcoxon-Mann-Whitney test was used as a non-parametric alternative.

2.3.4. Comparison of the AD Group Informants with the AD Group and Control Groups

In an initial analysis to evaluate whether there was a significant influence of the groups (AD Group Informants and AD Group) on the five personality dimensions of the NEO-FFI, an one factor analysis of variance was carried out - ANOVA. The assumptions of this statistical method were validated - Normality, with the exception of the Conscientiousness dimension, and Homogeneity of variances. With regard to the Conscientiousness dimension, the Wilcoxon-Mann-Whitney test was used as a non-parametric alternative.

The next object was to evaluate whether the differences observed in the mean results of the NEO-FFI personality dimensions, resulting from the difference between current and pre-morbid personality, were of statistical significance in the AD Group in comparison with the Control Group. For such purpose, it was necessary to create a new variable related to the difference between the current and pre-morbid personality (for each individual) of the mean results of the NEO-FFI dimensions, where the Informant evaluations were associated with the respective

evaluations of the individual of their respective group- variable with two levels: Personality Changes AD Group (PCADGroup) and Personality Changes Control Group (PCCGroup).

In order to evaluate whether there was a significant influence of the PCADGroup and PCCGroup on the respective changes in the NEO-FFI dimensions, resulting from the difference between current and pre-morbid personality, an one factor analysis of variance was carried out - ANOVA. The assumptions of this statistical method were validated - Normality and Homogeneity of variances: Levene ($p \geq 0.18$ for the dimensions; except for the Extraversion dimension which presents heterogeneous variance, $p \leq 0.03$). Welch's F statistic was used for this dimension.

3. Results

3.1. Comparison of the AD Group with the Control Group: current personality study

Table 2 presents the results of the multivariate covariance analysis (MANCOVA) on the effect of the AD Group and the Control Group on the five personality dimensions of the NEO-FFI. The MANCOVA reveals that the NEO-FFI traits are significantly influenced by the "Group" effect, after accounting for the variables Age, Schooling and the total MMSE as co-variables; the observed effect is of a high dimension and highly significant, while the power of the test is very good (Pillai trace = 0.48; $F(5116) = 21.68$, $p = 0.001$; $\eta^2_p = 0.48$; $\pi = 1.00$). In accordance with the hypothesis, the AD Group, in comparison with the Control Group, presented a higher mean result in the Neuroticism dimension, however the mean result in the Conscientiousness dimension was not significantly different, as would be expected.

3.2. Comparison of the AD Group Informants with the Control Group Informants: pre-morbid personality study

Table 3 presents the results of the analysis of variance (ANOVA) and the Wilcoxon-Mann-Whitney test on the effect of the AD Group Informants and the Control Group Informants on the five personality dimensions of the NEO-FFI. In accordance with the hypothesis, the AD Group Informants, in comparison with the Control Group Informants, presented a higher mean result in the Neuroticism dimension, however, contrary to initial expectations, they showed a higher mean result in the Conscientiousness dimension.

3.3. Comparison of the AD Group Informants with the AD Group and Control Groups: personality changes study

Table 4 presents the results of the analysis of variance (ANOVA) and the Wilcoxon-Mann-Whitney test on the effect of the AD Group Informants and the AD Group on the five personality dimensions of the NEO-FFI. In accordance with initial expectations, the AD Group, in comparison with the AD Group Informants, revealed changes, namely a higher mean result in the Neuroticism dimension and a lower mean result in the Conscientiousness dimension.

Table 5 presents the results of the analysis of variance (ANOVA) on the effect of the PCADGroup and PCCGroup on the changes of the NEO-FFI dimensions manifested between the present time and pre-morbidity. In line with the hypothesis, the PCADGroup in comparison with the PCCGroup revealed significant personality changes in the NEO-FFI dimensions, resulting from the difference in the mean results of the NEO-FFI dimensions between current and pre-morbid personality, namely an increase in the Neuroticism dimension and a decrease in the Conscientiousness dimension.

4. Discussion

In this sample of elderly women with Alzheimer's disease (AD), a significantly higher mean result in the Neuroticism dimension was observed in current and pre-morbid personality, however Hypothesis 1 and 2 are partially confirmed since a significantly lower mean result was not observed in the Conscientiousness dimension. The Conscientiousness dimension was also found to be high in pre-morbid personality. This may be justified by the "healthier" sample of AD participants (a methodological bias of this study) and the possibility of outliers in terms of the high Conscientiousness trait. It should be mentioned that other authors also refer to the particular behavior of the Conscientiousness dimension, indicating that it is highly variable among participants with AD, having observed an increase in inter-individual variability on this trait, in advanced age, perhaps due to heterogeneous pre-morbid characteristics. Even more pronounced personality alterations are reported in this dimension in individuals with higher pre-morbid levels associated with Obsessive-Compulsive Disorder (Allemand, Zimprich, & Hendriks, 2008; Chatterjee et al., 1992; Dawson et al., 2000; Nicholas et al., 2010; Pocnet et al., 2011). However, it is also possible that higher Conscientiousness scores in the pre-morbidity may be caused by a "halo effect" of the informants with respect to that characteristic in the AD participants. Maybe informants recall higher Conscientiousness scores because current Conscientiousness scores are way lower. The information given by a close relative about a patient's previous personality may be biased to some extent as a result (for example, the idealization of the patient and their previous relationship as well as the stress endured as a consequence of the change in their relationship) (e.g., Aitken, Simpson, & Bums, 1999; Pocnet et al., 2011). In addition to the hypotheses data, low mean results in the Openness to Experience and Agreeableness, stressing a continuity between pre-morbidity and the present time in AD, and a low mean result in the Extraversion dimension in the AD Group dimensions may also be observed.

The results support Hypothesis 3. In terms of personality traits (dimensions), a significant increase of the mean result in the Neuroticism dimension and a significant decrease in the mean result of the Conscientiousness dimension were confirmed in AD compared with the control groups. This fact replicates seemingly unanimous information that is highly important to research, and converges with the literature on personality changes in Dementia, personality characteristics that change in a situation of Dementia not only in cross-sectional and longitudinal studies, but also in meta-analyses, regardless of the given heterogeneity (e.g., Chatterjee et al., 1992; Dawson et al., 2000; Duberstein et al., 2010;

Table 2
Results of the multivariate covariance analysis (MANCOVA) on the effect of the Alzheimer's disease Group (AD Group) and the Control Group on the Five Personality dimensions of the NEO-FFI.

Dimensions	AD Group ($n = 44$)	Control Group ($n = 80$)	F	p	η^2_p	π
	M (SD)	M (SD)				
Neuroticism	32.73(8.29)	24.68(7.34)	31.38	**0.001**	0.21	1.00
Extraversion	22.70(6.48)	25.98(5.75)	4.56	**0.03**	0.04	0.56
Openness	15.70(5.86)	22.93(5.18)	37.09	**0.001**	0.24	1.00
Agreeableness	26.06(5.82)	33.39(5.11)	43.82	**0.001**	0.27	1.00
Conscientiousness	34.57(7.53)	33.63(6.44)	2.46	0.12	0.02	0.34

Note. η^2_p (effect size): ≤0.05 (Small); [0.05; 0.25] (Medium); [0.25; 0.50] (High); >0.50 (Very high); π (test power): [≥0.80; 1:00] (Cohen, 1988). In bold are identified cases in which $p < 0.05$.

Table 3
Results of the analysis of variance (ANOVA) and Wilcoxon-Mann-Whitney test on the effect of the Alzheimer's disease Group Informants (AD Group Informants) and the Control Group Informants on the Five Personality dimensions of the NEO-FFI.

Dimensions	AD Group Informants ($n = 40$)	Control Group Informants ($n = 42$)	F	p	η^2_p	π
	M (SD)	M (SD)				
Neuroticism	27.68(9.95)	23.50(9.04)	3.96	**0.05**	0.06	0.50
Extraversion	29.53(6.18)	26.83(8.08)	2.85	0.10	0.03	0.39
Openness	16.03(7.38)	23.62(8.45)	18.74	**0.001**	0.19	0.99
Agreeableness	26.90(7.08)	31.43(5.48)	10.54	**0.002**	0.12	0.89
Conscientiousness[a]	38.65(7.49)	33.64(7.26)	−3.48	**0.001**	–	–

Note. η^2_p (effect size): ≤0.05 (Small); [0.05; 0.25] (Medium); [0.25; 0.50] (High); >0.50 (Very high); π (test power): [≥0.80; 1:00] (Cohen, 1988). In bold are identified cases in which $p < 0.05$.
[a] Wilcoxon-Mann-Whitney test (Z).

Duchek et al., 2007; Osborne et al., 2010; Pocnet et al., 2011; Siegler et al., 1994; Strauss et al., 1993; Strauss & Pasupathi, 1994; Terracciano et al., 2014; von Gunten et al., 2009; Wahlin & Byrne, 2011; Wilson et al., 2003). A personality change may also be observed in a lower mean result in the Extraversion dimension which is in line with other readings (e.g., Chatterjee et al., 1992; Dawson et al., 2000; Siegler et al., 1994; Strauss et al., 1993; Strauss & Pasupathi, 1994) and in the Openness to Experience dimension, although a decrease is observed (the latter is not significant), a significant change is not observed in the situation of Dementia, at least not in this initial study, which is equally in keeping with the literature review that is still somewhat contradictory in terms of the importance of this personality trait on neurodegenerative diseases (e.g., Fratiglioni, Paillard-Borg, & Winblad, 2004; Low et al., 2013; Terracciano et al., 2014; Wahlin & Byrne, 2011).

As previously mentioned, personality changes in AD have been documented in the literature. An important question raised by some researchers is whether these data really reflect personality changes due to the disease itself or if they reflect an intensification of pre-morbid personality traits (e.g., Balsis et al., 2005; Duchek et al., 2007; Pocnet et al., 2012, 2013). In this study, we perceived a consistently high level of Neuroticism, from pre-morbidity to the present moment in comparison with a control group, whose personality change moves in a "positive" direction, by intensifying the pre-morbid trait, while always presenting medium effects. Extraversion does not differ in pre-morbidity, however it presents a low reading in the present time in comparison with a control group, whereby a small effect is observed, and the personality change is manifested in terms of a decrease from baseline, with a medium effect. Openness to Experience and Agreeableness are always low, from pre-morbidity to the present time compared with a control group, manifesting medium and high effects (in the case of current Agreeableness), which are the dimensions in which personality change is not observed. Hence, we suggest that there is stability across the life cycle in the negative expression of these traits. High Conscientiousness in pre-morbidity which does not differ in the present time, in comparison with a control group, whose personality change moves in a "negative" direction of the pre-morbid trait, shows a small effect. Indeed, the pattern is not clearly comprehensible.

There are some possible limitations to this study. The small size of the samples, especially since it is difficult to access individuals diagnosed with AD at the onset or in its early stages, with characteristics that may be evaluated in an interview format and whose Informant is equally available to participate. Variables such as disease duration, medication or other diseases would have been useful and informative. Furthermore, measuring personality changes by means of retrospective assessment by proxies may have introduced some memory bias. Also the rationale for selecting "prior to age 60 years" in the retrospective, informant-based measurement of personality domains, is controversy with some literature as Villemagne et al. (2013), that currently theorized prolonged period of pre-clinical AD and is it possible that 60 years is too old and may already reflect disease-related personality changes, rather than true premorbid traits.

5. Conclusions

It would be important in the future to re-define the concept of personality changes in AD, since in accordance with the data of this study, and, as verified, in line with other authors within this scope, it could be said that the term personality change should be only concisely applied to the Conscientiousness dimension. Indeed, in this study, the alteration of the latter follows a contrary path to that of pre-morbidity, while all the other dimensions behave as personality stereotypes, namely maintaining developmental congruence in terms of the direction of the trait, whether in relation to stability or intensification in its expression. To what extent are the characteristics of personality and Dementia connected in a kind of egosyntonic/alloplastic or egodysonic/autoplastic nature, or vice versa, or both?

It would also be interesting to investigate the role of the consistently low Openness to Experience and Agreeableness dimensions in a long term relationship with the other personality dimensions, since despite not having a main role as AD risk factors, Openness to Experience is

Table 4
Results of the analysis of variance (ANOVA) and Wilcoxon-Mann-Whitney test on the effect of the Alzheimer's disease Group Informants (AD Group Informants) and the Alzheimer's disease Group (AD Group) on the Five Personality dimensions of the NEO-FFI.

Dimensions	AD Group Informants ($n = 40$)	AD Group ($n = 44$)	F	p	η^2_p	π
	M (SD)	M (SD)				
Neuroticism	27.68(9.95)	32.73(8.29)	6.44	**0.01**	0.07	0.71
Extraversion	29.53(6.18)	22.70(6.48)	24.27	**0.001**	0.23	0.99
Openness	16.03(7.38)	15.70(5.86)	0.05	0.83	0.001	0.06
Agreeableness	26.90(7.08)	26.06(5.82)	0.37	0.55	0.004	0.09
Conscientiousness[a]	38.65(7.49)	34.57(7.53)	−2.80	**0.005**	–	–

Note. η^2_p (effect size): ≤0.05 (Small); [0.05; 0.25] (Medium); [0.25; 0.50] (High); >0.50 (Very high); π (test power): [≥0.80; 1:00] (Cohen, 1988). In bold are identified cases in which $p < 0.05$.
[a] Wilcoxon-Mann-Whitney test (Z).

Table 5
Results of the analysis of variance (ANOVA) on the effect of the Personality Changes AD Group (PCADGroup) and the Personality Changes Control Group (PCCGroup) on the NEO-FFI between current and pre-morbidity.

≠NEO-FFI dimensions current – pre-morbid	PCADGroup ($n = 40$)	PCCGroup ($n = 42$)	F	p	η^2_p	π
	M (SD)	M (SD)				
Neuroticism	5.25(11.82)	−0.57(11.14)	5.58	**0.02**	0.06	0.65
Extraversion[a]	−7.15(8.24)	0.01(10.68)	12.38	**0.001**	0.12	0.93
Openness	−0.93(7.04)	0.57(8.40)	0.80	0.38	0.009	0.14
Agreeableness	−1.65(7.74)	2.60(8.03)	6.25	**0.01**	0.07	0.70
Conscientiousness	−4.80(8.86)	0.98(9.45)	3.74	**0.05**	0.04	0.48

Note. η^2_p (effect size): ≤0.05 (Small); [0.05; 0.25] (Medium); [0.25; 0.50] (High); >0.50 (Very high); π (test power): [≥0.80; 1:00] (Cohen, 1988). In bold are identified cases in which $p < 0.05$.
[a] Welch's F statistic.

thought to have a protective effect of cognitive decline (e.g., Duberstein et al., 2010; Low et al., 2013; Williams, Suchy, & Kraybill, 2013). It should also be mentioned that low Agreeableness is configured as an important marker of psychopathology (e.g., Samuel & Widiger, 2008; Saulsman & Page, 2004).

The following considerations are deemed relevant and call for reflection. The Extraversion and Openness to Experience dimensions, analyzed as a meta-factor of the Plasticity (β) personality (e.g., DeYoung, Peterson, & Higgins, 2002), tend to evolve in AD in accordance with what is expected for personality development in advanced age (e.g., Weiss et al., 2005), while Neuroticism (inverse), Agreeableness and Conscientiousness, analyzed as a meta-factor of the Stability (α) personality (e.g., DeYoung et al., 2002), tend to evolve in AD in the opposite direction to what is expected for personality development in advanced age (e.g., Weiss et al., 2005). From a developmental perspective, could there be stability of a diminished Plasticity (β) throughout the life cycle and, in the long term, with the onset of the disease, a change in the meta-factor of the Stability (α) personality?

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