Personality traits in late-life depression: from group comparison to individual trajectories

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Personality traits in late-life depression: from group comparison to individual trajectories

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Abstract

The concept of personality is gradually shifting from the stability of a categorical model of personality disorders towards a dimensional model (DSM-V). In a dimensional approach, personality features are described along a bipolar continuum, and disorders are considered as extreme and maladaptive variants of ordinary personality traits. The present line of research analysis how dimensional models are of particular interest in old age psychiatry. Personality traits, as defined by the *Five-Factor Model* (FFM) of Costa and McCrae (1992), impact on the clinical expression and outcome of late-life depression as well as vice-versa.

A longitudinal study (Canuto et al., 2009) on treatment outcome in 62 old age depressed outpatients, showed that FFM dimensions and facets significantly predict remission of depressive symptoms, clinical progress and improved quality of life. On the opposite, a cross-sectional study analysed the impact of a depressive episode on personality dimensions in 38 remitted old age patients compared to 62 never-depressed controls. Contrary to cognitive variables and brain volumes, FFM facets sustainably differ in patients, even after remission from their depressive episode (Weber et al., 2010). Another cross-sectional comparison of the personality-depression relationship in 89 young and 92 older adults from the general population, revealed that Neuroticism is a direct and independent predictor of depression in young age as well as in old age, once patients' physical burden and subjective impact of life stressors has been accounted for (Weber et al., 2013). In the same sample, personality dimensions are associated with quality of life in old age, but not in young age, after controlling for acute depression features, physical health and psychosocial variables (Weber et al., 2015). Finally, patients' personality traits influence the poor recognition of late-life depression in old age patients by general hospital physicians, and they increase patients' chances to be referred for depressive mood to psychiatry-liaison services without actually presenting a depressive disorder (Canuto et al., 2016).

This line of research confirms the bi-directionality of the depression-personality traits relationship in late life. The dimensional *Five-Factor Model* of personality offers a promising theoretical framework to asses this relationship. It offers clinicians the opportunity to adopt a person-centred approach, that takes into account the patients' individual differences.

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1. Introduction

Today, the paradigm of personality psychopathology is shifting from one that is purely categorical in nature to one grounded in dimensional individual differences. The concept of personality currently attempts a gradual transition from the stability of a categorical model of personality disorders, originally introduced in 1980 in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III), towards a dimensional model of personality disorders in the current 5th edition of the DSM-V published in 2013 (APA, 2013; Zachar & First, 2015). In 1980, the diagnostic model was based upon the assumption that there are 10 personality types, each of which has a fundamental and presumably discrete nature. Yet, many clinicians and researchers like myself believe that personality disorders are best understood as extreme and maladaptive variants of ordinary personality traits that differ from what is considered average or ordinary, by degree, rather than in type. In a dimensional approach, personality features are described along a continuum, for example ranging from introversion to extraversion (Samuel, 2011). Widiger (2011) and Trull (2012) proposed to integrate normal and abnormal personality structure within a common, integrative model, and suggested that the optimal choice would be the Five-Factor Model (FFM) of general personality structure.

In 2012, when the 5th edition of the DSM was in preparation, the Personality and Personality Disorders Work Group of the DSM-V had proposed an hybrid dimensional-categorical model, that includes 25 specific facets (e.g. Eccentricity) organized into five broad trait domains: Negative Affectivity, Detachment, Antagonism, Disinhibition, and Psychoticism (APA, 2013). The facets are not equally distributed across domains, and some domains are characterized by six facets (i.e., Detachment), whereas other domains are characterized by only three facets (i.e., Psychoticism). In addition, some facets are represented in multiple domains (e.g., Hostility). The five domains of this DSM-V trait model are "maladaptive variants of the extensively validated and replicated model of

personality known as Big Five or Five-Factor Model of personality (FFM)" (APA, 2013, p. 773). This multidimensional maladaptive personality traits model had been proposed to represent individual differences in personality disorder expression (Krueger et al., 2012). The intension was to include normative adaptive personality traits as well as to define personality pathology. The model separates general personality disorder *severity* (significant impairment in self and interpersonal relationships, such as empathy or intimacy functioning) from personality disorder *style* (one or more pathological personality traits domains). However, the proposed model did not reach consensus in the American Psychiatric Association's Board of Trustees and it was included as an alternative model in Section III of the DSM-V among concepts requiring additional study (Emerging Measures and Models) (Morey et al., 2015).

While this hybrid model has since generated considerable and ongoing interest in young adults, little consideration has been given to the conceptualization of personality disorders in old age, even though the actual DSM-V diagnostic criteria are not adequately attuned to the living situations and experiences of older people (Debast et al., 2017; van Alphen et al., 2015). Existing studies indicate that Cluster A disorders (paranoid and schizoid personality disorder) and Cluster C disorders (obsessive-compulsive personality disorder) are more prevalent among older people than younger people. In contrast, Cluster B disorders (especially borderline and antisocial personality disorders) are less prevalent among older people than younger people (Balsis et al., 2007, 2009; Van Alphen et al., 2012). However, since the suitability of the DSM appears to be limited in the case of older adults, little empirical data exists to trace the personality disorders over the course of decades. Dimensional models allow for a more reliable analysis of context-specific changes and give raise to less measurement bias across age groups than the categorical models (Debast et al., 2015, 2017). Indeed, Van den Broeck and colleagues applied the multi-dimensional maladaptive personality trait model of the DSM-V in a study on 176 adults aged 72.7 (6.1) years, and results show that traits are measured equally well across young and old age. Their study confirmed the age neutrality of the 25 trait facets (Van den Broeck et al., 2013; 2014). Another study equally validated the DSM-V Section III trait model in 127 adults aged 74.2 (4.3) years, even though the authors mentioned that two of the dimensions, namely the Disinhibition and Psychoticism domains, might require age-specific indications (Debast et al., 2017).

The current ongoing transition from a categorical to a dimension approach of personality is an opportunity to integrate well-established findings from normal personality research into the international psychiatric nomenclatures such as the DSM-V or the future CIM-11. There is compelling evidence that normal-range personality traits provide clinically useful information, emphasizing the importance of assessing both adaptive and maladaptive aspects of personality within a clinical context (Samuel, 2011). Therefore, the present thesis illustrates the importance of including normative, adaptive, personality traits in old age mental health and more precisely late-life depression.

1.1. Five-Factor Model of personality

General traits models of personality, such as the *Big Five* (John et al., 2008) or the *Five-Factor Model* (McCrae & Costa, 2008), have been adopted as consensual frameworks to determine each person's individuality as a function of five broad bipolar dimensions: Neuroticism, Extraversion, Openness to experience, Agreeableness and Conscientiousness (O-C-E-A-N). According to these models, personality traits are defined as pervasive and enduring patterns of thoughts, feelings and behaviours that persist across situations and characterize individual differences. Each individual uniquely rates on a continuum between the extremes of these five dimensions. Neuroticism (N) contrasts emotional stability with negative emotionality, such as feeling anxious, nervous, sad, and tense. Extraversion (E) implies an energetic approach toward the social and material world and includes traits such as sociability, activity, assertiveness, and positive emotionality. Openness to Experience (O) describes the breadth, depth, originality, and complexity of an individual's mental and experiential life. Agreeableness (A) includes traits such as altruism, tender-mindedness, trust, and modesty. Finally, Conscientiousness (C) describes socially prescribed impulse control that facilitates task- and goal-directed behaviour, such as thinking before acting, delaying gratification, following norms and rules, and prioritizing tasks (Costa & McCrae, 1992).

According to the Five-Factor Model of Costa and McCrae, personality traits define basic tendencies that are internal psychological realities, as well as characteristic adaptations that reflect their concrete manifestations in daily life. The deeper psychological entities are not accessible to direct observation, yet can be inferred from self-rated questionnaires (McCrae & John, 2008). More

precisely, the Five-Factor Model is assessed with the NEO-PI, designed by Costa and McCrae (1992). Five big personality dimensions have been statistically identified by a lexical approach having their origins in the natural language of description of personality traits. The NEO-PI provides a general description of normal personality relevant to clinical, counseling, and empirical situations. The original version, published in 1978, included only three factors and was called Neuroticism-Extraversion-Openness Inventory (NEO-I). In 1985, Costa and McCrae published the first manual for the NEO that included all five factors, named the NEO Personality Inventory (NEO-PI, revised in 1990 NEO-PI-R). With the third updated version, published in 2010, Costa and McCrae intended to make the inventory accessible to a wider portion of the population (McCrae & Costa, 2010). The NEO-PI-3 includes 37 revised items that are easier to read and are appropriate for younger respondents or adults with lower education levels (McCrae & Costa, 2005). The NEO-PI consists of 240 statements self-rated rated on a five-point agreement scale, which are organized into five personality dimensions (factors), each factor being subdivided into six lower-order traits, called the 30 facets, and each facet is assessed by 8 statements. The NEO-PI was originally developed in the United States. Since its creation, the five factors have been normed and validated in several languages and cultures, and the French version of the instrument presents solid and well-documented psychometric qualities (Rolland, 1998, 2016). Note that Mooi et al. (2011) developed a short form for older adults, the NEO-PI-R-SF, that is a valid time-saving alternative when a fine-grained description of personality among older adults is required. Its factor structure proved highly equivalent to the parent instrument, indicating concordant validity.

1.2. Five-Factor Model and aging

Personality traits are formed through childhood and increase in stability throughout the lifespan with a peak after age 50 in the general population (Lucas et al., 2011; Roberts & DelVecchio, 2000). McCrae and Costa's (2008) Five-Factor Model emphasizes the biological roots of personality. A large amount of research has studied normative mean-level trends in personality development. Following a maturity principal, the normative mean-level changes show that overall individuals become more mature, socially dominant, agreeable, conscientious, and emotionally stable from young to middle-aged adulthood. Neuroticism, Extraversion, and Openness to experience appear to decrease with age, while, conversely, Agreeableness and Conscientiousness

appear to increase with age (Roberts et al., 2006; Debast et al., 2014). Interestingly, in later adulthood, these mean-level group changes drift into the opposite direction. Overall, Neuroticism increases, whereas Extraversion, Openness, Agreeableness and Conscientiousness, significantly decrease over time (Kandler et al., 2015; Milojev & Sibley, 2017; Wagner et al., 2016). Thus, although personality is relatively stable among all adult age groups, the highest levels of differential stability are found for middle-aged respondents in their 40s or 50s, and lower levels of stability are observed among younger but also older participants in their 60s (Lucas et al., 2011; Schwaba et al., 2018; Wagner et al., 2019). These opposite trends in old age groups can be explained by different developmental and adaptive strategies compared to younger adults (e.g., increasing social integrity and identity formation). Individuals may compensate for physiological, psychological and social losses in old age and adjust their beliefs and attitudes to critical life events such as retirement (Roberts et al., 2008).

Recent studies add that the moderating effect of age cohorts depends on the specific personality dimension (Wagner et al., 2019). Personality is largely a stable and trait-like individual difference construct and an unchanging kernel characterizes all five dimensions except two. Indeed, Conscientiousness and Agreeableness showed more occasion-specific variance than trait stability compared to the other three dimensions. The authors explain that occasion-specific changing factors have more influence on whether an individual is self-disciplined, goal-directed, and responsible. Likewise, Agreeableness is more strongly affected by fluctuating social and environmental characteristics. In summary, from a mean-level population perspective, individuals might be considered grounded in a solid kernel of personality during adult life, but at the same time, they have the capacity to negotiate and adapt to changing circumstances and environments throughout their life.

Besides these mean-level development trends, a few studies have focused on the degree to which individuals deviate from developmental group stability. Individual differences in personality trait stability have been reported in adulthood as well as in old age for all five personality dimensions except Neuroticism (Mroczek & Spiro, 2003; Small et al., 2003; Schwaba et al. 2018). For Neuroticism, individual differences in change were generally small and remained relatively constant across adulthood. These non-normative patterns of change are determined by individual life experiences, such as marriage, death of spouse, or memory complaints, as shown in a 12-year

follow-up study on 1600 elderly men (Mroczek & Spiro, 2003). A study on older twins shows that individual differences in personality traits are fairly stable due to both genetic and environmental sources, while individual differences in change are primarily due to environmental sources indicating plasticity in old age (Kandler et al., 2015).

Of special interest for clinicians is a body of evidence that focused on the stability of the individual, rather than on the stability of the five dimensions through lifespan. In opposition to the focus on mean-level development trends and its individual deviations, some studies have focused on the organization of several personality dimensions within the person (personality typology) and on how these configurations and organizations define different types of people throughout the lifespan (Steca et al., 2010). They have largely investigated early ages of life and have consistently demonstrated that three personality types can be identified in children, youth and adult samples (Asendorf et al., 2001). These three personality types include a large group of resilient or well-adapted individuals, which is contrasted with two less adjusted and maladapted types of individuals. Over-controllers are characterized by high impulse control, high anxiety, and low aggressiveness. Under-controllers are characterized by low impulse control, high trustworthiness, and open aggressiveness. Steca et al. (2010) demonstrated the replicability of these resilient, over-controlled and under-controlled personality types in an elderly population. Resilient older adults were characterized by desirable personality traits, being more extraverted, agreeable, conscientious, and emotionally stable. While over-controlled elderly adults showed very low Extraversion, Openness, and Agreeableness, and high Neuroticism, under-controllers were characterized by low Conscientiousness. The three types differ in terms of their well-being, quality of interpersonal relationships and leisure activities. Further, age is related to the number of individuals classified within each personality type. Namely, there are more resilients and fewer under-controllers in older compared with younger age groups (Specht et al., 2014).

1.3. Five-Factor Model in clinical populations

The five personality dimensions have been repeatedly related to physical health, to academic and work outcomes, as well as to social behaviours, but they have also emerged as powerful clinical tools for mental health professionals. They may give a useful portrait of patients' feelings and needs

and help therapists to formulate treatment plans and anticipate opportunities and pitfalls (Bagby et al., 2008; Miller, 1991). Several meta-analyses have emphasized the importance of personality traits in understanding individual differences in psychopathology (Kotov et al., 2010). High Neuroticism, together with low Conscientiousness, Agreeableness and Extraversion is the typical pattern of personality traits associated with mental disorders (Malouff et al., 2005). Besides, Wright and Simms (2015) suggest that large portions of the recognized psychopathologies can be also organized within a joint framework shared by the five personality trait domains as defined by the DSM-V Section III, namely five broad domains of symptoms and features related to internalizing, disinhibition, psychoticism, antagonism, and detachment.

Amongst the five personality dimensions, Neuroticism is the most consistent and strongest predictor of psychopathology (Kotov et al., 2010). While these findings are quite consistent, particularly with respect to Neuroticism, there is also a degree of conceptual overlap between Neuroticism and diagnosis of depression, since one dimension on which Neuroticism is measured is one's propensity to experience periods of depression. Interestingly, Lamers et al. (2012) found that personality traits have a different association with psychopathology than with wellbeing. While Neuroticism is associated with psychopathology as assessed with the *Brief Symptom Inventory*, Extraversion and Agreeableness significantly contribute to psychological and social wellbeing. Openness to experience is related to psychological, but not to emotional and social wellbeing. Individuals with high levels of Openness to experience are more willing to accept new ideas, to perform new behaviors, or to change habits, which may improve their functioning in individual life. There was no privileged association between Conscientiousness and psychopathology, emotional, psychological, and social wellbeing.

Several hypotheses have been studied to explain how dimensional personality traits may influence levels of mental health. Personality traits seem to influence the affective components of mental illness and mental health through both biological and behavioral mechanisms. Several studies show that Neuroticism and psychopathology on the one hand and Extraversion and positive mental health on the other hand share common physiological bases (Smits & Boeck, 2006). Serotonin neurotransmitters are associated with both Neuroticism and psychopathology, whereas dopamine neurotransmitters are related to Extraversion and positive affect (Lasky-Su et al., 2005). Besides

these biological pathways, personality may facilitate life events and create conditions that promote mental health through behavioral pathways. Persons with high Neuroticism report more daily problems, tend to react with more severe emotions, experience more mood spillover from prior occasions, and exhibit stronger reactions to recurring problems (Suls & Martin 2005). Alexithymia has been considered to play a mediating role between personality traits and mental health (Atari et al., 2016). High Neuroticism, low Extraversion, and low Conscientiousness predict higher scores of alexithymia. In turn, individuals with higher alexithymia experience difficulties in identifying and describing their own emotions, which lead to poorer mental health including depressive symptoms, somatic symptoms, anxiety, and social malfunction.

Interestingly, there is a tendency to organize personality traits profiles into broader higher-level meta-structures to investigate joint etiologic and trans-diagnostic models for normative and pathological personality as well as psychopathology. As explained by Wright and Simms (2015), "the potential for an organizing meta-structure that encompasses basic and pathological functioning would go a long way towards linking disparate scientific literatures and in so doing provide an organizing scheme for refining the study of psychopathology" (p3). With respect to the above described person-centered typology approach of personality traits, resilient, over-controller and under-controller personality types have been replicated not only in normal, but also in clinical populations, such as patients with eating disorders (Bohane et al., 2017). Patients with an eating disorder have a five-factor personality pattern that matches the under-controlled personality type, suggesting high Openness to Experience alongside high Neuroticism and low Agreeableness may be a risk factor for the development of an eating disorder. Rosenström et al. (2018) recently confirmed that three underlying factors are needed to adequately account for the population correlations between variables for eleven commonly studied psychiatric disorders, five pathological personality traits, and five normative personality traits. Both dimensional approaches, the DSM-V Section III trait model classification as well as the NEO-PI, have proven their utility in distinguishing personality profiles between diagnostic groups such as depressive, bipolar, psychotic, and alcohol use disorders (Heath et al., 2018).

1.4. Five-Factor Model and depression in younger adults

In a review on the relationship between personality and depression, Klein et al. (2011) grouped the seven models adopted by study authors into three groups. The first set of authors views personality and depression as having similar causal influences (common cause, continuum and precursor models). Personality and depression share similar etiological influences and are conceived on the same continuum or spectrum, without having a causal influence on the other. A second set of authors (predisposition and pathoplasticity models) holds that personality has causal effects on the onset or maintenance of depression. Finally, a third set of authors (concomitants and consequences models) views depression as having a causal influence on personality. Mental health professionals and clinicians mainly focus on the predisposition and pathoplasticity models, with the hope to identify patients that are at risk for developing a depressive episode, and to identify treatments with the most promising outcomes.

Analyzing the predisposition hypothesis, Allen et al. (2018) proposed to focus on an intermediate hierarchical level. Indeed, both behavior-genetic and factor-analytic studies showing that each of the five factors comprises two correlated but distinct sub-factors that group facets, named *aspects* (DeYoung et al., 2007; Jang et al., 2002; Naragon-Gainey et al., 2009). For example, Neuroticism comprises two aspects, withdrawal and volatility, Extraversion dimension groups two aspects, enthusiasm and assertiveness, and Conscientiousness includes two aspects labeled industriousness and orderliness. Those aspects interact in a different way with depression. Facets of Extraversion that load on enthusiasm show a negative relation with depressive symptoms, whereas facets loading on assertiveness are unrelated to depression (Naragon-Gainey et al., 2009). Allen et al. (2018) found that the previously reported three-way interaction between Neuroticism, Extraversion, and Conscientiousness is actually driven by traits located at a level of the personality hierarchy below the five factors (withdrawal, enthusiasm, and industriousness). Withdrawal, industriousness, and enthusiasm aspects interacted to predict depression. The authors describe a pattern of the interaction supported “a two out of three principle”, in which low risk scores on two trait dimensions protect against a high risk score on the third trait, and in which high risk scores on two traits are associated with equivalent depressive severity as high risk scores on all three traits.

A predisposition account for depression implies a complex interplay among risk factors involving moderation or mediation effects of personality. The most cited of these models is the diathesis-stress model (Klein et al., 2011), which hypotheses that stress moderates the influence of personality to precipitate the onset of depression, where depressive episodes have an enduring effect on personality, with alterations persisting even after recovery (complication or scar models). Precisely, a higher degree of Neuroticism and lower degrees of Extraversion, Agreeableness, and Conscientiousness have been significantly associated with greater perceived stress and depressive symptoms (Kim et al., 2016). Neuroticism and Extraversion were directly and indirectly associated with depressive symptoms via perceived stress, while Agreeableness and Conscientiousness were associated with depressive symptoms only through perceived stress. Higher levels of Extraversion are associated with higher pre-challenge cortisol levels and decreased cortisol reactivity in social stress situations in adults with major depressive disorder when compared to healthy controls (Chopra et al., 2019).

Pathoplasticity models consider that personality has a causal influence on depression, yet personality is thought to influence the expression of depression after onset, namely the severity of the symptoms, their course and their response to treatment (Klein et al., 2011). This relationship is considered to be bidirectional, and psychopathology is expected to differ in its appearance depending on patients' premorbid personality traits. In return, the expression of personality can be affected by the presence of a comorbid depression. With respect to the Five-Factor Model in younger adults, most studies suggested "vulnerable" personalities, characterized by high Neuroticism, low Conscientiousness, and to a lesser extent low Extraversion, predict a poorer course and response to treatment (Bagby et al., 2008; Bock et al., 2010; Bukh et al., 2016; De Fruyt et al., 2006; Morris et al., 2009; Quilty et al., 2008; Wardenaar et al., 2014). Wardenaar et al. (2014) found that recovery was quicker in "resilient" personality profiles, characterized by medium Neuroticism and Extraversion and higher Agreeableness and Conscientiousness. Dermody et al. (2016) explained that patient interpersonal behavior during treatment may be one way that patient personality impacts clinical outcomes in depression. Extraversion, Conscientiousness, and Neuroticism (inverse) predicted higher levels of patient communion throughout treatment,

which was in turn associated with improved treatment outcomes. Patient Agreeableness was inversely associated with agency throughout treatment, which was linked to poorer treatment response. In respect to pharmacological compliance, Extraversion has been shown to be a stronger negative predictor than depression severity or side effects (Cohen et al., 2004).

1.5. Five-factor model and depression in older adults

Following anxiety disorders, affective disorders are the second most prevalent mental disorder (13.7%) in a large European study on 3142 older adults aged 65+ years (Andreas et al., 2017). More precisely, major depressive episodes reach lifetime prevalence as high as 23.3% in Geneva. Depression in late life affects both old age depressed patients with early-onset depression and old age patients with disorder onset later in life after age 60 (late-onset depression). Traditionally, a first episode of depression after the age of 60 years is thought to be associated with increased neurological and vascular impairments. In contrast, the recurrent nature of depressive episodes in early-onset patients is mostly framed in terms of a bio-psycho-social approach, even in old age (Grace & O'Brien, 2003).

In old age, evidence on the relationship between personality dimensions and depression is a lot less abundant than in younger adults. Nevertheless, existing studies show that, in old age like in young age, personality traits affect patients' overall risk for disorder, as well as response to treatment. Presence of a depression diagnosis has been significantly associated with higher Neuroticism and lower Extraversion and Conscientiousness (Koorevaar et al., 2013). Five-Factor personality dimensions are also associated with severity of depressive symptoms in late life, in line with results from recent studies in younger adults. Further, the five dimensions are related to specific depression symptoms, namely mood and motivational symptoms and not somatic symptoms of late-life depression (Koorevaar et al., 2017). Neuroticism and Agreeableness are associated with mood related symptoms of depression, Conscientiousness with motivational symptoms, and Extraversion with both mood and motivational symptoms of depression.

As for younger depressed patients, researchers focused not only on the FFM personality dimensions, but also on the FFM personality facets to study their impact on depression. High

Neuroticism as well as its facets of depressiveness and stress vulnerability, have been linked greater risk of recurrence, greater risk of developing new depression (Hayward et al., 2011; Manning et al., 2017; Steunenberg et al., 2007; Weiss et al., 2009). Individuals high in vulnerability to stress are described as becoming dependent, hopeless, or panicked when facing trying situations, and such maladaptive coping in the presence of psychosocial stressors might perpetuate mood disturbance in depression. Vulnerability to stress, but also negative affect, impulsivity, anger-hostility, and anxiety facets of Neuroticism are associated with worse treatment outcome over time (Manning et al., 2017; Steffens et al., 2013). High vulnerability to stress facets of Neuroticism is also specifically associated with cognitive impairment in late-life depression (Manning et al., 2017; Steffens et al., 2013). Regarding Extraversion and Conscientiousness, only a subset of particular domain facets is associated with treatment outcome. Among Extraversion facets, lower scores on assertiveness, activity, and positive emotions were related to depression, while scores on the facets of warmth, gregariousness, and excitement seeking were not. Similarly, for Conscientiousness facets, competence, order, dutifulness, and self-discipline were related to depression, while achievement-striving and deliberation were not (Hayward et al., 2011). Higher competence, one of the Conscientiousness facets, is associated with faster temporal response to pharmacological treatment in late-life depression (Gildengers et al., 2005).

2. Personal line of research

Adopting a pathoplastic framework, in the past 10 years, we studied the association between the Five-Factor Model personality traits and depression in older adults, and more precisely the impact of personality on depression treatment outcome, the impact of personality on depression detection in the general old age population, the interaction of personality with stressful life events in association to depression, the interaction of personality and depression in their impact on patients' quality of life, as well as the impact of a depressive episode on personality traits (as well as cognitive and neuroimaging features) in remitted patients.

It is noteworthy to mention that the following articles (except one) have all been published before the release of the DSM-V and its Section III trait model. They are inspired by the conceptual

paradigm change from a categorical to a dimensional approach that surrounded the writings of the DSM-V. Indeed, having worked as a clinical psychologist for ten years in the geriatric psychiatry services of the University hospitals of Geneva, I am absolutely convinced of the clinical utility of a dimensional approach of personality traits, which allows for taking into account individual differences in mental health treatment of old age depressive disorders.

Besides, all articles include the revised NEO-PI-R and not its latest version, the NEO-PI-3. Indeed, the French validation of the NEO-PI-3 only became available in 2016.

2.1.Personality as determinant of late-life depression outcome

> Canuto, A., Giannakopoulos, P., Meiler-Mititelu, C., Delaloye, C., Herrmann, F. R., & Weber, K. (2009). Personality traits influence clinical outcome in day hospital-treated elderly depressed patients. *Am J Geriatr Psychiatry, 17*(4), 335-343.

As described above, personality traits, as assessed by the Five-Factor Model, have been shown to be potentially powerful determinant of the clinical outcome in old-age depression. In 2000, only a few empirical studies had addressed the relevance of five-factor personality profiles in predicting the evolution of of psychotherapeutic treatments, especially in elderly populations. Yet its utility in clinical practice had been known to psychotherapists since 1990 (McCrae, 1991; Miller, 1991). In 2009, we decided to investigate whether NEO-PI factors and facets influence treatment outcome in elderly depressed outpatients, who received psychotherapeutic treatment in the context of a psychogeriatric day hospital, using a prospective longitudinal design (see Appendix 1: Canuto et al., 2009).

In this study, we assessed 62 depressed outpatients who followed an intensive semi-residential therapeutic community treatment program in a psychiatric day hospital of Geneva University Hospitals. Study participants were predominately female (66%) and 73.0 (6.6) years old. They presented with major depression (75%, N=46) or depressive phase of bipolar illness (25%, N=16) according to *International Classification of Diseases, Tenth Revision* (ICD-10) criteria as diagnosed by two independent senior psychiatrists blind to the scope of the study. All patients had

at least one prior admission in psychiatric wards. Treatment in day hospital lasted a median time of 133 days to achieve remission, defined by the absence of ICD-10 criteria for depression. The majority of patients (88%, N=55) were treated with psychotropic drugs.

As detailed in Canuto et al. (2009), outcome measures included the Geriatric Depression Scale (GDS), the MOS Short Form Survey assessing patients' subjective mental and physical quality of life (SF-12 MCS and SF-12 PCS), and a Therapeutic Community Assessment scale, measuring patients' self-report (CAS) and staff evaluation of clinical progress (SAS). After admission, all of these instruments were re-administered after 3, 6, and 12 months, as well as at discharge. Univariate changes between admission and discharge were assessed Wilcoxon signed-ranks test for continuous variables. The relationships between each NEO-PI factor and outcome measures were assessed using cross-sectional time-series linear regression models, with a population averaged estimator and a simple intercept model, controlling for age, gender, and duration of treatment.

Study results showed a significant improvement in patients' depression (z=-3.17, p<0.001), as well their mental (but not their physical) quality of life (z=2.06, z=0.039), clinical progress as rated by patients (z=3.10, p=<0.001) and clinical progress as staff rated (z=5.34, p<0.001) (see Appendix 1).

TABLE 5. Impact of NEO-PI Factors and Facets on Clinical Outcome (N = 58)

	GDS			CAS			SF-12 MCS		
	β	z	p	*β*	z	p	*β*	z	p
Neuroticism	*0.066*	*2.85*	*0.004*	−0.09	−2.42	0.016	−0.068	−1.25	0.212
N3 Depressiveness	0.140	1.12	0.265	*−0.350*	*−2.81*	*0.005*	−0.181	−0.70	0.484
N6 Vulnerability	*0.293*	*3.43*	*0.001*	−0.184	−1.13	0.257	0.204	−1.17	0.243
Extraversion	−0.010	−0.43	0.669	0.050	1.26	0.206	0.091	2.10	0.035
E6 Positive emotions	−0.213	−1.89	0.059	0.298	2.34	0.019	*0.421*	*3.05*	*0.002*
Openness	−0.021	−0.92	0.360	0.019	0.56	0.574	0.092	2.07	0.038
O4 Actions	−0.144	−1.66	0.097	*0.471*	*3.54*	*<0.001*	0.311	1.53	0.125
Agreeableness	−0.003	−0.24	0.810	−0.047	−2.22	0.026	−0.014	−0.43	0.665
A5 Modesty	0.147	1.46	0.144	*−0.310*	*−2.72*	*0.007*	−0.350	−1.74	0.081
Conscientiousness	−0.025	−1.36	0.175	0.003	0.11	0.909	0.035	0.80	0.428
C1 Competence	−0.239	−2.29	0.022	0.315	1.93	0.053	0.148	0.53	0.594

Notes: Results represent the regression coefficients and significance values (italics) of the cross-sectional time-series linear regression models adjusted for age, gender, and duration of treatment with outcome measures as dependent variable and each NEO-PI factor separately as independent variable. p Values are computed using a z test to test the null hypothesis that β is equal to 0 versus the hypothesis that β is significantly different from zero. See text for details.

Table 1. published in Canuto et al. (2009)

Regarding the impact of NEO-PI personality dimensions on depressive symptoms, Neuroticism was the only NEO-PI domain with a significant impact on outcome scores changes as shown in Table 1. When the facets of Neuroticism were simultaneously considered, Vulnerability to stress (N6) was positively related to GDS score changes after controlling for age, gender and treatment duration. Depressiveness (N3) and Modesty (A5) were negatively related to patient-rated clinical progress (CAS). In contrast, Openness to actions (O4) was positively associated with CAS score changes in multivariate analyses. Among Extraversion facets, there was an association between Positive emotions (E6) and increase in mental quality of life (SF-12 MCS) at discharge. As for NEO-PI factors, no facet had a significant impact on staff-rated clinical progress (SAS) or physical quality of life (SF-12 PCS) (Table 1).

These results reveal that NEO-PI factors and facets may be independent predictors of response to treatment in the context of psychogeriatric day hospital care. Neuroticism represents the individual's tendency to experience psychological distress with the Vulnerability facet (N6) underlining the difficulty to cope with stress (Costa & McCrae, 1992). The present results imply that a higher level of Neuroticism, and especially of the Vulnerability to stress facet, is associated with a slower amendment of persistent depressive symptoms in the course of day hospital treatment. In respect to the self-perception of the clinical progress, lower levels of Depressiveness (N3) and Openness to actions (O4) facets were associated with higher staff rated clinical progress in the course of this community treatment. Patients' ability to deal with novelty and adaptation to group settings are needed to progress in psychotherapeutic treatments, and patients with high levels of Neuroticism display marked difficulties to change their coping strategy facing new situations. There was a strong negative association between Modesty (A5) facet and patient-rated clinical progress (CAS). Patients with high levels of this Agreeableness facet may be overtly compliant, accepting others' point of view to please sometimes to their own detriment. This over-compliance may be a serious obstacle to the therapeutic process. Patients with lower levels of Agreeableness might be abler to make realistic problem identification. Regarding patients' quality of life, high levels of Openness to experience and Extraversion had a positive impact on mental quality of life improvement in this day hospital setting. The strong positive relationship between Positive emotions (E6) facet and SF-12 MCS score increase parallels several previous reports showing that this facet is a key predictor of well-being.

In conclusion, this study (Canuto et al, 2009) indicates that NEO-PI profiles are associated with the clinical response to a psychotherapeutic day hospital treatment for the elderly. In the same line, another of our studies showed that personality traits influence psychotherapy endings and allow for predicting treatment dropout (Canuto et al., 2008). Agreeableness and Openness to experience were strongly associated with successful termination. Conscientiousness and Extraversion may have a differential impact depending on the type of group (isolated group psychotherapy versus large therapeutic community program). Neuroticism was however not related to the quality of termination.

2.2.Personality as vulnerability marker of neurocognitive decline

> Weber, K., Giannakopoulos, P., Delaloye, C., de Bilbao, F., Moy, G., Moussa, A., Canuto, A. (2010). Volumetric MRI changes, cognition and personality traits in old age depression. *J Affect Disord, 124*(3), 275-282.

In pathoplastic models, Klein et al. (2011) described how premorbid personality traits shape the expression of depression and its response to treatment on one side, and how personality traits can be affected in return by the presence of depression. Therefore, we studied Five-Factor Model personality in old age patients who had recently remitted from depression, as summarized in Weber et al. (2010) (See Appendix 2). This is of particular interest, because depression in old age is a multi-facet disorder that may affect not only mood regulation but also cognition, brain structure and personality. Early-onset depression (EOD) is usually defined by an onset of the first major depressive episode before 60 years of age. In older adults, EOD has been described as a distinctive phenomenological entity as opposed to late-onset depression (LOD), reflecting possible differences in etiology, neurophysiological patterns and guidance of anti-depressant treatment (Grace & O'Brien, 2003). LOD is thought to have a more organic and neurobiological age-related etiology and course, frequently associated with vascular burden and cognitive impairment. In contrast, EOD is thought to be associated with persisting changes of personality dimensions. Referring to the Five-Factor Model of personality, high levels of Neuroticism may not only predispose to depressive reactions and influence their outcome, but they may be present even in remitted patients. Previous studies in geriatric populations mostly focused on late-onset depression and limited their analysis on neuropsychological and neuroimaging parameters, neglecting psychological vulnerability

markers.

To analyze whether changes in personality dimensions occur in EOD patients in the absence of acute depressive symptoms, we performed a cross-sectional comparison between euthymic EOD and healthy elderly including detailed neuropsychological evaluation, assessment of both volumetric changes in limbic areas and vascular burden and assessment of personality profiles according to the Five-Factor Model (see Appendix 2). Diagnosis of EOD and absence of psychiatric disorder in healthy controls was established using the Mini International Neuropsychiatric Interview administered by a senior psychiatrist. 38 patients aged 66.1 (6.2) years were recruited in geriatric psychiatry divisions of the University Hospitals of Geneva and Lausanne. 62 healthy controls aged 71.1 (7.3) were recruited in elderly-specific clubs (such as gym classes, social and leisure activities, etc.) and via advertisements in local newspapers. A comprehensive neurocognitive battery was administered and included the global Mattis Dementia Rating Scale as well as specific measures of processing speed, working memory, episodic memory and executive functioning. MRI scans were performed and volumetric estimates of the amygdala, hippocampus, anterior cingular and entorhinal cortices were determined both by morphometric and voxel-based methods. Personality was self-assessed with the French NEO-PI. Linear regression models were also built with cognitive parameters, volumetric estimates, vascular lesions, and NEO-PI factor/facet scores as the dependent variables and diagnostic group, socio-demographic, history of depression, and number of depressive episodes as the independent variables.

Table 4
Personality factor and facet scores in the present series.

		EOD ($N=38$)	Controls ($N=62$)		
Factor	Facet	Mean (SD)	Mean (SD)	t [a]	p
Neuroticism [b]		88.50 (27.62)	74.16 (22.21)	−2.62	**0.010**
	Anxiety (N1)	17.32 (7.31)	13.60 (6.20)	−2.61	**0.011**
	Angry hostility (N2) [b]	12.76 (5.29)	11.45 (4.98)	−1.25	0.214
	Depression (N3) [b]	16.97 (6.50)	12.97 (4.79)	−3.10	**0.002**
	Self-consciousness (N4) [b]	16.13 (6.01)	13.73 (3.88)	−1.92	0.059
	Impulsiveness (N5)	14.76 (5.30)	13.79 (4.29)	−0.95	0.342
	Vulnerability (N6) [b]	12.39 (5.84)	9.87 (4.69)	−2.09	0.039
Extraversion		92.34 (24.09)	101.19 (21.66)	1.85	0.068
	Warmth (E1) [b]	21.37 (4.35)	23.74 (4.09)	2.96	**0.003**
	Gregariousness (E2)	14.26 (5.83)	14.94 (5.26)	0.58	0.563
	Assertiveness (E3)	13.24 (6.25)	14.66 (5.07)	1.18	0.240
	Activity (E4)	16.45 (5.54)	17.76 (5.33)	1.16	0.247
	Excitement seeking (E5) [b]	11.74 (4.94)	11.74 (4.93)	0.04	0.960
	Positive emotions (E6) [b]	16.42 (6.32)	19.95 (4.93)	2.93	**0.004**

[a] T-test comparisons were made between EOD patients and healthy controls. Statistically significant differences (p threshold value of 0.01) are in bold.
[b] Data were transformed prior to analysis.

Table 2. Published in Weber et al. (2010)

Surprisingly, results revealed no significant group differences, neither for the cognitive variables, nor for brain volumes or vascular burden. However, contrasting with the negative neuropsychological and MRI data, group comparisons revealed significant differences between healthy controls and EOD patients for Neuroticism and Extraversion facets, as shown in Table 2. Patients scored significantly higher than controls on Neuroticism ($t(69)=-2.62$, $p=0.010$) and two of its facets, namely anxiety (N1, $t(68)=-2.61$, $0=0.011$) and depression (N3, $t(66)=-3.10$, $p=0.002$). In respect to Extraversion, patients scored significantly lower on two facets: warmth (E1, $t(89)=2.96$, $0=0.003$) and positive Emotions (E6, $t(64)=2.93$, $p=0.004$). Factor and facet scores for Agreeableness, Conscientiousness and Openness to experience were not significantly different between the two groups.

From a neurocognitive perspective, the present study shows that euthymic EOD patients are preserved both in terms of global functioning and depression-specific cognitive domains. In line with the cognitive preservation, our MRI data documented both intact volume in the main limbic areas and absence of significant vascular burden in EOD cases. In contrast, the only markers that significantly differentiated EOD cases from controls were their personality traits. Depressed elderly individuals showed a tendency to be shy, fearful, and anxious (N1). They also experienced more feelings of guilt, sadness, helplessness and loneliness (N3). Patients tended to be more introverted, less sociable and naturally active, confident and optimistic. They were less interested and showed less sympathy to other people and they also failed to experience positive emotions such as joy and happiness (E1, E6). As hypothesized by previous evidence, while late-onset depression may be more driven by acquired pathology such as vascular burden, genetic background and personality dimensions may be the most important determinants of EOD.

It is notable, that a two-years follow-up of the same sample (Weber et al., 2012) showed that the increased Neuroticism factor and anxiety facet scores as well as the decreased warmth and positive emotions facet scores found at baseline reached the level of healthy controls after 2 years. Only the depression facet scores remained significantly higher in EOD patients compared to controls upon follow-up. Results were independent of depressive relapse since baseline (25% of the patients). These findings suggest that both cognitive performances and brain volumes show long-term preservation in older EOD patients. In contrast, the depression-related personality facet might be a trait like marker of depression that persists in the long-term evolution of this mood state. As

described in the introduction, in younger patients, Klein et al. (2011) described that the link between personality and depressive illness has been frequently conceptualized as bidirectional. Personality directly induces the onset of depression, and in return the depressive episode has an enduring effect on personality, with alterations persisting after depression remission (consequences or scar model). Personality is expected to impact on the course and the expression of depression after onset, and in return, depression affects the expression of personality too. Several criticisms raised the doubt about the cross-sectional personality-psychopathology relationships because it may be complicated by the influence of patient's mood state on the self-reported questionnaires of their personality. They consider that changes in self-reported personality measures are merely a depression related measurement bias (Klein et al., 2011). Personality assessments often cover state affect as well as trait variances, the variance of the first masking the variance of the second during acute episodes (Clark et al., 2003). Indeed, results of the present study reinforce previous evidence, which showed that even though levels of Neuroticism decreased after remission, they did not reach the normal range (De Fruyt et al., 2006; Morey et al., 2010).

Aging might add to the complexity and heterogeneity of this interplay since it is characterized by significant biological, social and psychological changes that should be addressed using dynamic and multivariate approaches. Our observations corroborate the point of view of Margrett et al. (2010), who stressed the need to assess the synergistic effects of cognition, stable and time-varying attributes of personality in the evolution of late-life depression.

2.3. Personality and stressful life events in late-life depression

> Weber, K., Giannakopoulos, P., Herrmann, F. R., Bartolomei, J., DiGiorgio, S., Ortiz Chicherio, N., … Canuto, A. (2013). Stressful life events and neuroticism as predictors of late-life versus early-life depression. *Psychogeriatrics*, *13*(4), 221–228.

After studying the relationship between the five-factor model of personality in old age depressed patients, we were wondering how personality traits are associated with acute major depression across the age spectrum and if the relationship reported in younger patients also holds in older adults. In 2012, most of the existing evidence on acutely depressed patients showed no

simultaneous inclusion of young and elderly patients. Therefore, we decided to assess the association of the Five-Factor Model of personality traits and major depression in two samples of young and old depressed outpatients and two age-matched groups of healthy controls. A first analysis on these four groups (Weber et al., 2012) showed that Neuroticism was the only factor to be associated with acute depression independently of the age group. Indeed, it was increased physical burden (cumulative illnesses) and moderate depression severity that allowed for differentiating late-life compared to young age depression. Adopting an integrative approach, we continued to further explore the relationship between personality and depression, by taking into account additional demographic, psychosocial and physical health covariates. In younger adults, the occurrence of depression is triggered by a combination of long-standing factors such as personality traits (Neuroticism) and more acute factors such as the subjective impact of stressful life events. In our second analysis, we decided to assess whether this combination also holds in older adults or whether late-life depression is specifically triggered by comorbid physical illnesses (See Appendix 3: Weber et al., 2013).

This second study compared 79 outpatients (38 young and 41 old) with major depression and 102 never-depressed controls (51 young and 51 old). Within each of these two groups, two age groups were determined, ranging from 25 to 50 years and from 60 to 85 years respectively, resulting into a comparison between four groups. All patients were recruited in the outpatient services of the Divisions of Geriatric and Adult Psychiatry of the University Hospitals of Geneva and received combined pharmacotherapy and psychotherapy treatment at the moment of inclusion. Never-depressed controls were recruited through advertisements in local newspapers. Assessments included the Social Readjustment Rating Scale (SRRS), assessing frequency of 43 common stressful life events over the previous 12 months, the Cumulative Illness Rating Scale (SRRS), rating the severity of impairment in 13 organ systems, and the revised NEO Personality Inventory (NEO-PI-R). Regarding the stressful life events, to estimate the individual differences in each person's ability to cope and react to stressful life events, participants were asked to rate their own subjective emotional impact of each event (sei-SRRS score). Depression severity was rated on the Hamilton Rating Scale for Depression (HRSD). Logistic regression models analyzed the association between depression and subjective impact of stressful life events while controlling for Neuroticism and physical illness.

Comparison of depression characteristics between young age and old age depressed patients revealed that depression in young age is associated with higher depressive symptom severity (HRSD $t(77)=6.81$, $p<0.001$), shorter disease duration ($t(77)=4.49$, $p<0.001$) and earlier age of onset ($t(77)=5.32$, $p<0.001$), compared to depression in old age. Not surprisingly, Neuroticism was higher in the depressed patients group than in control subjects ($F(1,177)=133.75$, $p<0.001$), and higher in the younger than in the older age group $F(1,177)=10.68$, $p=0.001$). Likewise, physical health burden was stronger in depressed patients than in healthy controls ($F(1,177)=62.99$, $p<0.001$), and stronger in older than in younger adults ($F(1,177)=61.39$, $p<0.001$). Both patients and controls reported a similar number of stressful life events in the past 12 months (SRRS scores). Interestingly, controls experienced significantly fewer stressful life events in old age than in young age ($F(1,177)=13.19$, $p<0.001$). Regarding depression, it was the subjective impact of stressful life events scores (sei-SRRS), and not the events themselves, that was significantly more negative in depressed patients than in controls ($F(1,177)=95,17$, $p<0.001$). Additionally, young controls reported more life events with a positive impact than did older controls $F(1,177)=24.34$, $p<0.001$), contrary to depressed patients.

Table 3 Determinants of depression in the young vs the old age group

		Regression coefficients		
	Predictors	OR	*P*-value	R^2†
Patients/controls				
Young (*n* = 89)	SRRS‡	0.99	0.327	0.91
	sei-SRRS§	0.47	0.007	
	Neuroticism¶	1.12	0.005	
	CIRS††	2.10	0.060	
Old (*n* = 92)	SRRS	1.00	0.639	0.61
	sei-SRRS	0.85	0.035	
	Neuroticism	1.06	<0.001	
	CIRS‡	1.25	0.049	
Young/old				
Depressed patients (*n* = 79)	SRRS	1.00	0.251	0.47
	sei-SRRS	0.95	0.354	
	Neuroticism	0.96	0.001	
	CIRS	1.63	<0.001	

†Nagelkerke's R^2. ‡Social Readjustment Rating Scale (SRRS) total score (range 0–1466). §Subjective emotional impact of stressful life events (sei-SRRS) range: −26–18. ¶Neuroticism factor score reflects the NEO Personality Inventory-Revised (range: 0–192). ††Cumulative Illness Rating Scale (CIRS) total score range: 0–52. OR, odds ratio.

Table 3. Published in Weber et al. (2013)

Regarding the predictors of depression, results are displayed in Table 3. In the young age group 91% of the depression variance between patients and controls was predicted by a more negative emotional impact of stressful life events ($R^2=0.65$) and higher Neuroticism ($R^2=0.26$). In the older age group, only 61% were explained by these two variables. While the prediction of Neuroticism

for depression is similar in old age (R^2=0.27) than in young age, the negative emotional impact of life events has a lot less predictive power in the old age group (R^2=0.30). However, in the old age group, the severity of physical health burden emerged as a significant predictor. The overall number of stressful life events in the past 12 months (SRRS score) did not significantly predict depression per se, neither in young, nor in old age. Importantly, the interaction between Neuroticism and emotional impact of life events (sei-SRRS) was introduced into the same regression models to predict depression. It showed no significant influence on depression, suggesting that both variables act as independent predictors. When depression is predicted within the depressed group to distinguish early- from late-life depression, lower levels of Neuroticism and higher physical health burden are the two variables that significantly differentiate old age depressed patients from young age depressed patients (R^2= 0.47).

This study revealed that a high level of Neuroticism is a stable predictor of depression in both age groups. Previous lines of evidence had suggested an environmentally mediated relationship between Neuroticism and depression. In existing evidence, Neuroticism has been shown to interact with stressful life events to trigger new episodes of recurrent depression according to some authors, while other authors found no such interaction. We confirmed the absence of interaction between Neuroticism and the impact of stressful life events in the present study. Personality did not act as a moderator on the stress–depression relationship. Neuroticism emerged as a direct and independent predictor of major depression, once patients' physical burden and subjective impact of life stressors had been accounted for, in young age as well as in old age patients. It could be argued that Neuroticism simply reflects an increase in depressive mood in both age groups. The results showed however that the relative importance of Neuroticism in predicting depression (patients vs controls) is equal in both life periods, independent of the severity of the depressive episode.

Our findings point to a differential impact of psychosocial and health determinants of major depression in young and old age community-dwelling adults. The subjective negative impact of stressful life events and high Neuroticism scores are associated with depression in both life periods. However, in late life, the impact of stressful life events is tempered, whereas physical health burden becomes a significant predictor of depression.

2.4. Personality and quality of life in late-life depression

> Weber, K., Canuto, A., Giannakopoulos, P., Mouchian, A., Meiler-Mititelu, C., Meiler, A., ... De Ribaupierre, A. (2015). Personality, psychosocial and health-related predictors of quality of life in old age. *Aging Ment Health,19(2),151-158*.

After finding that in old age, personality, and more particularly Neuroticism, does not necessarily interact with stressful life events en enhancing depression, we were wondering whether Neuroticism rather interacts with depression to impact on patients' quality of life. Following the pathoplastic approach, we hypothesized that personality does not play a key role as risk or protective factor to develop depression, but rather that personality plays a role on how patients experience their depression once they developed it. More precisely, we decided to analyze whether Neuroticism interacts with depression to impact on patients' level of subjective quality of life (See Appendix 4: Weber et al., 2015). And we questioned this association with respect to our two age groups: 92 young (aged from 25 to 50 years) and 89 older (aged from 60 to 85 years) adults

Using a cross-sectional design (See Appendix 4), our study measured subjective quality of life in two groups of young and older adults carefully assessed for their depressive symptoms. We adopted a multi-factorial perspective and hypothesized that quality of life is explained by multiple factors not only in younger adults, but also in older populations. Based on the integrative works of Ryff (2008) in old age, and the lifespan perspective of Friedman (Friedman, 2000; Friedman & Kern, 2014), we hypothesized that four sets of factors could impact decisively on the individual perception of the quality of life: psychosocial characteristics, presence of depression, current health variables such as comorbid physical illnesses, and long-term individual characteristics such as the five personality dimensions of Costa and McCrae (1992).

Participants were recruited through advertisements in local newspapers and by board certified psychiatrists in the outpatient settings of the Mental Health and Psychiatry Department of the University Hospitals of Geneva. All participants were initially interviewed with the Mini International Neuropsychiatric Interview (MINI) by a senior psychiatrist or a trained clinical psychologist. All depressed participants received combined pharmacotherapy and psychotherapy treatment at the moment of study inclusion. The severity of depressive symptoms was measured by the Hamilton Rating Scale for Depression (HRSD). Quality of life was self-rated on the World Health Organization Quality of Life questionnaire (WHOQOL-Bref). The five personality factors

were self-assessed with the revised French NEO-PI-R. Social support was self-estimated by participants as the number of trustworthy relationships. Education was determined by the number of years of formal education. To assess the age-related differences in the relationship between quality of life and the various predictor variables, the same hierarchical linear regression model was estimated separately for each age group (Tables 4 and 5).

Table 2. Quality of life determinants (WHOQOL-Bref total score) in old-age group ($N = 92$).

		Regression coefficients			Change statistics		
Blocks	Determinants	*B*	SE	*p*	R^2	*df*	*P*
1	(Constant)	70.64	1.04		0.65	(1,90)	< **0.001**
	HRSD[a]	−1.15	0.09	< **0.001**			
2	(Constant)	68.12	3.91		0.72	(4,86)	**0.001**
	HRSD	−0.96	0.09	< **0.001**			
	Gender[b]	2.72	1.43	0.060			
	Education	0.06	0.17	0.702			
	CIRS[c]	−3.03	0.89	**0.001**			
	Social support	0.48	0.25	0.058			
3	(Constant)	43.11	8.66		0.78	(5,81)	**0.002**
	HRSD	−0.72	0.12	< **0.001**			
	Gender	2.67	1.42	0.063			
	Education	−0.08	0.17	0.629			
	CIRS	−2.16	0.84	**0.012**			
	Social support	0.46	0.23	0.052			
	Neuroticism	−0.05	0.03	0.126			
	Extraversion	0.02	0.04	0.689			
	Openness	0.09	0.04	**0.040**			
	Agreeableness	0.08	0.04	**0.048**			
	Conscientiousness	0.06	0.03	0.081			

[a]HRSD = Hamilton Rating Scale for Depression.
[b]1 = Male, 2 = Female.
[c]CIRS = Cumulative Illness Rating Scale total score normalized with square-root transformation.

Table 4. Published in Weber et al. (2015)

Study results show that an identical level of quality of life in both age groups, as scored on the WHOQOL-Bref. In the old adults age group, as illustrated in Table 4, 65% percent of the variance was explained by depression severity (HDRS score). Incremental R^2 changes revealed that the inclusion of education, social support and physical illness explaining an additional 7% of quality of life variance. Personality factors further added an extra 6% to reach a final prediction of 78% of the quality of life variance. Depression severity showed the strongest negative effect on quality of life (B=-0.72, SE=0.12, $p < 0.001$), followed by physical illness (B=-2.16, SE=0.84, p=0.012). Both high levels of Openness to experience (B=0.09, SE=0.04, p=0.040) and Agreeableness (B=0.08, SE=0.04, p=0.048) had a significant positive effect on quality of life.

Table 3. Quality of life determinants (WHOQOL-Bref total score) in young age group ($N = 89$).

		Regression coefficients			Change statistics		
Blocks	Determinants	*B*	SE	*p*	R^2	*df*	*P*
1	(Constant)	70.61	0.82		0.76	(1, 87)	< **0.001**
	HRSD[a]	−0.82	0.05	< **0.001**			
2	(Constant)	64.90	3.81		0.77	(4, 83)	0.384
	HRSD	−0.74	0.07	< **0.001**			
	Gender[b]	0.22	1.23	0.858			
	Education	0.15	0.16	0.335			
	CIRS[c]	−0.11	0.89	0.899			
	Social support	0.37	0.23	0.110			
3	(Constant)	65.40	7.57		0.81	(5, 78)	**0.023**
	HRSD	−0.57	0.09	< 0.001			
	Gender	1.46	1.33	0.276			
	Education	0.11	0.16	0.494			
	CIRS	−0.20	0.85	0.819			
	Social support	0.43	0.24	0.077			
	Neuroticism	−0.06	0.03	0.045			
	Extraversion	−0.03	0.04	0.422			
	Openness	0.05	0.03	0.170			
	Agreeableness	−0.05	0.04	0.174			
	Conscientiousness	0.05	0.03	0.102			

[a]HRSD = Hamilton Rating Scale for Depression.
[b]1 = Male, 2 = Female.
[c]CIRS = Cumulative Illness Rating Scale total score normalized with square-root transformation.

Table 5. Published in Weber et al. (2015)

In contrast, in the younger age group (see Table 5), 76% of the quality of life variance was already explained by depression severity alone (B=0.82, SE=0.05, $p < 0.001$). In contrast to the older cases, the inclusion of physical illness, social support and education did not significantly improve the percentage of WHOQOL-Bref scores variance explained by the model. None of the five personality factors emerged as a significant individual predictor of quality of life in this age group after controlling for all other variables.

These results reveal that some personality dimensions are associated with quality of life in old age, but not in young age, after controlling for acute depression features, physical health and psychosocial variables. In old age, Openness to experience and Agreeableness showed a positive association with quality of life after adjusting for these variables (contrary to Neuroticism, Extraversion and Conscientiousness). Openness to experience is defined by one's receptivity to one's feelings, intellectual curiosity, arts, values or new experiences. McCrae and Costa (1991) have suggested that Openness to experience may amplify both negative and positive emotional reactions. Indeed, Openness to experience was associated with higher levels of quality of life in

our study. Agreeableness reflects one's way of managing interpersonal relationships; namely trust, straightforwardness, altruism, conflict management, modesty and tender mindedness (Costa & McCrae, 1992). Our study confirms that this personality dimension plays a key role in the subjective perception of the quality of life in old age.

2.5.Personality and late-life depression detection the general hospital

> Canuto, A., Gkinis, G., DiGiorgio, S., Arpone, F., Herrmann, F. R., & Weber, K. (2016). Agreement between physicians and liaison psychiatrists on depression in old age patients of a general hospital: influence of symptom severity, age and personality. *Aging Ment Health, 20*(10), 1092-1098.

The above reported findings have important implications for old age health professionals. Comorbid depressive episodes are common among general hospital inpatients. However, depression still remains poorly recognized in patients aged 60 years and older. Clinical implications are inadequate medication, treatment delays and impact on patients' quality of life. Interestingly, patients' personality plays a key role not only in the way old age patients themselves cope with their depression, but it also influences the way health professionals perceive and treat old age depression. Primary care patients do not necessarily explicitly report their psychosocial symptoms to non-psychiatric physicians. Unfamiliar with individual differences in depressive mood, physicians who are sensitive to non-verbal expressions of emotion may overestimate depression; whilst physicians who tend to blame depressed patients for causing, exaggerating or prolonging their depression, may be less accurate in depression recognition.

To address this issue, we performed a study to determine the degree of agreement between primary care physicians' and liaison psychiatrists' evaluation of depression, and second, to analyze how patients' clinical presentation and personality traits influence the degree of agreement between primary care physicians and and liaison psychiatrists (Canuto et al., 2016, see Appendix 5). The study included 148 old age inpatients who were consecutively referred by physicians for psychiatric investigation to the consultation-liaison psychiatry service of the University Hospitals of Geneva, by the different medical departments of this general hospital (internal medicine, surgery, re-education). Once referred to the consultation-liaison service, patients were evaluated by a psychiatrist within a maximum of 36 hours following the referral as part of the routine

assessment. All patients were administered the structured Mini International Neuropsychiatric Interview (MINI) by a senior psychiatrist. Binary coding was applied to both evaluations, for the physicians (1= presence of depressive mood/0= other rational for referral) as well as for the psychiatrists (1= diagnosis of major depressive episode according to ICD-10 diagnostic criteria/0= other or no diagnosis). This crossing of physicians' and psychiatrists' evaluations results into a crosstab of four possible cases of agreement. Patients self-assessed their personality dimensions on the abbreviated Big Five Inventory 10 items (BFI-10) because of the limited assessment time. The context of the consultation-liaison psychiatry did not offer the possibility to assess the full NEO-PI-R. To maintain the focus on depression, out of the four possible agreements, logistic regression models were used to analyze which variables predict the degree of agreement between physicians' and psychiatrists' evaluation for those patients referred to the liaison-psychiatric consultation for depressive mood.

Results show that agreement between physicians' initial impression of depression and the psychiatrists' final diagnosis revealed to be fair (Cohen's kappa =0.21, p=0.002). Among the 82/148 patients referred expressly for depressive mood to the liaison-consultation service, 33/82 (40%) indeed received a diagnosis of a major depressive disorder according to ICD-10 criteria.

Table 3. Determinants of agreement between physicians and psychiatrists (1 = agreement on depression for 33/148 patients, 0 = non-agreement on depression for 115/148 patients).

	OR	*p*	95% CI	
Psychiatric symptoms (HoNOS65+)				
Psychol. distress due to physical illness	1.06	0.798	(0.69; 1.60)	$R^2 = 0.26$ ($p < 0.001$)
Anxious symptoms	1.02	0.896	(0.70; 1.49)	
Depressive symptoms	**2.32**	**<0.001**	(1.47; 3.67)	
Problems activities of daily living	0.99	0.964	(0.65; 1.51)	
Cognitive problems	1.09	0.762	(0.63; 1.87)	
Age	**0.90**	**0.011**	(0.84; 0.97)	
Gender (1 = male)	2.34	0.103	(0.84; 6.50)	

Note: Significant determinants are highlighted in bold.

Table 6. Published in Canuto et al. (2016)

Further, when agreement on depression was predicted by personality (see Table 6), such as assessed with the BFI-10, together with age and gender, the model was not statistically significant. In contrast, when agreement on depression was predicted by psychiatric symptoms, age and gender, the model was statistically significant (R^2 =0.26, p<0.001) and revealed that the severity of depressive symptoms significantly doubled the odds (OR=2.32 (1.47; 3.67), p<0.001) of agreement

between physicians and psychiatrists' evaluation, independently of patients' gender (Table 6). In addition, patients' age significantly reduced the odds (OR =0.90 (0.84; 0.97), p=0.011) of agreement. The younger are the patients, the stronger is the degree of agreement between physicians' and psychiatrists' evaluation of depression.

Table 4. Determinants of non-agreement between physicians (who referred for depressive mood) and physicians (who did not confirm diagnosis of a major depressive episode) (1 = non-agreement on depression 49/148, 0 = remaining 99/148).

	OR	*p*	95% CI	
Personality traits (BFI)				
Neuroticism	**0.82**	**0.016**	(0.70; 0.96)	$R^2 = 0.12$ ($p = 0.002$)
Extraversion	1.01	0.932	(0.84; 1.21)	
Openness	**1.24**	**0.007**	(1.06; 1.45)	
Agreeableness	1.04	0.705	(0.85; 1.26)	
Conscientiousness	1.06	0.617	(0.85; 1.31)	
Age	1.04	0.170	(0.98; 1.09)	
Gender (1 = male)	0.64	0.292	(0.28; 1.46)	

Note: Significant determinants are highlighted in bold.

Table 7. Published in Canuto et al. (2016)

Interestingly, the pattern was the opposite regarding the lack of agreement on depression between physicians and psychiatrists (see Table 7). While agreement was predicted by symptom severity and age, but not personality, non-agreement was predicted by personality dimensions, but not by psychiatric symptoms, after adjusting for age and gender. As shown in Table 7, lower levels of Neuroticism (OR = 0.82 (0.70; 0.96), p=0.016) as well as higher levels of Openness to experience increased the odds of non-agreement (OR =1.24 (1.06; 1.45), p=0.007).

Patients presenting with higher levels of Openness to experience, as well as lower levels of Neuroticism, tended to be referred for psychiatric evaluation of depressive mood without actually presenting a depressive disorder. According to the Big Five dimensions of personality (John, 1990), Openness to experience (versus closed-mindedness) describes the breadth, depth, originality and complexity of the person's mental and experiential life. Patients with higher Openness scores show more interest in their inner feelings, emotions, intellectual curiosity or readiness to re-examine their values. They express more easily their thoughts and emotions, seek more actively and appreciate new experiences, and simply show more interest in psychological approaches and more readiness to engage in a helping alliance with professionals (Miller, 1991). They may more easily perceive the need for mental health care and may be able to keep higher levels of well-being compared to individuals with lower levels of openness. Regarding Neuroticism, while higher Neuroticism has

been shown by other authors to lead to exaggerated health care utilization and overtreatment (Cuijpers et al., 2007), in this study lower Neuroticism lead to misinterpretation of depressive symptoms. Individuals with low Neuroticism scores tend to be even-tempered, level-headed and optimistic. They are less likely to feel tense or worried, and they remain calm and think clearly even in stressful situations. Indeed, when the expression of the depressive mood state is not reinforced by the negative trait emotionality of Neuroticism, depressive mood is less clearly identified by primary care physicians. Indeed, among the patients referred for depression by physicians, 27% actually presented an anxiety disorder and 7% presented a cerebral disease according to the psychiatrist's diagnosis.

In their study on younger adults, Seekles et al. (2012) found that higher levels of Openness as well as higher levels of Neuroticism are associated with patients' capacity to receive the care they need, regardless of the severity of their depressive disorders. Interestingly in the present study, it was high Openness to experience and low Neuroticism scores that diminished physician's odd for referral and increased patients' chances to be referred for depressive mood without actually presenting a depressive disorder. While higher Neuroticism leads to exaggerated health care utilization and overtreatment (Cuijpers et al., 2007), lower Neuroticism may be one of the explanations for under-recognition and under-treatment of depressive disorders.

3. Discussion

3.1. Current state of the art

Our research is based on the use of a dimensional approach of personality in order to assess the impact of personality in clinical expression and outcome of late-life depression. Personality is addressed by means of the Five-Factor Model of personality traits, as defined by Costa and McCrae (1992). This model defines each person's individuality according to five broad bipolar dimensions: Neuroticism, Extraversion, Openness to experience, Agreeableness and Conscientiousness. Several researchers and clinicians have recommended its use to define personality disorders in diagnostic manuals such as the DSM-V or the CIM-11 (Samuel, 2011; Trull, 2012; Widiger, 2011). These authors believe that personality disorders are best understood as extreme and maladaptive

variants of ordinary normal-range personality traits. Personality traits and personality disorder share the same fundamental nature, but differ in terms of intensity (Samuel, 2011). Building research on conceptualizing personality disorders as maladaptive, extreme variants of general personality traits, allows for assessing both normal and abnormal personality within the same dimensional model using bipolar constructs. A dimensional approach provides useful information about the characteristics of personality defining a statistically reliable model of normality taking into account intermediate at risk cases. This lecture of personality makes it possible to explore prodromal phases that precede clinically overt disorders that are mainly defined in some cases quite arbitrarily by social dysfunction or individual suffering. The DSM-V has finally chosen to continue the use of categorical definitions of personality disorders. However, it has included the dimensional approach in its Section III as an emerging model that requires additional studies.

Dimensional trait models of personality such as the Five-Factor Model are of particular interest in old age psychiatry. Indeed, the FFM offers two advantages. First, a large body of research shows that personality development continues throughout the entire life-span. Personality is formed in childhood and increases in stability from young to middle-age adulthood. After the age of 60 years, individuals have a stronger tendency to deviate form the mainstream normative trend of personality development, especially for Contentiousness and Agreeableness factors, that are proved to change facing significant late-life events such as retirement, bereavement or cognitive decline. Thus, the FFM permits to consider the late-life context when assessing personality. Second, the FFM offers the advantage to assess personality throughout the lifespan, with or without the occurrence of a personality disorder. To date, there is a tendency to organize personality traits into broader higher-level meta-concepts and to assess personality by grouping personality dimensions into *personality types* to isolate less adjusted and maladapted types of individuals (over-controllers or under-controllers) from resilient and adapted individuals (Bohane et al., 2017).

The present data addresses first the complex relationship between depression and personality in old age, and more precisely the causal role of personality in the maintenance and expression of depression (pathoplastic approach), as well as the bidirectional nature of this relationship. Clinicians know that depressive episodes alter personality and these changes persist after recovery from depression. Attempts to identify personality traits that enhance vulnerability to depression have been limited by a tendency to focus on broad traits in isolation, rather than examining more

specific traits and their interactions. Several recent studies suggest to focus on underlying facets and lower-order sub-factors (Allen et al., 2018). In parallel, the higher-order personality types have been distinguished including vulnerable personalities, who present a poor depression course and response to treatment, as well as resilient personality profiles, who recover more easily (Wardenaar et al., 2014). Further, well-known vulnerability models consider that personality interacts with stressful life events to precipitate the onset of depression (diathesis-stress model) (Klein et al., 2011).

3.2. One step beyond the current state of the art

Our study assessing the impact of the Five-Factor Model of personality on psychiatric day hospital treatment of depression in old age clearly confirmed the utility of assessing not only the five broad personality dimensions, but also their underlying facets (Canuto et al., 2009). This study confirmed strong relationship between Neuroticism and depressive symptoms, that has been described repeatedly in younger depressed patients, yet only rarely in older depressed patients (Hayward et al., 2011; Steffens et al., 2013), including the privileged relationship between depression and the vulnerability to stress and depressiveness facets of Neuroticism. Both the Neuroticism factor and the vulnerability facet significantly predicted slower amendment of persistent depressive symptoms and depressiveness predicted clinical progress over the course of the treatment, after adjusting for age, gender and duration of treatment. Our observations also reveal the beneficial effect of Openness and Agreeableness on clinical progress and quality of life in elderly depressed individuals. Personality facets such as the Openness to actions facet and the modesty facet of Agreeableness are related to clinical progress, while the positive emotions facets of Extraversion is associated with better mental quality of life. The focus on personality facets allows for a precise description of those patients that are better responders when treating depression in therapeutic community oriented settings. Patients with lower depressiveness and lower stress-vulnerability, with higher flexibility to change, a competitive spirit, and positive emotionality, are more likely to present a positive outcome in this particular treatment setting. Each of these personality facets acts as an independent predictor of late-life depression treatment outcome.

After confirming the impact of personality facets on the the clinical outcome of depression treatment, we examined the bi-directionality of the depression-personality relationship in late life. The aim was to determine the impact of depression on personality traits after the recovery form a depressive episode. This issue is of particular importance, because it raises the state-trait debate of personality traits. Several authors have argued that there is a large conceptual overlap between Neuroticism and depressive symptoms, particularly since Depressiveness (defined as the tendency to experience feelings of guilt, sadness, despondency and loneliness) is also one of the facets of Neuroticism (Clark et al., 2003). Personality assessments often cover state affect as well as trait variances, the variance of the first masking the variance of the second during acute episodes. Critics defend that Neuroticism is merely a contaminant of the depressive mood state, rather than a personality dimension that has both depressive mood-state and trait-like properties. In our earlier work (Weber, 2012), the Hamilton Rating Scale of Depression (HRSD) score explained 55% of the variance of the Neuroticism score, showing that both scales did not assess the same construct. Regression models predicting late-life depression revealed that Neuroticism only predicts depression, when it is used as a personality dimension that includes both mood-state dependant and trait-like properties. The mood-independent variance of Neuroticism does not significantly predict late-life depression (Table 8 published in Weber, 2012, p. 54).

The trait-like character of personality factors/facets in late-life depression is also defended by our results in a series of old age depressed patients who undergo detailed neuropsychological testing and structural MRI after remission (Weber et al., 2010). Results show that the only markers that significantly differentiated remitted patients from controls were their personality traits. Even in euthymic state, scores on Neuroticism and two of its facets (anxiety and depression) were significantly higher in depressed patients. Likewise, the scores of the depressed group on the warmth and positive emotions facets of Extraversion were significantly lower than those of controls. These observations are consistent with previous reports in younger cohorts and imply that the increased Neuroticism factor and facets and the decreased Extraversion facets of euthymic patients with mood disorders is a consistent finding across the age spectrum. Taken together, the personality effect on clinical depression outcome, and the reverse impact of depression on personality after recovery, allow for considering a pathoplastic approach and the bi-directionality of the depression-personality relationship in old age.

We also explored the interaction of personality traits and stressful life events and its impact on late-life depression to address the hypothesis an of environmentally mediated relationship between Neuroticism and depression in old age (Weber et al., 2013). Our findings confirm that Neuroticism is a stable predictor of depression in young as well as in old age depressed patients. Further, we confirmed the absence of interaction between Neuroticism and stressful life events in the present study, indicating that this personality factor did not act as a moderator on the stress–depression relationship in old age. This personality factor emerged as a direct and independent predictor of major depression, once patients' physical burden and subjective impact of life stressors have been accounted for, in young age as well as in old age patients. Besides, in late life, the impact of stressful life events is tempered, whereas physical health burden becomes a significant predictor of depression. Personality does not seem to act as predisposition which triggers depression under certain late-life conditions. Neuroticism shows a direct relationship with depression rather than a moderator or mediator role over the lifespan. As has been described in the general population, for Neuroticism, individual differences in change over lifespan are generally small and this dimension is known to be resistant over time, with little occasion-specific changes (Mroczek & Spiro, 2003).

In younger adults, impact of personality on depression outcome has focused on remission of mood symptoms as well as on increase of patients' subjective well-being. We decided to study the impact of the depression-personality relation on patients' subjective quality of life comparing young and old age (Weber et al., 2014). The results show that Openness to experience and Extraversion factors predict quality of life in old age after adjusting for severity of depression, physical illness, gender, education and social support. In this study, the five-factor personality traits have a protective impact in older adults. In younger age, quality of life is predominantly explained by the severity of depression symptoms. In contrast, in older age, quality of life is explained by depressive symptoms, but also by comorbid physical illness and personality traits. Old age approaches clearly gain from enlarging the focus not only on the Neuroticism-depressive symptoms relationship, but also englobe the other personality dimensions, when predicting quality of life in old age depressed patients.

Still focusing on the impact of personality on the expression of depression, we hypothesized that patients' personality plays a key role not only in the way old age patients themselves cope with their depression, but also influences the way health professionals perceive and treat old age depression. In our study on old age depression in a general hospital (Canuto et al., 2015), we found that old age patients with more open personalities, yet lower levels of Neuroticism, tend to be referred for depressive mood to psychiatry-liaison services by their primary care physicians even though they presented another or even no psychiatric disorder. While higher Neuroticism has been reported to lead to exaggerated health care utilization and overtreatment, lower Neuroticism may be one of the explanations for under-recognition and under-treatment of depressive disorders in late life.

3.3.Future perspectives

This thesis confirms that personality traits and depression are related in old age and that the dimensional Five-Factor Model of Personality offers a promising theoretical framework to asses this relationship from many angles. Indeed, the FFM offers the necessary flexibility to assess personality in different populations, namely in depressed old age outpatients and inpatients, as well as in the general population (Canuto et al., 2009, 2016; Weber et al., 2010). Further, the FFM allows comparison between different age groups (Weber et al., 2013; 2015), as well as between different clinical states (Canuto et al., 2009; Weber et al., 2010). Finally, the FFM offers the possibility to analyze the combination of different personality facets when addressing vulnerability versus resilience personality profiles that overlap the five broad dimensions (Canuto et al., 2009; Weber et al., 2010), or focus on one or several of the five main dimensions when addressing personality in the context of other related variables, such as stressful life events or quality of life (Weber et al., 2013; 2015), or when time constraints only allow the administration of a brief version of the questionnaire (Canuto et al., 2016).

Future studies will definitively gain from adopting a dimensional personality approach when studying is association with psychopathology. It offers clinician the opportunity to adopt a person-centered approach, that takes into account the individual differences in the way patients expression their depression and benefit from psychiatric treatments, in the way depression impacts on their

subjective quality of life, and in the way they ask for specialized psychiatric help in a general hospital setting. Assessing personality traits along with depressive mood or other psychiatric symptoms informs mental health professionals on old age patients' individual resources and difficulties to deal with depression, and take into account the overall situation including psychosocial and health issues, and not merely the depressive symptoms.

Future studies should aim to replicate the studies of this thesis in old age populations by using the proposed dimensional model of the DSM-V Section III, to encourage to use of internationally recognized nomenclatures, and offer additional evidence in the context of the current ongoing paradigm change.

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