University of Cyprus

DEPARTMENT OF PSYCHOLOGY

THE CONTRIBUTION OF OCCUPATION, LEISURE ACTIVITIES
AND COPING STRATEGIES IN COGNITIVE PERFORMANCE
ACROSS THE LIFESPAN: A LATENT MODEL APPROACH TO COGNITIVE
RESERVE IN GREEK CYPRIOT ADULTS.

DOCTOR OF PHILOSOPHY DISSERTATION

JULIANA PROKOPIOU

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JULIANA PROKOPIOU

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*The present Doctoral Dissertation was submitted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy at the **Department of Psychology** and was approved on the April 24, 2018 by the members of the **Examination Committee**:*

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The present doctoral dissertation was submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy of the University of Cyprus. It is a product of
original work of my own, unless otherwise mentioned through references, notes or any
other references.

Juliana Prokopiou

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ΠΕΡΙΛΗΨΗ

Η παρούσα μελέτη διερεύνησε μία ολοκληρωμένη προσέγγιση του Γνωστικού Αποθέματος (ΓΑ) ως συνάρτηση των διαδραστικών ατομικών και περιβαλλοντικών μηχανισμών με την χρήση μοντέλων δομικών εξισώσεων (Structural Equation Modelling, SEM). Συγκεκριμένα, εξετάστηκαν οι μηχανισμοί μέσω των οποίων οι δημογραφικές και περιβαλλοντικές μεταβλητές επηρεάζουν το ΓΑ στη μέση ηλικία, κατά την οποία οι δυνατότητες της νευρωνικής πλαστικότητας, αναδιοργάνωσης και διατήρησης των γνωστικών ικανοτήτων, εξακολουθούν να υφίστανται (Reuter-Lorenz & Lustig, 2005). Επιπρόσθετα, το προτεινόμενο μοντέλο παρείχε μια ολοκληρωμένη προσέγγιση διερευνώντας τη συνεισφορά των παραγόντων του ΓΑ οι οποίοι διερευνώνται λιγότερο συχνά (επαγγελματική επίτευξη, επαγγελματική-προσωπική συνάφεια και στρατηγικές αντιμετώπισης του στρες), στις γνωστικές λειτουργίες όπως αυτές μελετήθηκαν από σύνθετα εργαλεία εκτελεστικών λειτουργιών και λεκτικής μνήμης. Συγκεκριμένα, διερευνήθηκαν τα μοτίβα συμμετοχής σε ψυχαγωγικές δραστηριότητες οι οποίες περιλαμβάνουν γνωστικές, σωματικές, καλλιτεχνικές και κοινωνικές δραστηριότητες σε τρία ηλικιακά στάδια (νεαρή ηλικία, μέση ηλικία και γήρας), σε συνδυασμό με το επαγγελματικό επίτευγμα και τη συνάφεια μεταξύ του επαγγέλματος και της προσωπικότητας σε υγιείς Ελληνοκυπρίους.

Τα δεδομένα αναλύθηκαν κυρίως μέσω αναλύσεων πολλαπλής παλινδρόμησης και SEM. Στη μελέτη έλαβαν μέρος 100 συμμετέχοντες ηλικίας 40-64 ετών και 50 συμμετέχοντες ηλικίας 65-89 ετών, οι οποίοι στρατολογήθηκαν από τη Νευρογνωστική Μελέτη Ενηλίκων. Οι αναλύσεις διερεύνησαν τον τρόπο με τον οποίο το επίπεδο της συνάφειας μεταξύ επαγγέλματος και προσωπικότητας, η συμμετοχή σε ψυχαγωγικές δραστηριότητες και οι ατομικές στρατηγικές αντιμετώπισης του στρες συσχετίστηκαν με τη γνωστική επίδοση. Οι αναλύσεις παλινδρόμησης διεξήχθησαν για να ελεγχθεί η συμβολή του επαγγελματικού επιτεύγματος και της συνάφειας, των ψυχαγωγικών δραστηριοτήτων

και των στρατηγικών αντιμετώπισης του στρες στη γνωστική επίδοση τόσο στους μεσήλικες όσο και στους ηλικιωμένους συμμετέχοντες. Τα αποτελέσματα έδειξαν ότι συχνότερη εμπλοκή στις γνωστικές, καλλιτεχνικές και σωματικές δραστηριότητες μειώνει τη συμβολή της εκπαίδευσης στην γνωστική επίδοση. Τα ευρήματα αυτά εντοπίστηκαν κυρίως στην ομάδα των μεγαλύτερων ενηλίκων. Επιπλέον, υπήρξαν αποκλίσεις μεταξύ των ηλικιακών ομάδων όσον αφορά τη συμβολή των ψυχαγωγικών δραστηριοτήτων , του επαγγελματικού επιτεύγματος και της εκπαίδευσης στο ΓΑ. Τα ευρήματα υποστηρίζουν την ανάγκη ενσωμάτωσης πολλαπλών παραγόντων και μια δια βίου προσέγγιση στην εκτίμηση του ΓΑ στην γήρανση.

Η παρούσα μελέτη προσέφερε θεωρητικές και κλινικές προεκτάσεις που υπογραμμίζουν το ρόλο των επαγγελματικών και γνωστικών δραστηριοτήτων στην ενίσχυση του ΓΑ στη μέση ηλικία. Τα προκαταρκτικά αυτά ευρήματα επέκτειναν τις γνώσεις μας για τη θεωρητική και την κατασκευαστική έννοια του ΓΑ ως συνάρτηση ενός συνδυασμού προσωπικών και περιβαλλοντικών μεταβλητών κατά τη διάρκεια της ζωής.

ABSTRACT

The present study investigated an approach of Cognitive Reserve (CR) as a function of interactive individual and environmental mechanisms through latent variable modeling techniques. It specifically examined mechanisms through which demographic and environmental variables interact and impact the CR at midlife during which the potential for plasticity, reorganization and preservation of capacities is still enduring (Reuter-Lorenz & Lustig, 2005). Additionally, the suggested model provided a comprehensive approach investigating the contribution of less often explored variables of CR (occupational attainment, occupational congruence, and coping strategies) on cognitive functions as estimated by composite scores of executive function , and of verbal memory. Specifically, patterns of involvement in leisure activities (cognitive, physical, artistic, and social) across life stages (young age, middle age, and old age) and in combination with occupational attainment and congruence were investigated for a sample of healthy sample of Greek Cypriot older adults.

Data were analyzed mainly through multiple regression and Structural Equation Modeling (SEM) analyses. One hundred middle aged adults (40-64yrs old) and 50 older adults aged from 65-89 years old recruited from the Neurocognitive Study of the Aging, participated in the study. Path modeling examined the way through which level of past and current occupational congruence, involvement in leisure activities, and individual coping strategies were associated with CR measures. Regression analyses were conducted to test for contribution of occupational-personality congruence and attainment, leisure activities and coping strategies on cognitive performance for both middle aged and older adults. The results revealed that the greater engagement in cognitive, artistic and physical activities reduced the contribution of education, one of traditionally investigated variables in late life cognition. Such findings were mainly prominent within the older adult group. Additionally, there were discrepancies among age groups on the contribution of leisure activities, occupational

attainment and education in CR. The findings support the need for incorporating multiple proxies and a lifespan approach in estimating late life CR.

The present study offered theoretical and clinical implications that underline the role of occupational and cognitive activities in boosting CR starting from middle age. The preliminary findings extended our knowledge of the theoretical conceptualization of the CR construct as a function of personal and environmental variables and across life.

ACKNOWLEDGMENTS

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CHAPTER 1

General Introduction

The available evidence on cognitive aging and its protective factors favors the hypothesis that maintaining a cognitively engaged and physically active lifestyle promotes successful cognitive aging (Cheng, 2016; Fratiglioni, Paillard-Borg, & Winblad, 2004). Considering ways of facilitating successful cognitive aging becomes even more imperative in the face of continuing increases in life expectancy and the exponential increase in the number of elderly people worldwide (Oeppen & Vaupel, 2002). There is indeed some evidence suggesting that this could be achieved by augmenting or bolstering of cognitive reserve (CR) (Vance, 2012; Hertzog et al., 2009; Tucker & Stern, 2011). Researchers rely on the concept of CR to account for individual differences in the ability to cope with physiological or pathological cognitive decline during late adulthood (Stern, 2009). The CR hypothesis suggests that the brain actively attempts to cope with damage by using pre-existing cognitive processes or enlisting compensatory strategies through neuronal reserve or Brain Reserve. As such, it is assumed that people with higher CR can withstand more age-related changes or disease related pathology by effectively and flexibly using cognitive paradigms or compensatory brain networks (Stern, 2012).

Moreover, the available evidence on enrichment effects on adult cognitive development emphasizes the potential of behavior to influence levels of cognitive functioning (Hertzog & Jopp, 2010). According to this theoretical framework, individuals influence whether they function in the higher or lower ranges of their possible functioning zone at any point during their cognitive development. Consequently, it is believed that there exists some potential for positive change or even plasticity which is still maintained in adult cognition (Hertzog et al, 2009). Research examining person-environment

interactions that are likely to promote growth throughout the adult life span has led to the development of the construct of the engaged lifestyle. Indeed, some studies indicate that engagement in enrichment behaviors in early midlife (physical exercise and other leisure-time activity) that are of a quality and degree not previously manifested at earlier stages, is associated with better memory performance and slower rate of memory decline in later stages of aging (Richards, Hardy & Wadsworth, 2003).

Although the effects of change of physical activity patterns on memory were examined in similar studies (Rovio et al., 2005) , there is not enough evidence supporting the long-term effects of both demographic and environmental variables on cognition with the exception of age and education for which there is substantial research. Some authors have also reported that mental, physical, and social activities could each have different effects on different domains of cognitive functioning (e.g., Fritsch et al., 2007; Richards & Deary, 2005; Wilson et al., 2005). Recently, a number of researchers suggest that CR should not be measured by a single measure, but as a latent construct (Giogkaraki, Michaelides & Constantinidou, 2013; Jones et al., 2011). Therefore, there is clearly a need for additional studies that assess the influence of a multitude of lifestyle choices –including occupational, physical and social on later-life cognition.

The main idea conveyed from theories and studies on enrichment effects on adult cognitive development is that there may be late-life improvements in cognitive functioning if an individual engages in enrichment behaviors in midlife that are of a quality and degree not previously manifested at earlier ages (Hertzog, Karmer, Wislon, & Lindenberger, 2009). Additionally, research on enrichment effects suggests that positive enriching experiences could lead to enhanced self-perception of cognitive efficacy, which in turn may influence individuals' readiness to engage in similar or additional cognitively stimulating activities (Willis et al., 2006).

We suggest that similar mechanisms occur during the complex stage of middle age. Overall, midlife can be characterized by an attempt to balance career, relationships and various physical or leisure activities (Newman et al., 2003). The midlife period is often marked by major life events such as career settlement or changes, death of a parent, children leaving home, hormonal changes, and other events. Due to the changing personal and social roles at this stage in life, it is reasonable to assume that midlife can be associated with change in patterns of involvement in cognitively stimulating occupational and/or leisure activities. Data from studies on human development support hypotheses about change in social roles, status and health with substantial curvilinear change within middle age and associations of work involvement and physical health during late middle age (Helson & Soto, 2005). Similarly, socioemotional selectivity theory (SST), a lifespan theory of motivation maintains that goals, preferences, and even cognitive processes, such as attention and memory, change systematically as time horizons shrink (Carstensen, 2006).

Moreover, brain biomarkers associated with aging are noted after the age of 50 (Jones et al., 2006). Findings suggest that white matter volume increases through adolescence up to about age 50 after which there is a rapid decline associated with white matter degeneration during normal aging, with faster changes in Apolipoprotein 4 allele carriers (ApoE4). Myelinated pathways are critical for high speed intra and inter-hemispheric conduction affecting executive function, working memory, and language retrieval abilities (Finch, 2009). In addition to neuronal loss, the normal aging process results in synaptic changes which has been associated with reductions in cognitive performance (Terry & Katzman, 2001).

Despite theories focusing on the deficits associated with the aging process, there exists behavioral and neuroimaging evidence that the adult brain exhibits functional plasticity, reorganization, and preservation of capacities (Reuter-Lorenz & Lustig, 2005).

Indeed, studies looking at large samples do not report abrupt cognitive decline in the 40s, regardless of the apparent course of white matter volume change starting around mid-forties. Such findings consider changes with age to be encouraging, as they show that the middle-aged brain demonstrates plasticity by allocating resources in order to accomplish the task at hand.

Although mild degeneration of intracranial white matter is present during middle age, there is still evidence of neurogenesis in areas including the hippocampus, occurring through stimulation of brain derived neurotrophic factors by mechanisms such as enriched environment and physical activity (Brown et al., 2003). Regardless of decline in functions such as working memory and digit span during the early middle age, recent cross-sectional studies found an increase in hippocampal volume prior to age 50 but loss in hippocampal volume after that age (Walhovd et al., 2005). Other investigators reported no decreases (Good et al., 2010) or only modest decreases in hippocampal volume after age 50 (Raz et al., 2004).

Based on previous studies, changes of lifestyle factors during this stage (either in frequency or quality of leisure cognitive activity involved) may affect the cognitive performance of midlife adults (Hertzog et al., 2009). However, it still remains to be investigated if these changes occurring as a function of personal and environmental mechanisms will be sustained beyond middle age. The specific role of middle-age cognitive and lifestyle changes as possible predictors of later processes in life is generally unclear. The changes during this stage have been relatively neglected mainly because age-related changes often emerge slowly and are hard to discern. As such, there are only a few theoretical models that relate to middle age behavioral mechanisms and cognitive aging.

There is a major gap in the literature of cognitive aging on the exact contribution of midlife environmental effects in boosting CR during midlife. Furthermore, there is scarcity of research on the potential long lasting protective role of specific environmental factors in

cognitive abilities later in life. Additionally, research suggests that there is a need to investigate the determinants of cognitive decline and assess the extent to which the cognitive trajectories of individuals during their middle age years could predict later life performance and whether these trajectories could be modifiable (Cheng, 2016; Hertzog et al, 2008).

This study intends to examine the contributing role of both contextual and demographic variables characterizing the midlife stage in boosting of CR. Such details can provide insight on how interventions to increase reserve in midlife can lead to greater cognitive performance later in life.

Theoretical Framework: Occupational Congruence, Involvement in Cognitively Stimulating Activities, and Cognitive Enrichment

The person-environment fit theory, as a cornerstone of the field of vocational psychology, dates back to Parsons (1909). It is based on the notion of assisting individuals to select environments that would optimize their individual performance. It is generally referred to as the degree of fit between the person and the environment (P-E fit). P-E fit denotes that attitudes, behavior, and other individual outcomes result not from the person or environment separately, but rather from the relation between the two (Edwards, 1996; Lewin, 1951). Most career choice theories are based on the theory that people perform better and are more satisfied in occupational environments that match their interests or other personal variables (Dawis & Lofquist, 1984; Holland, 1973; 1997). Overall theories of work adjustment, specifically the Minnesota Theory of Work Adjustment (MTWA) view work as an interactive and reciprocal process between the individual and the work environment (Dawis & Lofquist, 1984). There is considerable literature linking person–environment congruence to job satisfaction, and job satisfaction is considered to be a major component of general life satisfaction (Walsh & Eggerth, 2005).

Considering the life areas affected by work, it seems plausible that job satisfaction may well contribute to non-work-related life satisfaction.

Holland's six letter hexagon is one of the most comprehensive theories to test the person-environment fit and has been widely used as a theoretical framework in research studies addressing job outcomes and job performance. According to Holland (1997), there are six personality types (realistic, investigative, artistic, social, enterprising, and conventional) in which people can be categorized. He also theorizes that work environments can be categorized by these six types. The level of Person-Occupation Congruence is the focal point of Holland's theory and this has been defined as the level of congruence between an individual personality pattern and the pattern of work environment (Holland, 1997). Moreover, the application of the congruence model in career counseling and academic advising with diverse groups of students has yielded support for the validity of the congruence relation to reliably predict career-related criteria (Tracey, Darcy & Kovalsky, 2000). Related research (Tracey & Robins, 2005) has demonstrated that the congruence index used in various studies may be one of the most significant factors in the PE fit relations ability to predict outcome criteria.

Although career development or career change is a major focus for most adults in midlife stage, there is not enough literature addressing how a better fit between someone's personality and main held occupation (occupation –interest congruence level) might contribute to increase or boost levels of cognitive reserve during the middle age. In fact, the concept of interest- occupation congruence nicely fits within the lines of the cognitive enrichment hypothesis in terms of a life span perspective on development (Baltes, Lindenberger, & Staudinger, 2006). Although early models of person-environment fit described a static relationship between person and environment characteristics, recent models consider an ongoing, reciprocal impact that these variables may have on one another (Caplan, 1983; Kohn & Schooler, 1982). Specifically, French (1974) suggested

that an individual may respond to a low congruence person-environment fit through application of various defense mechanisms including movement towards closer person-environment fit. More recent evidence (Betz & Rottinghaus, 2006; Durr & Tracey, 2009) indicates that interests are strongly related to both contextual and personal variables, and that if one's competence on performing certain tasks increases so do their interests in that area. Quite often, the acquisition and modification of interests is determined by additional sociocultural factors, such as access to opportunity. For instance, due to environmental barriers or limited opportunities, people may choose less interesting options based on what work is available to them. Theories of career development and counseling assume that when such opportunities for change or learning experience occur, shifts in interest are largely due to changing self-efficacy beliefs and outcome expectations (Brown & Lent, 2004).

The cognitive development and enrichment hypothesis (Baltes, Lindenberger, & Staudinger, 2006) has two important features: a) levels of performance are malleable and open to enhancement throughout lifespan, but b) upper limits of performance are constrained by the boundaries created by biological aging. Despite the fact that there is improvement of performance in older adults, changes associated with biological aging place constraints on maximal levels of cognitive performance with advancing age (Karmer & Willis, 2003; Singer, Lindenberger, & Baltes, 2003). This means that one can take advantage of positive enhancement factors but with advancing age, it becomes more difficult to function at the maximum level of performance. In fact, various studies suggest that the level of cognitive functioning during middle age could set the point of cognitive development trajectory in late adulthood (Frazier & Hooker, 2006; Stine-Morrow, 2007). In a review of studies on enrichment and enhancement of cognitive functioning in older adults (Hertzog et al., 2009), the authors strongly suggest that efforts to enrich cognition during midlife could have substantial impact on late life cognitive functioning.

Consequently, this study investigated the main contributors that might affect CR in middle age and in later adulthood and their role in cognitive performance during late adulthood.

The present study was based on the theory that CR is not a fixed construct but continues to evolve across the lifespan. The cognitive enrichment hypothesis could be also understood in terms of patterns of involvement in occupational and leisure activities.   It is quite possible that a highly congruent situation is perceived as a positive enrichment effect based on past findings on placement on congruent environments (Dawis & Lofquist, 1984; Holland, 1973; 1997). In line with findings by Betz & Rottinghous (2006) an individuals' perception of competence to successfully perform at work would be associated with an increased interest to get more involved in such activities (Durr et al., 2009). Similarly, research on enrichment effects (Willis et al., 2006; Tranter & Koutsaal, 2008) supports that positive enriching experiences, could lead to enhanced self-perception of cognitive efficacy, which in turn may influence the individual's readiness to engage in cognitively stimulating activities. The high congruence situation therefore, leads to the enhanced self-perception of a general cognitive efficacy which in turn will influence their readiness to engage in cognitively stimulating activities either at work or during leisure time. The relation between involvement in cognitively stimulating activities and cognitive reserve has been established by a number of studies (Karp, Andel, & Parker, 2009; Fratiglioni, Paillard-Borg, & Winblad, 2004; Wilson, Bennett & Bienias, 2002). Occupational achievement, stability and satisfaction depend on congruence between one's personality and job environment, according to Holland's theory of vocational types. As a result, it could be expected that high occupation-personality congruence individuals would benefit both from a higher level of involvement in work related activities.

Occupational Congruence and Involvement in Cognitive Stimulating Activities

The P-E fit approach to psychological health has been widely investigated in the past (Edwards &Cooper, 1990). The lack of correspondence between the environment and the person or a low occupational congruence is hypothesized to generate negative psychological, physiological and behavioral outcomes. It is suggested that as the individual experiences various job-related strains over a period of time, their effects could culminate in various types of illnesses (Van Harrison, 1978). While occupational congruence leads to feelings of satisfaction and well-being, incongruence has the opposite effects. The Minnesota Theory of Work Adjustment (MTWA), conceptualizes the fit between an individual and a job or organization (Dawis & Lofquist, 1984). Some components of MTWA explain the process by which either the person or the environment adjusts or adapts to minimize the deterioration in fit between personality and the environment. This theory also implies a relation between person-environment fit and job satisfaction and tenure. For example, there are three major criteria that are viewed as indicators of work adjustment: satisfaction, satisfactoriness and tenure. Satisfaction is the outcome from the match between the individual's vocational interests, motivational needs, and values and the extent to which the organization is able to provide appropriate rewards and reinforcement of these; satisfactoriness covers efficiency, productivity, the ability to get along with a supervisor and coworkers; and tenure is the length of time an individual and environment interact, as a function of both satisfaction and satisfactoriness (Dawis & Lofquist, 1984). Although these constructs are not included in the present study, they underline a possible line of research that could better link occupational congruence to cognitive health and aging.

The effects of occupational congruence are mainly studied in relation to job satisfaction, psychological well-being and academic achievement within the occupational and academic context. Specifically, in a study by Wolniak and Pascarella (2005)

congruence was found to be causally related to intrinsic job satisfaction. Volkwein and

Zhou (2003) previously had demonstrated that intrinsic satisfaction has the most significant

impact on overall satisfaction. While the importance of the overall job satisfaction is

evident in one's personal life, intrinsic satisfaction includes aspects such as career

advancement and personal growth (Herzberg, 1966). As also implied by the MTWA, if

there is a high degree of satisfaction and satisfactoriness (the employer's satisfaction with

the employee performance), tenure and work adjustment can be predicted (Eggerth, 2008)

Work adjustment process is a dynamic process on its own, and therefore its various

aspects were not the main focus of this project. This project adopted the theoretical

perspective suggesting that during middle age, processes related to occupational and

leisure activities could be associated with internal individual variables such as individual

coping strategies. Specifically, people placed in highly congruent occupational settings are

more likely to feel more self-confident not only about their career but also about their

cognitive ability to deal with similar cognitively stimulating activities. In contrast, people

placed in low congruence occupational settings, could experience possible negative

feelings or experiences associated with the degree of mismatch between occupation and

their interests (Lupien, 2009). As a result, these individuals are not expected to have the

same level of involvement professionally as do the high congruent individuals.

The level of involvement in additional cognitively stimulating activities could be

altered by personal factors such as the ability to take action and change the perceived

situation. This could be done either by changing career or by getting involved in more

meaningful social or physical activities. There are a number of studies that focus on

positive and negative factors that may be associated with cognitive performance. For

example, there is a line of research indicating that stress or chronic distress is associated

with changes in cognition. The findings overall support that more distress is associated

with lower cognitive performance and may also predict cognitive function in old age

(Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002).

Another important factor to successful cognitive aging relates to positive attributes

such as adaptive coping strategies. These in turn could lead to the attainment of desired

goals, higher levels of subjective well-being or effective management of emotional distress

(Folkman &Moskowitz, 2004). There are findings reporting that more adaptive coping

strategies may help to explain patterns of cognitive decline associated with normal aging

and other degenerative processes (DeFrias, Dixon, & Backman, 2003). In short, someone's

coping strategy could shape the outcome of the level and pattern of involvement in

fulfilling cognitively stimulating activities.

In summary, theories of cognitive development emphasize that some of the

degenerative neurobiological changes occurring in older adulthood could interfere with the

full benefit of environmental and/or cognitive enrichment efforts (Brown et al., 2003). The

available evidence from this line of studies indicates that the above factors extend their

influence from early midlife (when they are boosted the most due to complexity of roles,

variety of experiences exposed to, brain ongoing neuroplasticity) to late life.

Consequently, it is crucial that efforts are being directed towards maximizing levels of

cognitive performance during a life stage that can still allow for optimization of abilities.

The investigation of variables that influence the robustness of cognitive reserve during the

critical stage of middle age and possibly set the point for a lifetime trajectory of cognitive

development is the major purpose of this project.

Cognitive Reserve Construct: Definition and its Multiple Predictors

Reserve is a theoretical construct believed to explain individual differences in the

relationship between neuropathology and cognitive performance (Stern, 2012). The

concept of reserve has been proposed to help account for the discrepancy between some

pathogenic factor (e.g., age) and measurable pathology (e.g., white matter hyperintensities) and between the pathology and its clinical manifestations. In a review of studies on reserve (Stern 2009), refers to two models of reserve pertaining to cognitive functioning: brain and cognitive reserve. Brain reserve refers to structural aspects of the brain while cognitive reserve relates to how cognitive tasks are coordinated, involving access to complex networks. Brain reserve is mainly conceptualized as a passive process while cognitive reserve is conceptualized as an active process. The passive model or cerebral reserve refers to the amount of brain damage that can be sustained before clinical expression of disease. The threshold model (Satz, 1993) is one of the most accepted passive model and it implies the concept of brain reserve capacity (BRC), related to measures including brain size or number or neurons. These models are mainly considered passive because they are mainly quantitative models and they postulate that there is a common functional impairment cut-off for everyone. On the contrary, the active models or reserve suggest that the brain actively attempts to compensate for environmental tasks (Baldivia et al., 2008). According to Stern et al. (2009) there are two kinds of active reserve models including cognitive reserve and neuronal compensation. In spite of the differences in approach between models of brain reserve and cognitive reserve, there is evidence that both might be interdependent and related. For example, there is a small but significant relationship between IQ and brain volume. Also, it has been demonstrated that enriching environments, a factor of CR captured by variables such as participation in leisure activities and occupational complexity, promote neurogenesis in the dentate gyrus of the hippocampus (Churchill et al., 2002).

Cognitive reserve is thought to reflect in part life experiences. Conceptualized as a malleable trait, reserve is a potential mechanism through which the effects of brain pathology can be modified by experiences and events over the life course (Stern, 2012). There is emerging evidence that cognitive reserve is not static during adulthood like IQ,

but that it may be a potentially modifiable characteristic (Valenzuela & Sachdev, 2006, Willis et al., 2006). Although neuronal plasticity and development is mainly confined to early life, neuronal plasticity permits cognitive reserve to be enhanced or maintained during the adult years (Richards et al., 2003). The neuroscience literature indicates a variety of lifestyle factors that may encourage positive neuroplasticity supporting cognitive reserve and thus cognitive functioning (Vance, 2012).

Overall, the variables that are typically associated with CR can be grouped in three main domains: "premorbid" intelligence (Scarmeas et al., 2003; Sumowski et al., 2009); demographic variables such as SES, years of education, occupation level (Stern et al., 1999); and Leisure activity or environmental variables indexed by cognitive, physical and social leisure activities (Fratiglioni et al., 2004; Wilson et al., 2002).

Richards and Sacker (2003) studied the lifetime antecedents of cognitive reserve variables and the results revealed that three CR measures, IQ, educational attainment, and occupation, each provided unique contribution to cognitive function in middle age. The findings also suggested that CR is not fixed in early years but continues to be affected by events and circumstances as they unfold across the lifespan. A more recent study by Reed et al., (2011) aimed to define the independent and combined effects of observed demographic and life experience variables on cognitive reserve. Among all the variables, the strongest correlate of late life cognitive reserve was cognitively stimulating activities during leisure time at age 40. Cognitive activities at study entry (at around age of 70) and much closer to the time at which reserve was measured, had a significant, but lesser independent effect on reserve. When modeled along with the other predictors the effects of education on reserve were actually negative.

Given the need of development of a more extensive life course model of cognitive reserve, the current study investigates a multidimensional model of cognitive reserve. It investigates the possibility that demographic and environmental variables pertinent to

middle age activities, could hold promise in boosting of cognitive reserve during this specific life stage and relate to better cognitive performance both during middle and older age.

Statement of the Problem

There is a lack of research that aims to identify the optimal patterns and mechanisms that boost cognitive reserve starting from the middle age. So far, involvement in cognitively stimulating activities and the occupation attainment and complexity have been suggested as main contributors to the formation of cognitive reserve. However, it is crucial that when exploring the cognitive reserve construct, we do not consider personal or environmental factors in isolation but we explore the possibility of a person-environment mechanism as a possible contributor of CR.

In fact, the World Health Organization's International Classification of Functioning, Disability and Health (ICF) recognizes the role of environmental factors as an essential aspect of the scientific understanding of functioning and posits that health and function are a result of reciprocal interaction between the person and the context (WHO, 2001). The model of functioning proposed in the ICF classification suggests dynamic and reciprocal relations within the context of environmental and personal factors. The ICF defines health in terms of the universe of well-being, composed of health domains of well-being and other domains of well-being including education, employment, social interactions (Peterson, 2005).

Several lines of research have investigated the role of occupational congruence as a predictor of worker satisfaction, performance and persistence on a particular occupation (Durr &Tracey, 2009). Additionally, there is a line of research that has investigated the role of type and complexity of occupation on cognitive performance (Dartigues & Gagnon,

1992; Baldivia et al, 2008). Nevertheless, the available data on prediction of cognitive

reserve from the level of occupational congruence is limited as of today.

More specifically, there is limited research that has investigated the contributing

role of congruence on CR during the middle life and its consequences within the cognitive

aging context. Past studies point out at specific demographic and lifestyle factors that seem

to affect CR including education, occupation, social, physical, and leisure activities

(Richards & Deary, 2005; Stern, 2009). However, only a few studies have addressed the

issue of how these different potential contributors of reserve relate to each other. Are there

specific mechanisms that explain their contribution to CR? Which experiences contribute

the most and during which stage of life?

A limited number of studies have examined the underlying structure of CR in

clinical populations, including one in traumatic brain injury TBI (Levi, Rassovsky,

Agranov, Kaufman & Vakil, 2013). In this study, the investigators tested whether the three

CR components (SES, IQ, and Leisure activity) represent one unitary construct or separate

factors. Their results revealed a best fitting model that consisted of three separate factors

with distinct patterns of associations among the three factors (Levi et al., 2013). Such

findings have important implications in understanding the multi-factorial structure of CR in

the context of TBI and of pathological aging. While the study suffered several

methodological limitations (small sample size and heterogeneity of injury characteristics

and participants' time of injury) it provided a methodological approach for future

investigation of the variables constituting brain reserve (BR; total brain volume, head

circumference) and of the reciprocal relationship thought to exist between CR and BR

structures and their roles in protecting against brain damage and cognitive aging.

One reason the question of what contributes to reserve is not often studied has to do

with how CR is modeled. In a typical study of reserve a variable that is conceptualized as a

marker of reserve is examined as a predictor of outcomes such as dementia. If a significant

relationship is observed such that the predictor is associated with, for example, lower rates of dementia the result is interpreted as evidence for reserve. Although CR can be best captured when considered as a lifetime process studies on lifestyle factors and CR have mainly focused on specific life stages (Valenzuela & Sachdev, 2007) and they have mainly investigated the role of education or leisure activities without considering the possible mechanisms underlying their relations and their contribution in the formation of CR. This could be attributed to the fact that CR is relatively a recently investigated construct and limited research has been the focus of more specific variables associated with CR starting from early adulthood. Indeed, the investigation of the mechanisms associated with situations or processes occurring during the middle-age could provide us with valuable information in establishing links between middle-age changes and cognitive development and decline later in life. Consequently, it is important that we focus not only on "if" and" how" the lifetime activities affect late- life cognition, but also on the sustainability of such effects in old age. Thus, conduction of longitudinal follow up studies provide us with the benefit of examining these long lasting effects of involvement in cognitively stimulating activities at earlier points in life on cognitive aging patterns.

The current project suggests a model where cognitive reserve as a multidimensional and not fixed construct is best boosted during the middle age stage, even though it may continue to be affected by late life experiences. The study explores the interactive mechanisms of personal and environmental variables and their effect on CR. Specifically, the variables under investigation included level of person-environment congruence (as measured by the level of fit between occupation and personality type), level of involvement in cognitively stimulating activities and the possible moderating role of coping strategies. The mechanism through which these variables interact is expected to explain the increase of CR during middle age and its relation to cognitive aging.

Finally, it is worth mentioning that studies on cognitive reserve have led to some conflicting results and interpretations. For example, there exists evidence suggesting that cognitive reserve does not slow the rate of cognitive decline (Singh-Manoux, et al., 2011). The findings from this study suggested that rate of cognitive decline did not differ between the reserve groups except for occupation where there was some evidence of greater decline in the high occupation group. Additionally, a vast variety of studies have addressed the reserve construct by defining it on the basis of a single or a limited number of indicators, without referring to specific constructs and to the nature of their relationships (Satz, Cole, Hardy, & Rassovsky, 2011). Overall, there are both conceptual and measurement challenges currently existing in the CR literature that cause lack of uniformity and mixed findings. The proposed study was designed to clarify some of the existing discrepancies with regards to multidimensional structure of CR and the contributing role of CR proxies on cognitive performance among healthy older adults.

Purpose of the Study

The goal of the present study was to identify personal, environmental, and person-environment fit factors that can contribute to the formation of CR during the middle life and identify their contribution on cognitive performance in late adulthood. Also, the study had two main objectives: The first objective was to investigate the psychometric properties of the proposed personality and interest (SDS), coping (Brief-COPE) and leisure activity (LEQ) scales within the Greek Cypriot sociocultural context and secondly to test for a comprehensive theoretical model of CR by examining the contribution of personality-occupation congruence combined with the more conventional proxies of CR including education and occupational attainment. These factors have not been investigated yet and it was hypothesized that they will contribute to the formation of a robust cognitive reserve during the midlife years.

The introduced approach examined how the associations between personal (Holland type personality, coping strategies and environmental (main lifetime occupation, frequency of involvement in leisure cognitive activities) variables can enhance CR during the middle age. Specifically, this project investigated the effects of a high congruency person environment fit, occupational attainment and involvement in cognitively stimulating leisure activities on CR within a sample of middle age to older adults (40-89 yrs old). In fact, the multivariate and predictive relationships between personal demographic attributes (education, coping) and the fit between such attributes and the environment (person-environment fit /occupational congruence) have not been researched. This study used the existing version of The Lifetime Experience Questionnaire (LEQ) (Valenzuela & Sachdev, 2007) to assess for the level of participation in leisure activities.. Currently this instrument seems to be the only instrument available to quantify the lifestyle factors related to CR from a lifetime perspective. The psychometric properties of LEQ, however, have been only validated within an older Australian and American adult population. Therefore, one of the goals of the study was to adapt and validate a Greek equivalent version of the LEQ among healthy Greek Cypriot adults.

Some studies suggest that cognitive reserve might be represented by mature cognitive function (Richards & Sacker, 2003); however it is almost impossible to capture peak cognitive ability since cognitive function can be augmented throughout adulthood (Richards, Hardy, & Wadsworthm 2003). In fact, one could rightfully ask: Why take a life-course approach to CR? It is believed that a life-course approach assumes factors that act during cognitive development and aging processes, which might influence enhancement of CR. Considering cognitive reserve as a developmental process and as a continuum from early to late adulthood can provide useful insights on maximizing its effects on cognitive aging. The moderating role of CR in reducing the direct negative effect of age on verbal

memory and executive function has been established by earlier investigations (Giogkaraki, Michaelides & Constantinidou, 2013).

Consequently, one of the main objectives of this study was to identify and capture this period in life during which CR can be boosted the best. The study implemented a life-course model of CR in order to identify the stage in life during which the personal and environmental factors would significantly contribute in predicting of cognitive performance.

Innovation of the Study

The study of behavior as a result of the interaction between the individual and the surrounding environment is commonly referred to as person-environment (PE) fit research. A "match"or "best-fit" of individual to environment is viewed as expressing itself in high performance, satisfaction, and little stress in the system whereas a "lack of fit" is viewed as resulting in decreased performance, dissatisfaction, and stress in the system. Most of the existing Person-Environment fit research has mainly focused on predicting performance, job-satisfaction, and stress in the workplace.

This study aimed to further explore and interpret the concept of cognitive reserve as a function of both personal and environmental factors. The proposed model adds another dimension to the traditional concept of cognitive reserve, as it suggests the inclusion of - environmental factors and personality (occupation-personality congruence) in addition to well-known variables of education and level of involvement in cognitively stimulating activities.

More importantly, the applicability of a proposed interactive model of CR within a specific sociocultural context has not yet been tested. The structure of interest is not universal and may be influenced by culture or ethnicity. Culture has been suggested to influence the strength and interrelations of vocational preferences. Even though the

Holland's hexagonal model has been tested for a group of Greek participants (Sideropoulou-Dimakakou, Mylonas, & Argyropoulou, 2008) there is a lack of relevant research within the Greek Cypriot cultural context. The results of this past study could be only applied and validated for a limited sample size and age range (156 university undergraduate and graduate students).

The proposed study is based on models of CR from a lifetime perspective with the innovation of examining patterns and possible mechanisms that explain the change of involvement in cognitively stimulating activities from a cognitive enrichment hypothesis. Past studies have mainly examined the relationship between physical activity and cognition but not with regards to the cognitive-enrichment hypothesis.

Finally, the current study provided the opportunity to validate the application of instruments for the first time within the Greek Cypriot sample of older adults. It specifically validated the Self Directed Search (SDS) and a quite recent instrument applied in CR studies that measures involvement in leisure activities. The Lifetime Experiences Questionnaire (LEQ; Valenzuela & Sachdev, 2007) represents the accumulated level of cognitive reserve throughout life but also three subscores representing each stage of life young adulthood stage, middle age, late life. The LEQ may offer additional clinical and theoretical implications in the area of the cognitive aging research.

Participants

The study included a total of 150 adult participants aged 40-89. Specifically, there were 100 participants aged 40-64 years and an additional of 50 participants ages 65-89 years who were mainly recruited from the Neurocognitive Study of the Aging in Cyprus (NEUROAGE). NEUROAGE is a longitudinal project exploring neuropsychological-neurocognitive performance, health indices and biological markers, as well as quality of

life issues in over 600 elderly Greek Cypriot community volunteers. Baseline data from NEUROAGE were included in the present project.

The inclusion criteria for the current study participants was the following: 1) Males and females over the age of 40; 2) Good general health with no previous history of neurological disorder such as head trauma or stroke or other neurodegenerative disorder; 3) No history of severe psychiatric or emotional disorder requiring hospitalization; 3) MMSE score of 24 or higher, and; 4) Geriatric Depression Score of 6 or lower.

Measures

Participants were administered a battery of neurocognitive and language tests to assess general cognitive functioning and certain aspects of language abilities adapted and translated into Greek and used in previous research (Constantinidou, Christodoulou, et al., 2012;Lezak, Howieson, & Loring, 2004). The Mini Mental State Examination (MMSE) and the Geriatric Depression Scale (GDS) served as screening tools for the study inclusion. Predictive and Outcome variables were as follows:

1. Occupation-Personality Congruency.

The Self-Directed Search (SDS) Greek Edition was used to assess personality type. The SDS yields a three-letter personality code based on self –reports of preferred activities, occupations, individual competencies, and self-estimates of abilities. The Greek edition of Holland's (1985) Occupations Finder was used to define each job in terms of a three-letter code. The Holland's SDS personality codes were compared with main lifetime occupational code to assess for the level of occupational congruence. First-letter agreement based on the hexagon (Holland, 1973) was used as congruence measures. There were scores from 1 to 4, with higher scores representing increasing levels of congruence.

2. Coping Strategies.

This was assessed with the Greek version of the Brief COPE (Kapsou, Panagiotou & Kokkinos, 2010). Example of some items used in this scale are: a) I've been turning to work or other activities to take my mind off things; b) I've been trying to find comfort in my religion or spiritual beliefs; c) I've been trying to get advice or help from other people about what to do; d) I've been taking action to try to make the situation better.

3. Leisure Activities.

Lifespan mental activity was estimated using a Greek adaptation of the Lifetime of Experiences Questionnaire (LEQ) (Valenzuela & Sachdev, 2007). The LEQ measures complex mental activity levels in the domains of education, occupation, creative arts, reading, writing, socializing and day-to-day habits in each of the life stages of young adulthood (13–30 years of age), middle age (30– 65 years) and late life (post 65 year). Each life stage produces a sub score and these are summed to produce a total score. The LEQ is therefore a part-retrospective and part-contemporaneous measure whereby higher LEQ scores indicate a higher level of complex mental activities across the lifespan. The LEQ has been shown to be a reliable and valid measure of complex mental activity: Item Response Theory estimates of reliability ranged from 0.85–0.92, the test-retest reliability correlation coefficient was 0.98, and higher LEQ scores independently predicted decreased cognitive decline over 18 months (Valenzuela & Sachdev, 2007). Moreover, the use of a such questionnaire to evaluate the level of involvement in cognitively stimulating leisure activities has been successfully applied in additional studies examining the construct of CR (Scarmeas et al., 2003; Valenzuela & Sachdev, 2007).

Cognitive Performance Outcomes as measured by Executive Function and Memory Tests.

A neurocognitive test battery was administered to all participants. It incorporated tests of verbal memory (VM), executive functioning (EF), and language. Mini Mental

Status Examination in Greek (MMSE; Fountoulakis, Tsolaki, Chantzi, & Kazis, 2000). A score under 24 (out of possible 30) was the cutoff for study inclusion.Geriatric Depression Scale in Greek (GDS; Fountoulakis et al., 1999) was used as a screening for mood disorders, especially depression.

1. Greek Version of the Trail Making Tests (TMT) A and B (Constantinidou, Papacostas, Nicou, & Themistocleous, 2008; Zalonis et al., 2008). The TMT provides information on visual search, scanning, speed of processing, mental flexibility, and executive functions. Originally, it was part of the Army Individual Test Battery and subsequently was incorporated into the Halstead–Reitan Battery. Specifically, Part A of the test requires attention, visual scanning and speed of eye–hand coordination as well as information processing, while part B in addition to all the component required in Part A, assesses with more precision the ability to alternate between two cognitive sets of stimuli also referred to as mental flexibility or cognitive shift, all critical to EF. The total number of seconds required to complete each task is the measure analyzed in this study.

2. Symbol Digits Modalities Test (SDMT; Smith, 1982). It primarily assesses complex scanning, visual tracking, and eye hand coordination within a time constraint. The total number of items correct in 90 seconds was the score used in the analysis as indicated in the administration manual.

3. Greek Version of the Verbal Fluency. Two verbal fluency tasks: Animal recall and Words from the letter F were implemented, modified from the Controlled Oral Word Association Test (COWAT; Kosmidis, Vlahou, Panagiotaki, & Kiosseoglou, 2004). The total correct items retrieved in 60 seconds were used as the score for each of the word fluency tasks.

Composite EF, Verbal Memory and CR Scores - In addition to specific memory and EF scores, composite scores were used. Such scores were created using all tests that measure cognitive functioning by first standardizing the raw scores on each test to z-scores using the

baseline mean and standard deviation value in the entire cohort for each test. Then the z scores were averaged to yield the composite z scores for EF, Verbal Memory and CR. (Constantinidou et al., 2008; Konstantinou et al., 2016)

4. Greek Version of the Hopkins Verbal Learning Test (HVLT)-Revised (Benedict, Schretlen, Groninger, & Brandt, 1998; adapted in Greek by Constantinidou upon permission from the publisher); Learning trials (first trial: HVLT1 and the total score of the three learning trials: HVLTimmediate), delayed recall (HVLTdelayed), to assess list learning and delayed recall performance. A list of 12 words from three taxonomic categories will be presented to the subject with words read aloud at the rate of approximately one word every two seconds. The test includes three list learning trials. Delayed recall is assessed 20-25 minutes later. Immediately after administration of the Delayed Recall trial, a forced-choice recognition test is administered. The recognition test includes the 12 target words plus 12 distractors (six semantically-related and six semantically-unrelated). The test is scored and yields measures of: a) verbal learning (sum of trials 1-3), b) retention, and c) recognition ability.

5. Greek Version of the Logical Memory Story A from the Wechsler Memory Scale – Revised: Immediate & delayed recall of a short story material (Constantinidou & Ioannou, 2008). Logical Memory I (LMI) assesses narrative memory under a free recall condition. Logical Memory II (LMII) is a delayed condition assessing long−term narrative memory with free recall.

Definition of the latent constructs

Past studies that explicitly evaluate CR have used either of the following variables as the main sources of CR: education, occupation type, intelligence, leisure activities. Literature suggests that cognitive reserve may operate by allowing for more flexible strategy use, an ability that is captured by executive function (EF) tasks (Tucker & Stern,

2011). Specifically, there are studies that found that measures of CR as operationalized by WRAT and PPVT were found to highly overlap with EF tasks (Constantinidou et al, 2012). The present study followed the approach suggested by Giogkaraki et al., (2013) considering the years of education, occupation, coping and leisure activities as formative indicators of CR and the passive vocabulary and reading measures tests were used as reflective indicators of CR. Specifically, the total number of correct responses in the Greek Version of the Peabody Picture Vocabulary Test (PPVT–III; Simos, Kasselimis, & Mouzaki, 2011) was used to assess receptive or passive vocabulary. Reading was measured using the total number of pseudowords read correctly in 45 seconds as measured by a test of pseudowords in Greek (Simos, Sideridis, Kasselimis, & Mouzaki, 2013).

Verbal memory was defined as a latent factor with five reflective observed-score indicators: Hopkins Verbal Learning Test Trial 1 (HVLT1), the total score of the HVLT three learning trials(HVLTimmediate), and the delayed recall score (HVLTdelayed), Logical Memory immediate, and Logical Memory delayed. Executive function was also defined as a latent factor with five reflective indicators: Trail Making A (TMTA), Trail Making B (TMTB), Symbol Digits Modalities Test, Verbal Fluency for semantic category, and phonemic verbal fluency. The above tasks are speeded, mainly measuring attentional control and set-shifting and verbal fluency ability (Fisk & Sharp, 2004).

Statistical Analyses

Descriptive, correlational and factor analyses were initially conducted to investigate the statistical properties of the interest inventory (SDS), coping (Brief Cope) and leisure activity measures (LEQ). Secondly, there were a series of multiple regression analyses conducted to test for the predictability of each suggested model within young and old adult groups, separately and combined. Finally, SEM analyses investigated the goodness of fit of the proposed theoretical models to the data. SEM analyses comprised of both the structural

and the measurement model; the measurement model deals with the links between the

latent variables and their observed measures (i.e., the CFA model), and the structural

model depicts the links among the latent variables themselves (Byrne, 2010). SEM

analyses assessed relationships among the independent variables (occupational congruence,

coping, LEQ) and their roles/contribution in the formation of latent variable CR (as

measured by Word Reading, PPVT). Specifically, path modeling described the way that

level of main past occupational congruence, level of involvement of cognitively

stimulating activities, and coping skills were associated with CR measures. It was

expected that would be independent pathways from occupational variables to cognitive

reserve, from coping to cognitive reserve and from level of activities (LEQ) to CR.

Estimating the Model

In line with current practice, several criteria to assess the fit of the model to the data

were used. If the root mean square error of approximation (RMSEA; Steiger, 1990) is

<0.08, the suggested model is considered to have a close fit to the data. The comparative fit

index (CFI) (Bentler, 1990) was also considered as an index of choice with values

restricted to lie on a 0 to 1 continuum, with higher values indicating a better fit. To test for

the hypothesis that that LEQ scores could be indicative of the accumulated level of CR and

of Cognitive Performance (with main indicator HVLT & LM) Pearson's Correlation

analyses were conducted to test for the degree of correlation between the main formative

variables of Cognitive Reserve Items (Word Reading, PPVT) and LEQ scores (both for

Middle Age subscore and LEQ Total score). The proposed model is illustrated in Figure 1.

Finally, this dissertation project was organized in the three following chapters.

Chapter 2 investigated and presented the psychometric properties of the self-reported

scales within the Cypriot sample of adults. Chapter 3 investigated the contribution of both

environmental and personal demographic variables to cognitive outcomes and CR. Chapter

4 investigated a model of CR including both formative (education, occupation, coping and

leisure activities) and reflective (passive vocabulary and reading) variables.
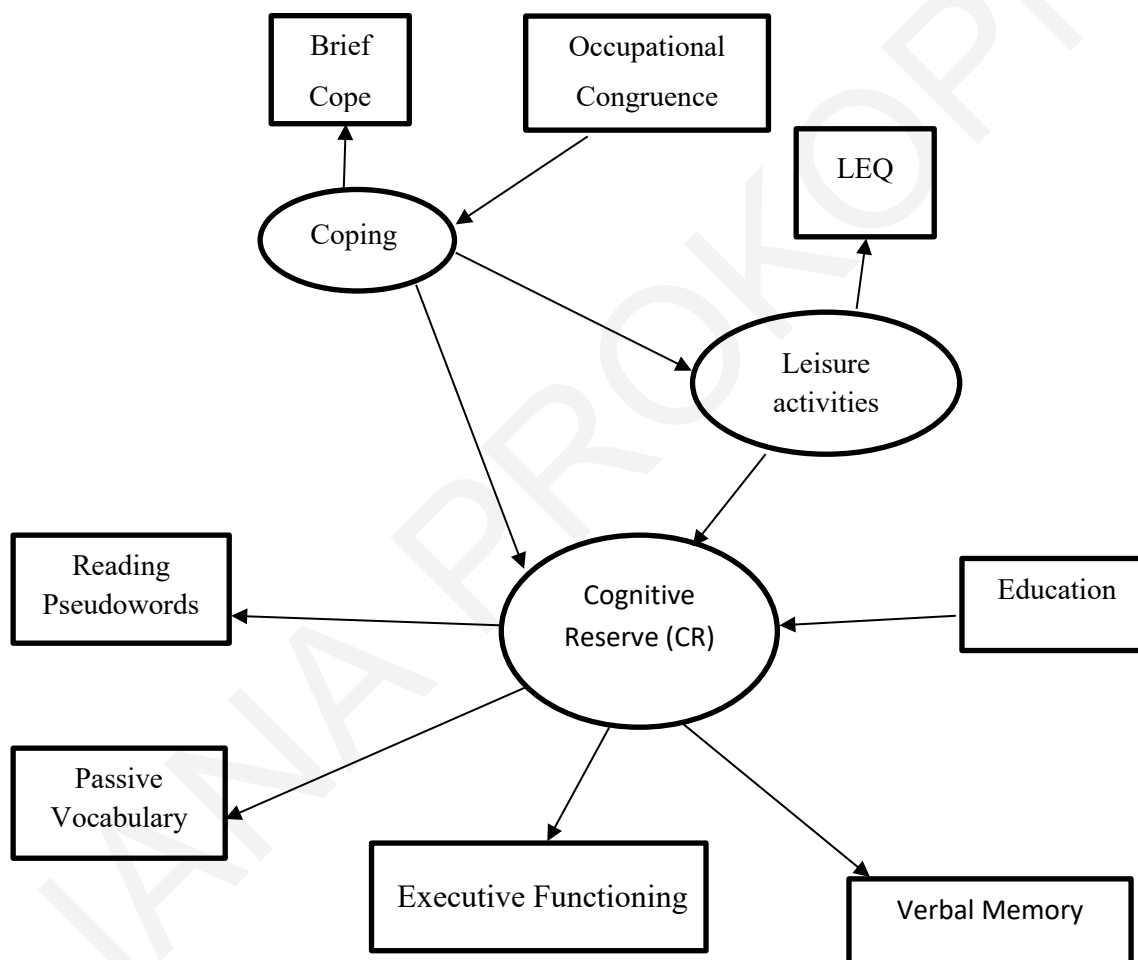
Figure 1. Suggested mechanisms through which Occupation, Leisure activities and Coping

contribute to CR

CHAPTER 2

Investigation of Psychometric Properties of the Self-Reported Scales

Introduction

The Brief- COPE consists of 14 two-item scales. Factor analytic studies have demonstrated that broader dimensions of coping also exist. Kapsou et al., 2010 validated the Brief Cope in Greek for a sample of Greek speaking adults and the results indicated adequate psychometric characteristics for the Greek translation of the Brief-COPE for this population. Nevertheless, the dimensional understanding of the construct of coping is not very consistent across theoretical models. Past studies have identified these main factors: the use of instrumental support, use of emotional support, and venting loading on emotion-focused coping; planning, positive reframing, acceptance, active coping, and self-blame loading on problem/task coping; and denial, self-distraction, and behavioral disengagement loading on avoidance coping (Lyne &Roger, 2000). There are additional studies that have mainly identified three or four interpretable higher-order factors as obtained with an oblique principal axis factoring on the 14 scales (Hasking & Oei, 2002; Michaelides et al, 2016). However, the majority of research support three underlying coping factors reflected in the COPE (task, emotion and avoidance) (Hasking, 2001).

The Brief Cope has been used extensively in research investigating the coping-health link, however there is not enough research on the coping –cognitive wellbeing link in non-clinical samples of advanced age and within a specific cultural context. Although several studies have explored how people cope with various stressors in different settings and cultures, it is important to develop a reliable factor structure for the Brief COPE and understand the key dimensions of coping within the cognitive aging context. Furthermore, the evaluation of coping strategies (emotional, task or avoidant or other) in relation to the level of involvement in complex leisure activities and to cognitive functioning may be an

essential precursor to the development of effective interventions to improve mental health and quality of life among older adults.

Finally, there is a line of studies supporting that an active cognitive lifestyle may provide a protective role in the long-term maintenance of cognition (Suo et al., 2017; Fratiglioni et al., 2004; Valenzuela &Sachdev, 2007). Indeed, additional sources even suggest that cognitive activity during adulthood can even compensate for low education on the outcome variable memory performance (Lachman, Agrigoroaei, Murphy, & Tun, 2009). It could be that discrepancies between years of education and lifelong involvement in cognitively stimulating leisure activities, are an indication of other traits related to reserve. Therefore, the frequency of involvement in various types of leisure activities could be understood both in terms of preferred coping strategies and of lifelong occupational interests or activities. For example, persons with more frequent involvement in cognitively stimulating leisure activities activity may have higher levels of motivation, curiosity and certain coping preferences which can effectively build reserve. Occupational attainment has additionally been suggested as a marker of CR in a number of studies (Ghaffar et al., 2012; Stern et al., 1995). Therefore, the present study is expected to emphasize the importance of considering additional variables including coping patterns and occupational attainment to the existing list of variables that define cognitive reserve. The present study investigated the psychometric properties for the Greek translation of the Lifetime Experiences Questionnaire (LEQ) for a Greek Cypriot sample of healthy adults. LEQ is considered to be a reliable and valid instrument for assessing complex lifespan mental activity which is protective against cognitive decline. Most of the LEQ Life Stage subscales have demonstrated internal coherence a coefficients > 0.7. In one study, (Glei et al. 2005) a positive relationship between total LEQ and cognitive change was found and was insensitive to exclusion of outlier data. In the same study, life-stage subscores showed

a similar relationship with cognitive decline as the total LEQ score, hence the LEQ total score may represent a useful approximation of the neurocognitive brain-reserve construct.

Present Study

The purpose of this study was to examine the psychometric properties of the self-reported scales used in this dissertation. Specifically we investigated the psychometric properties for the Brief COPE, the SDS, and the LEQ scales. Confirmatory Factor Analyses (CFA) were conducted in order to examine the fit indicators for each of the scales. Finally, the analyses examined the contribution of demographic indices including gender, age and education in relation to coping preferences, Holland's personality types and level of activity type as reported in each scale. The exploration of specific dimensions for Holland's types of interests and for the LEQ subscales is expected to provide preliminary data for the development and validation of cultural specific tools that may be used for estimation of complex mental activities across the lifespan.

Firstly, it was hypothesized that the factor analyses findings of the Greek version of the Brief-Cope would suggest the presence of broader underlying dimensions of coping. In previous studies, individuals with at least some college education have reported using most strategies to a greater degree than their lower educated counterparts except for denial and behavioral disengagement. To the contrary, religion has been reported to a greater degree by individuals with no college education (Kapsou et al, 2010). In respect to such demographic characteristics and based on past research it was expected that participants with higher levels of education would report applying more frequently most of the coping strategies than the participants with lower levels of education. It was also expected that there would be an interaction between the types of reported strategies and levels of education, with lower levels of education being associated with more frequent use of religious coping strategies.

Secondly, it was hypothesized that the correlations for the adjacent types in Holland's hexagonal model would be reasonably high (for example between the Artistic and Social types). As it has been supported by previous literature on Holland's types, it was also expected that there would be statistically significant gender differences in interests, abilities and preferences for mainly Realistic and Artistic types of occupations with men reporting stronger preferences for the Realistic ones and women indicating stronger preferences for social or artistic types of activities/occupations.

Finally, we expected our findings to demonstrate that LEQ is a reliable and valid tool for the estimation of complex mental activities across the lifespan. Furthermore, it was expected that there will be significant associations between the three subscales of LEQ (Young to Midlife and to Late life). According to previous findings, it was hypothesized that the highest correlation will be between the Young Adulthood and the Mid Life subscales and the lowest between MidLife and Late Life subscales. Furthermore it was expected that there would be significant gender differences with regards to frequency of involvement in various types of leisure activities, with males being more frequently involved in physical rather than artistic or social types of activities.

Method

Participants

Participants in this study consisted of 150 healthy adults between 40 and 89 years of age. Participants were mainly recruited from the Neurocognitive Study for the Aging, a longitudinal project exploring neuropsychological–neurocognitive performance, health indices, and quality of life issues in elderly Greek Cypriot community volunteers and through advertisement of the study within the greater Nicosia community. The inclusion criteria for all participants were the following: (a) native Greek speakers, (b) males and females of age 40 and above, (c) good general health with no previous history of

neurological disorder such as head trauma, stroke, or neurodegenerative disorder, (d) no history of severe psychiatric or emotional disorder requiring hospitalization, (e) Mini-Mental State Examination (MMSE) score of 23 or higher, and (f) Geriatric Depression Score (GDS) of 9 or lower. All the participants provided signed consent for the participation in the study.

Measures

COPE-Brief (Carver, 1997).

COPE-B is a 28-item measure of strategies used by individuals to cope with problems and stress. It consists of 14 scales of two items each, answered on a 4-point Likert type scale, ranging from 1 (not at all) to 4 (very much), where higher scores indicate higher use of coping strategies, and was adapted in Greek by Kapsou, Panayiotou, Kokkinos, and Demetriou (2010). The 14 scales include acceptance, active coping, positive reframing, planning, use of instrumental support, use of emotional support, behavioral disengagement, self-distraction, self-blame, humor, denial, religion, venting, and substance use. All participants responded to the 28 items of the Brief-COPE in the context of larger questionnaire packages. Instructions directed participants to indicate ways in which they typically cope with stress in their life, rather than in specific situations.

SDS (Self Directed Search) Holland, 1994.

The Self-Directed Search (SDS) is an easy-to-use, self-administered test that helps individuals identify their vocational interests. It requires about 35 - 45 minutes to complete and the respondents answer questions about their activities, competencies, occupations, and self-estimate and then calculate their total scores. The SDS comprises of scales that assess the six interest types. The scales used for the purpose of this study were 1) "activities" (measures the activities that the person likes to participate in, in relation to each type); 2) "competencies" (measures the competencies that the participant believes that he/she possesses in relation to each type); 3) "occupations" (measures the occupations that one

would like to engage in, in relation to each type) and 4) "self-estimates" (measures the general abilities that the participant believes that he/she possesses in relation to each type). The "Activities" and "Competencies" scales consist of 66 items each (11 items assessing each type), the "Occupations" scale consists of 84 items (14 items assessing each type), and the "Self-estimates" scale consists of 12 items.

LEQ (Valenzuela & Sachdev, 2007)

The LEQ is constructed around two major dimensions: Life-stages and specific versus non-specific mental activity. The three life-stages assessed by the LEQ include: Young Adulthood (13–30 years), Mid Life (30–65 years or until retirement), Late life (from 65 years or retirement until present date). The scale was translated into Greek using front and back translation by researchers fluent in both Greek and English. Differences in translation were resolved through consensus .The LEQ scale provides a mental activity total score plus three subscores; one for young adulthood stage, one for middle age and one for later life and it is based upon significant validated research. The scale has both specific and non-specific mental activity questions for each stage. For the purposes of such study we used mainly the general questions for each stage which dealt mainly with people's participation in a number of non-specific mental activities during each of the three life-stages. These included questions about frequency or proficiency related to: playing musical instruments, following an artistic pursuit, reading, visiting family, social outings, playing sport or practicing a physical discipline, learning a new language, travel and hobbies. Answers were scored on a scale from 0 (never) to 5 (every day) with 5 indicating high involvement in each of the complex leisure activities.

Procedure

Participants were recruited voluntarily in the study and were interviewed by a trained research assistant. Data were collected in-person during one or two sessions using demographic questionnaires, self-report scales and neuropsychological assessments. They

were administered a battery of neurocognitive and language tests in order to assess certain

aspects of cognitive and language functioning. Along with the neurocognitive measures

there were 3 questionnaires administered in order to assess a) the participants' coping

strategies, b) the participants' level of participation in cognitive, physical and social

activities, and c) the participants' preferences, abilities and interests in various professional

activities.

Data Analyses

Brief-COPE Data Analyses

Reliability. To assess internal consistency, we calculated Cronbach's alpha, overall

and for each subscale, considering alpha values of 0.70 and higher indicative of good

internal consistency (reference here).

Exploratory factor analysis (EFA). Before conducting Confirmatory Factor

Analysis (CFA) an exploratory factor analysis was conducted. EFA of the Brief COPE

with 14 sub-scales was carried out using the principal-components factor extraction

method with a varimax rotation to test the loading strength of the items on the factors. The

eigenvalue was fixed at 1.5 and factor loading lambda at 0.5 in the EFA to guide item

retention. For a sample of 100, the factor loadings should be greater than .5 for 200 should

be greater than .3 according to Stevens (1992).

Confirmatory factor analysis (CFA). CFA of the original 28 item Brief COPE

scale was performed on the entire sample of participants using the original 14 factor

structure to evaluate the fit of each subscale for the adult Greek-Cypriot population. The

root mean square error of approximation (RMSEA) was calculated, with a goal of 0.05 for

good model fit (45). Bentler's comparative fit index (CFI) was computed with a cutoff

point of 0.95 set for good model fit (46, 47) and Cronbach's alpha was calculated for each

of the sub-scales. Analysis was conducted in IBM SPSS AMOS 20 using maximum

likelihood estimation (MLE). In CFA significant chi-square statistics indicate a

nonsignificant result (the model is not a suitable fit to the data). First the 14 subscales were

examined, to determine if the items did load into these factors. Model fit was evaluated

with the following indices: the chi square statistic as a measure of the overall model fit, the

Comparative Fit Index (CFI), the Standardized Root Mean Square Residual (SRMR), and

the Root Mean Square Error of Approximation (RMSEA). Values of CFI close to .95,

SRMR less than .08 and RMSEA close to .06 are an evidence of good fit between a

hypothesized model and the data (Hu & Bentler, 1999).

SDS Data Analyses

Descriptive statistics were computed for each personality type for the six

distributions.

Reliability. The internal consistency of the factors was investigated with the use of

Cronbach's alpha coefficient. Cronbach's alpha is a measure of how well each individual

item in scale correlates with the sum of the remaining items. An alpha coefficient equal to

or greater than 0.7 was considered acceptable and indicates good reliability.

Correlation Analyses. The inter correlations for the 6 personality types were

computed. It was expected that the correlations for the adjacent types in Holland's

hexagonal model would be reasonably high (for example between the Artistic and Social).

Factor analysis. The exploratory factor analysis (EFA) was used to analyze

interrelations among the items of the questionnaire. The SDS questionnaire has a large

number of questions, thus the exploratory factor analysis was the best way to recognize and

explain the dimensions of the various factors. A Principal Component Analysis (PCA) with

orthogonal Varimax rotation was conducted, to assess the internal structure of the measure.

The number of factors retained, was derived by considering the magnitude of the

eigenvalues (greater than 1) and the proportion of variance extracted. When one item has

poor loadings (less than 0.4) on more than one component, it was removed from the analysis.

LEQ Data Analyses

Lastly, descriptive and correlational analyses were conducted to reveal the psychometric properties of the LEQ scale within a sample of Greek-Cypriot adults. Responses from the LEQ scale were expected to identify the most often endorsed statements regarding the type of activities carried out during each stage of life for this sample of participants. Following ANOVA analysis were conducted to investigate the effect of gender and education on types of activities preferred during lifetime.

Results

Brief-COPE

Socio Demographic Characteristics. The socio-demographic characteristics of the 150 participants are presented in the Table 1. Fifty-two males (34.7%) and 98 females (65.3%) aged from 40 to 89 years old with a mean age of M= 56.19 and SD =14.11 participated in this study. Two thirds (n = 100) or 66.7% of the study participants were under 65 and 50 or 33.3% were over 65. The educational level of the sample varied from 4 years to 22 years of education with a mean of M= 12.31 years and SD= 4.54.

Reliability. The Cronbach's alpha for the overall Brief COPE was 0.78 indicating good consistency among the 28 items. The alphas for the 14 sub-scales ranged from 0.40 to 0. 78, with the lowest alpha for the substance use subscale and the highest for the religious support subscale. Regardless of the fact that each subscale had only two items each, overall the alphas for 10 out of the 14 sub-scales were >0.53. No items were removed or subjected to transformation.

Correlation. Pearson correlations were calculated between all the Brief-COPE scales. In previous studies, statistically significant associations have been found to exist of

a small-to-medium range, between most scales. Specifically, Carver et al. (1989) study

reported weak but significant correlations between various COPE scales indicating that the

various coping strategies are distinct but not mutually exclusive (Kapsou, 2010). Table 2

presents the correlation statistics for the 14 items of the Brief Cope.

Table 1. Socio Demographic Characteristics by Gender

Characteristics	Total		Gender			
			Male (n=52)		Female (n=98)	
	n	%	n	%	n	%
Age (years)						
40-65	100	66.7	28	53.8	72	73.5
> 65	50	33.3	24	46.2	26	26.5
Education						
Primary School (0-6) years	36	24	12	23.1	24	24.5
Secondary (up to 12 years)	38	25.3	12	23.1	26	26.5
College and Above (> 12 years)	76	50.7	28	53.8	48	49.0
Current Employment Status						
Working	86	57.3	28	53.8	58	59.2
Unemployed	12	8	1	1.9	11	11.2
Retired	52	34.7	23	44.2	29	29.6

Notes: The term "unemployed" refers to the current occupational status. All participants

had at least 8-10 years of lifetime working experience.

Table 2. Inter-correlations between the 14 Brief-COPE subscales

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. SELFDISTRACT.	1	.39**	.18*	-.01	.22**	.17*	.01	.07	.05	.25**	.17*	.11	01	.08
2. ACTIVECOPING	.39**	1	.13	.01	.26**	.23**	-.00	.17*	.41**	.56**	.09	.19*	.11	.17*
3.DENIAL	.18*	.13	1	.05	.06	.13	.31**	.18*	.21**	.17*	.01	.08	.22**	.35**
4. SUBSTNACE	.01	.01	.06	1	.11	.10	.05	.06	.03	.09	.10	.06	.05	.12
5. EMOTIONAL	.21**	.26**	.06	-.11	1	.75**	.08	.31**	.08	.24**	.01	.11	.13	.01
6.INSTRUMSUPPORT	.17*	.23**	.13	.10	.75**	1	.15	.29**	.10	.32**	.01	.09	.22**	.08
7.BEHAVIORDISEN.	.01	.01	.31**	.05	.08	.15	1	.08	.05	.09	.10	.26**	.02	.08
8. VENTING	.07	.17*	.18*	.06	.31**	.29**	.08	1	.10	.18*	.34**	.08	.05	.15
9. POSITIVEREFRAM.	.05	.41**	.21**	.03	.08	.10	.05	.10	1	.43**	.05	.25**	.32**	.33**
10. PLANNING	.25**	.56**	.17*	.09	.24**	.32**	-.09	.18*	.43**	1	.01	.22**	.16*	.36**
11. HUMOR	.17*	.09	.01	.10	.01	.01	.10	.34**	.05	.00	1	.12	.31**	.17*
12. ACCEPTANCE	.11	.19*	.08	.06	.11	.09	.26**	.08	.25**	.22**	.12	1	.03	.01
13. RELIGION	.01	.12	.22**	-.05	.13	.22**	.02	.05	.32**	.16*	.31**	.03	1	.25**
14. SELFBLAME	.08	.17*	.35**	.12	.01	.08	.08	.15	.33**	.36**	.17*	.01	.25**	1

Notes. **. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Exploratory Factor Analyses. Preliminary analyses of the data indicated that KMO

value is .65. For the KMO if the value is greater than .5 is considered almost acceptable so

although it is not that high it is still ok to continue with our data analyses. Bartlett's test of

sphericity was significant with a value less than .05. Analyses of the eigenvalues and a

scree plot from the EFA revealed an 8 factor solution. The results of the EFA indicated

eight factors with eigenvalues over 1 to be extracted, which explained 62.59 percent of the

variance (KMO =. 65).

Our results indicated that when a varimax principal axis factor on the 14 scales was

used, the factors extracted corresponded roughly to similar factors found in previous

studies (Michaelides et al, 2016; Hasking & Oei, 2002; Lyne & Roger, 2000) as described

above. The 8 factors identified initially were then combined and loaded on 4 higher order

factors. Specifically, they were: An ***emotion-support seeking coping*** factor comprised by

use of instrumental support and use of emotional support. There was the ***problem/task***

coping factor comprised by planning, positive reframing and active coping. The next factor

identified was ***avoidance coping*** factor comprised by behavioral disengagement items and

denial. Religion items loaded separately on an additional separate factor. The results of the

factor loadings are presented in Table 3.

Table 3. Factor loadings emerging from Principal Component Analysis of Greek Brief-COPE

	Observed Factor Loadings			
Items	1	2	3	4
Emot. Support2	.83			
Instr.Support2	.82			
Instr.Support1	.81			
Emot. Support1	.82			
PositiveReframing1		.65		
PositiveReframing2		.70		
Active Coping2		.67		
Planning1		. 67		
Planning2		.71		
Behav.Disengagement1			.58	
Behav.Disengagement2			.60	
Denial 1			. 63	
Religion2				-.58
Religion1				- .53

Notes: 1 = Support Seeking/Emotion Focused Coping; 2 = Problem/Task Coping; 3 = Avoidant Coping; 4 = Religious

Confirmatory Factor Analysis.

The CFA results indicated that when the Religion was combined within the avoidant coping style, the model had a better fit. In the current model we had included religion after the modification indices indicated that religion should be included in the avoidance factor. The higher the probability associated with the chi-square, the closer the fit (Bollen, 1989). Chi square statistic for the model was 43.35 based on 17 degrees of freedom ($p < .001$, chi-square/d.f. = 2,48. Indices of fit (Comparative Fit Index (CFI), which is recommended to be > 0.90 (Mueller, 1996) was CFI = .93; Root-Mean-Square Error of Approximation (RMSEA), recommended to be <0.08 (Hu & Bentler, 1999) was .08.Figure 2 presents the 3 factor model of Brief COPE. It is suggested that a 3 factor model incorporating religion as part of avoidant coping is the most acceptable model. Additionally, a 3 factor model incorporating task, emotion and avoidant coping has often been reported in the literature and it seems to be the model of choice in describing coping styles (Hasking & Oei, 2002).
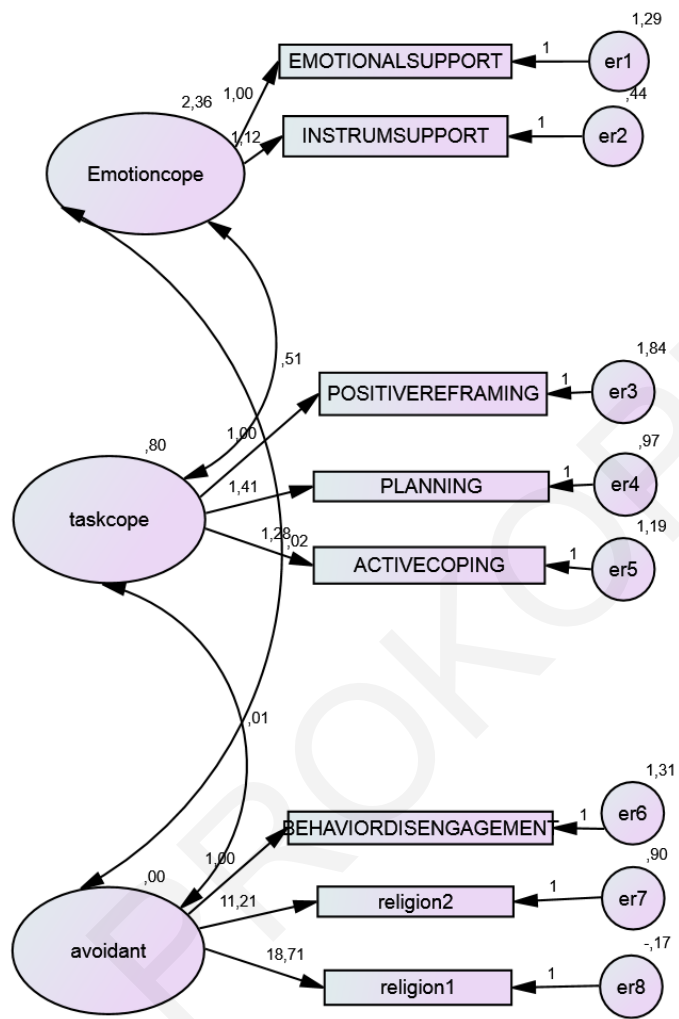
Figure 2. Path diagram of the final confirmatory model of the Brief-COPE.

Self-Directed Search (SDS)

Descriptive statistics were computed for each personality type to test for deviation from normality for the six distributions. For the Realistic type the participants mean was rather low in comparison to the other five personality type means. The table 4 presents the mean distributions and SD for each type of personality (RIASEC) by gender. The independent t- test results by gender for each of the 6 personality types indicate that for the Realistic type, on average men preferred the Realistic type occupation and interests (M=24.71,SE=1.48) as compared to women (M=12.55, SE=.70). This difference was significant, t (148)=7,38, p <.05. For the rest of the Holland types although there were mean differences between the two genders, they were not statistically significant ($p > .05$).

Cronbach's alpha coefficient for the total number of items (224 items) was 0.92, which indicates that the total scale has very high internal consistency. It was also noted that it was not necessary to delete any of the items to improve the reliability score of the test. The internal consistency reliability coefficients in the present study ranged from .69 to. 87 for the "Activities" Scale, from .76 to. 89 for the "Competencies" Scale, from .69 to .87 for the "Occupations" Scale, and from .51 to .88 for the "Self-estimates" scale. Additionally, for the total Scale named "Activities" across all the 6 interest types, the reliability coefficient was .82, for the total "Competencies" scale was .86, for the total "Occupations" Scale was .88 and for the total "Self-estimates" scale was .70.

Table 4. Means and Standard Deviations by Gender for each Personality Type

Holland Type	Gender	Mean	SD
Realistic	Males (n=52)	24.7	10.7
	Females (n=98)	12.5	6.9
Investigative	Male	21.6	10.6
	Female	17.9	9.8
Artistic	Male	18.7	10.5

	Female	24.6	11.2
Social	Male	29.6	10.1
	Female	37.6	9.5
Enterprising	Male	26.1	12.5
	Female	21.7	11.9
Conventional	Male	21.5	12.7
	Female	18.7	11.9

Correlation Analyses. Intercorrelations among the scales for the six personality types along with the mean scores for each subscale are presented in table 5. As it was expected, the correlations for the adjacent type in Holland's hexagonal model were reasonably high. Specifically there were a significant moderate to high relationship between the Social and Artistic types ($r =$. 52) and between the Conventional and Enterprising types ($r =$.46). However, there were also noted significant relationships between the Investigative and Enterprising types ($r =$. 35) as well as between the Conventional and Investigative types ($r =$.29).

Table 5. Intercorrelations among all subscales and the mean scores for the Holland's six personality types

(N=150)	R	I	A	S	E	C
R	**16.76**	.18*	.07	.23**	.18*	.05
I	.18*	**19.27**	.14	.26**	.35**	.29**
A	.07	.14	**22.58**	.52**	.15	.12
S	.23**	.26**	.52**	**34.84**	.18	.04
E	.18*	.35**	.15	.18	**23.23**	.46**
C	.05	.29**	.12	.04	.46**	**19.64**

Notes: **. Correlation is significant at the 0.01 level (2-tailed).
       *. Correlation is significant at the 0.05 level (2-tailed).

Exploratory Factor analysis. In order to measure the sampling adequacy the KMO measure was applied for each of the subscales used in the SDS scale (activities, competencies, occupations and self-estimation). Also as part of preliminary analyses, Bartlett's Test of sphericity is highly significant ($p<.001$) and the KMO initially had a value of .67 which indicated that some items were problematic. Since the overall KMO was mediocre (Kaiser, 1974), variables with a value of below .5 in the anti image correlation matrix table were excluded from the analyses. The KMO value was reassessed and it was .70.

Analyses of the eigenvalues and a scree plot from the EFA revealed a 6 factor solution. The results of the EFA indicated six factors with eigenvalues over 1 to be extracted, which explained 67.23 percent of the variance (KMO = .70). Specifically, the factors identified were: enterprising, which was composed by items of enterprising activities, enterprising competencies and enterprising self-estimates. The second factor was the conventional type with items of conventional activities, competencies, occupations and self-estimates. The third factor identified was realistic type with items of realistic activities, competencies, occupations and self-estimates. The fourth factor identified was investigative with items of investigative competencies and self-estimates. The fifth factor was mainly composed of items having to do with occupational preferences including realistic, investigative, social and conventional occupations. The sixth factor was the artistic factor, although there were social items loading in this factor as well. This scale consisted of items of artistic activities, competencies, occupations and self-estimates. The social factor was not clearly loading on a single factor. The results of the factor loading for the SDS scale are presented in the Table 6.

Table 6. Factor loadings emerging from Principal Component Analysis of Holland's SDS

Items	*Observed Factor Loadings*					
	1	2	3	4	5	6
EnterpriseActivity	.83					
EnterpriseCompetencies	.87					
EnterpriseSelf-estimate	.80					
ConventionActivity		.72				
ConventionalCompetencies		.76				
ConventionalOccupations		.57				
ConventioanlSelf-estimate		.79				
RealisticActivity			.85			
RealisticCompetencies			.84			
RealisticOccupations			.63			
RealisticSelf-estimate			.65			
InvestigativeCopmetencies				.80		
InvestigativeSelf-estimate				.85		
OccupationRealistic					.54	
OccupationInvestigative					.74	
OccupationSocial					.64	
OccupationConventional					.50	
ArtisticActivity						.78
ArtisticCompetencies						.74
ArtisticOccupations						.62
ArtisticSelfestimate						.77

Notes: 1 = Enterprising; 2 = Conventional; 3 = Realistic; 4 = Investigative; 5= Occupation Preferences; 6=Artistic

LEQ

Reliability. Results from the classical *a* (Cronbach model) reliability analyses are

shown in the Table 7. The cross correlations between the life stage subscales indicated

moderate to high associations: Young-Midlife ($r = .67$, $p<.001$); Young-Late Life ($r =.54$,

$p < .001$); Midlife-Late life ($r =.74$, $p<.001$). The initial independent T-Test results

indicated that there were some statistically significant differences between males and

females with regards to frequency of involvement in Artistic (practicing or playing a musical instrument, drawing, painting, acting) and Mental (cognitive) type of activities involved (reading, usage of a foreign language, travelling etc). Specifically, for the artistic type of activities, females reported higher involvement (M=6.62, SE=.046) than males (*M*=4.73, *SE*=.62). Such difference was significant *t*(148) = - 2.43, *p* <.05. Additionally, for the cognitive type of activities was observed that males were more frequently involved (*M*=14.77, *SE*=.68) than females (*M*=12.98, *SE*=.45) with a statistical significant difference *t*(148)=2.26, *p*<.05. However, there were no significant differences observed between the two genders for the other types of activities including level of in involvement physical activity or for the level of involvement in social activities, *p > .05*.

Exploratory Factor Analysis. Factor analysis was performed on all LEQ items. There were initially 7 factors identified with eigenvalues >1.0, together accounting for about 72% of the variance for the whole LEQ scale data. Valenzuela and Sachdev, 2007 had considered a smaller number of factors in order to facilitate interpretation of the factors in their validation study of LEQ. This decision was also confirmed by the scree plot which indicated a 4 factor solution. Consequently, the first four factors were considered in more detail and together they explained 58% of variance in the scale. Specifically, Factor 1 explained 22 % of the variance and loaded heavily on the leisure activities including use of foreign language and travelling (exposure to foreign stimuli).

The second factor loaded more heavily on items dealing with reading and explained about 15 % of the variance and was named the cognitive factor. Factor 3 loaded mainly on artistic activities including painting, drawing, writing and counting for about 11% of the variance. The fourth factor was the physical activities factor explaining about 9% of the variance. Table 8 presents the factor loadings from the Varimax rotation for the LEQ scale.

Confirmatory Factor Analyses. CFA for the LEQ scale with the 4 factor scores derived from the Factor Analyses provided a relatively good model of the 4 constructs

related to each other and also each of the observed variables loading significantly on the

respective latent factor. Figure 3 presents the path diagram for the CFA results for the LEQ

scale. Chi square statistic for the specified model was 52.69 based on 38 degrees of

freedom (p = .05, chi-square/df = 1.38. Indices of fit (Comparative Fit Index (CFI), which

is recommended to be > 0.90 (Mueller, 1996) was CFI = .95; Root-Mean-Square Error of

Approximation (RMSEA), recommended to be <0.08 (Hu & Bentler, 1999) was .05.

Table 7. Descriptive and Item Analyses Results of raw Lifetime Experiences Questionnaire (LEQ)

	Young Adulthood Subscore	Midlife Subscore	Late Life Subscore	Total LEQ
Mean	21.94	21.52	18.23	56.49
SD	5.25	4.15	4.60	12.60
Alpha Reliability Coefficient	.55	.46	.48	.79

Table 8. Factor loadings emerging from Principal Component Analysis of LEQ scale

	Observed Factor Loadings			
Items	1	2	3	4
LEQ young 6	.66			
LEQ young 7	.72			
LEQ middle 6	.65			
LEQ middle 7	.60			
LEQ old 6	.63			
LEQ old 7	.58			
LEQ young 5		.83		
LEQ middle 5		.79		
LEQ old 5		.82		

LEQ young 1	.61	
LEQ young 3	.83	
LEQ middle 3	.85	
LEQ old 3	.60	
LEQ young 4		.76
LEQ middle 4		.67
LEQ old 4		.56

Notes: 1 = Foreign exposure; 2 = Cognitive; 3 = Artistic; 4 = Physical activity
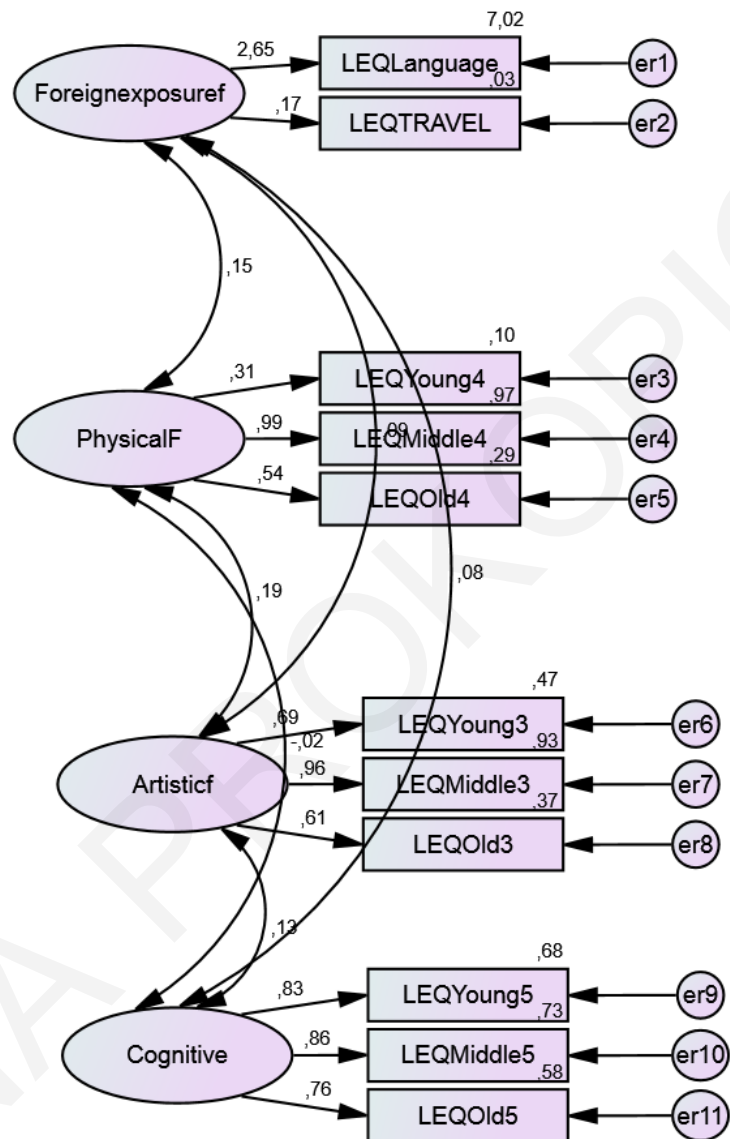
Figure 3. Path diagram of the final confirmatory model for the LEQ scale

Discussion

The aim of the present study was first to investigate the psychometric properties of the self-reported scales used in Greek. It will specifically further explore and validate the use of such scales within a sample of Greek Cypriot adults over 45. Previous findings have showed that the COPE comprises of three factors measuring emotion-focused coping, rational or active coping, and avoidance (Lyne & Roger, 2000).

As it was first hypothesized, overall the results are in partial agreement with previous factor analytic findings and they suggest the presence of broader underlying dimensions of coping. The instrumental and emotional support seeking factor of the COPE scale could be interpreted in terms of an interpersonal theory of coping with stress. Such investigations have developed links between coping and social support and broadening the concept of coping as it has traditionally been defined to include interpersonal and relational skills. Greenglass (1993) provided data that supported the Functional Support Model, suggesting that close relationships contribute to well-being through increasing use of more effective coping forms, i.e., instrumental and internal control, with a corresponding decrease in negative affect. For this line of research, coping and social support are seen as having functions in common -instrumental, emotional and perceptional which includes informational support that can alter perceptions of meaningful aspects of stressful situations.

More specifically, EFA showed that some factors consisted of a single scale's items, while some factors contained clusters of several scales. Thus, religion and substance use scales emerged as independent factors. This is in agreement with Fillion et al. (2002). Additionally, one of the denial items (i.e. I've been refusing to believe that it has happened), one of the planning items (i.e. I've been thinking hard about what steps to take) and one of the behavior disengagement items (i.e. I've been giving up the attempt to cope) loaded on more than one factor.

There are findings indicating that women tend to employ emotion-focused coping whereas men tend to use problem-focused coping, perhaps because societal standards encourage men to be more individualistic, while women are often expected to be interpersonal (Washburn et al., 2004). The sample in the present study was predominantly women with predominantly middle aged participants as compared to older participants. In previous findings, middle-aged women had scored significantly higher in Use of emotional support, Use of instrumental support and Humor than the old-aged group. Such findings within the healthcare setting interpreted that for women, emotional or instrumental support, such as counseling, information and advice, can be effective approaches linked to better wellbeing.

As supported by additional studies, the results of the present study indicated that there were significant group differences by education level with regards to frequency of use for Denial, Substance Use, Religion and Self Blame coping strategies. It was observed that participants with college or university education (education level more than 12 years) tended to report less frequent use of religion coping strategies as compared to the participants who had only completed up to 6 years of formal education (from 0-6 years of education). A similar pattern followed for the Denial, Self-Blame and Substance Use coping strategies.

However, the results of this study also indicated moderate-to-strong correlations between the two coping strategies such as expression of negative feelings and seeking support (emotional and instrumental). Such association may indicate that when people experience intense emotions that stimulate venting may need to seek more emotional or instrumental support. The emotion focused coping dimension included the use of humor as well as a coping strategy. Furthermore, the self-criticism or feelings of guilt scale loaded into the task focused dimension including other coping strategies such as planning and active coping. This may also suggest that when people feel that they are to blame for a

problem they may tend to get involved in more task-focused solutions. The presence of

moderate correlations between coping dimensions that appear contradictory, such as

active/positive coping and expression of negative feelings, may indicate that, when needed,

individuals can employ a variety of strategies to cope with their distress that are different

but not mutually exclusive (Kapsou, et al., 2010).

Past studies investigating the psychometric properties of Cope have suggested the

presence of 3 factors specifically named as: a) *emotion-focused coping* comprised by

items of use of instrumental support, use of emotional support, and venting   b)

problem/task coping comprised by planning, positive reframing, acceptance, active coping,

and self-blame and c) *avoidance coping* comprised of items on denial, self-distraction, and

behavioral disengagement. The results of the current study indicated that the 3 factor

model emotional coping, avoidance and task coping was a relatively good fit to the data

based on further modifications of the model. Overall, the findings supported the broad

dimension of coping as it has been reflected in previous findings. The current study

specifically supported a five-factor structure that included the three major broader

dimensions of coping. However, several strategies in the original Brief COPE did not

figure prominently in this specific Greek Cypriot population. Self-distraction did not factor

strongly in coping strategies employed by the current study participants. Previous studies

also did not identify self-distraction as an important component of coping in some other

cultural contexts (Mohanraj et al., 2015).

In previous studies, religion did not load in the analysis but that did not preclude its

importance as a way of coping. As Carver et al. (1989) commented, the item pool for

religion-focused coping were very restricted, and also only a relatively small sub-set of UK

samples were likely to use religion as a coping. On the contrary, religious practices and

beliefs represent a substantial socio-cultural aspect of the Greek Cypriot culture, especially

among the older adults. Hence the religion subscale was maintained and was further identified as a separate factor.

As hypothesized the preliminary results of this study supported the validity of Holland's model in Cyprus, indicating that the structure of vocational interests in a sample of healthy adults is similar to the structure found in other cultures. The self-report scale in this study was based on Holland's RIASEC (Realistic, Investigative, Artistic, Social, Enterprising & Conventional) vocational interest model and was tested by administering of the Self-Directed Search-SDS (Holland, 1994). The only difference observed was that the social dimension of the scale was not clearly defined. Social and artistic characteristics of the typology are expected to be associated as it was the case with our sample, as they are closely presented in Holland's model. The descriptive statistics results indicated that with two exceptions (Realistic type score and slightly the Conventional type score) the distributions followed the normal distribution. Previous research has supported the use of such instrument to be applicable to the university student population in Greece (Sidiropoulou-Dimakaki, Mylonas & Argyropoulou, 2008). According to Holland's model, types that are next to one another on the hexagon are most closely related, for example Realistic and Investigative, Artistic and Social, Enterprising and Conventional. The results of the present study indicated that for the Greek Cypriot older adult population the same pattern of the model applies. The results correspond with previous findings specifically showing that there is a strong association between the Social and Artistic types as well as between the Conventional and Enterprising types. The association found between the Investigative and Enterprising as well as between the Conventional and Investigative types, although not typical of the Holland's suggested model of interests, could be interpreted as an expression of the Greek Cypriot sociocultural characteristics needed to be further replicated in the future. The present study was only a preliminary

study which investigated the properties of the Holland's RIASEC model within a sample of healthy older adults.

Finally, the Lifetime Experiences Questionnaire (LEQ; Valenzuela & Sachdev, 2007) was used as a self-report scale to determine both the current mental activity levels and how active one had been over the lifetime. The internal coherence of LEQ items was overall mostly adequate, with an overall alpha coefficient of .79. The Midlife subscale showed the least coherence although we should keep in mind that the value of *a* moderate to strong average correlations depends on the number of items in the scale (Cortina, 1993). In terms of dimensionality of LEQ, it was suggested that LEQ assesses a multidimensional construct, which conforms to previous findings (Valenzuela et al, 2007). As it was hypothesized with regards to gender differences, the results of this study suggested that females tended to be more often involved than men in artistic type of activities including drawing, painting or acting and that men tended to be more often involved in other types of activities including (usage of a foreign language or travelling).

The inter-correlation analyses of the full range of mental activities at each stage of life were moderate to highly correlated with the highest correlation between the Mid Life and Late Life subscales (.74) and the lowest between Young and Late life (.54). This result is not in line with previous findings, although it emphasizes the good predictability of LEQ to predict the level of involvement in complex mental activity in another life stage.

CHAPTER 3

Occupation and Leisure Activities as predictors of Cognitive Outcomes

Introduction

Recently, the notion that life experiences can modify age-related neuropathological changes has gained considerable empirical support (Ward et al., 2015, Stern, 2002). Because cognitive reserve cannot be directly quantified, proxy measures have been suggested. Researchers have assessed behavioural proxies for brain reserve including education, occupational status and engagement in active lifestyles. Education has been the most studied indicator of the cognitive reserve. Occupational status has also been investigated as a brain reserve indicator. A French study classified main life-time occupations into categories and found that farm workers, domestic service employees and blue-collar workers had more cognitive impairment than workers in intellectual occupations, even after controlling for age, sex, education and sensory impairment (Dartigues, Gagnon & Letenneur, 1992). Several possible explanations were considered for such differences including occupational exposure to toxic chemicals, lower cognitive stimulation throughout life, poorer medical care and health behaviors.   In a more recent study investigating the association between occupational attainment and cognitive outcomes in Multiple Sclerosis (MS), occupational attainment added significant variance to indices of information processing speed, executive function and memory after accounting for brain atrophy and premorbid IQ, (Ghaffar et al., 2012). Specifically, MS patients with low occupational attainment fared worse cognitively than those with high occupational attainment after controlling for brain atrophy and premorbid IQ.

A number of additional studies have linked participation in various leisure activities with reduced dementia risk. In fact, such studies have further identified the engagement in a mentally active lifestyle to be an important brain reserve factor (Fratiglioni et al. 2000; Scarmeas et al. 2001). Evidence from observational studies suggests that participating in

cognitive leisure activities may have a protective effect on the development of Alzheimer's

disease and other dementias (Stern & Munn, 2010). Suo, Lao and Valenzuela (2012)

found that higher total Lifetime Experiences Questionnaire scores were linked with

increased grey matter volume in the medial temporal lobe, especially in the hippocampus.

Related studies have reported that supervisory and managerial experience in midlife was

the dominant contributor to this effect. Specifically, the rate of hippocampal atrophy in

late-life in those with high level supervisory experience in midlife was five-times slower

than those with no midlife supervisory experience (Suo, Lao, & Valenzuela, 2012;

Supervisory Experience at work and hippocampal atrophy). This is one of the first studies

suggesting that managerial and supervisory experience is connected to hippocampal

integrity after retirement, some 20-30 years later. As results based in previous work (Suo

et al., 2012) suggest, "managerial work is heavily reliant on cognitive processes such as

linguistic competency, verbal comprehension and verbal memory processes that together

may trigger long term neuroplastic and neuroprotective changes in the hippocampus" (Suo

et al., 2017). Additionally, managerial experience during working life tends to bias a

person towards seeking out more social contacts in late life (Suo et al. 2012), a behavioral

trait that is linked to lower dementia risk and may protect the hippocampus (Fratiglioni et

al. 2004). This is a possible behavioral explanation for such observed long term

associations.

Occupation type has also been associated with cognitive outcomes in earlier

literature investigating whether an individual's main occupation predicts cognitive decline.

Results have indicated that cognitive impairment in old age varies across occupational

groups (Dartigues et al., 1992). Such early findings have been followed by similar

evidence indicating that the lowest cognitive test performance and highest prevalence of

dementia were found in the realistic occupations which involve skill trades, technical and

some service occupations.

Occupation in these studies was coded according to the classification of Holland's taxonomy which provides a classification of occupations according to their psychological demands (Holland, 1997). The taxonomy places occupations into six categories: 'realistic' (includes skilled trades, technical, some service occupations), 'investigative' (includes scientific and some technical occupations), 'artistic' (includes artistic, musical and literary occupations),'social' (includes educational and social welfare occupations), 'enterprising' (includes managerial and sales occupations) and 'conventional' (includes office and clerical occupations). Holland's taxonomy has been widely researched and accepted in vocational guidance. This taxonomy has also the advantage of focusing on the common psychological demands of broad groups of occupations. For example, the realistic occupations involve greater use of manual skills and less use of literacy and other intellectual skills.

The Person Environment fit approach to psychological health has been widely investigated in the past (Edwards &Cooper, 1990). The lack of correspondence between the environment and the person or a low occupational congruence is hypothesized to generate deleterious psychological, physiological and behavioral outcomes. It is suggested that as the individual experiences various job-related strains over a period of time, their effects culminate in various types of illness (Van Harrison, 1978). While occupational congruence leads to feelings of satisfaction and well-being, incongruence has the opposite effects. This project adopts an additional theoretical perspective suggesting that during middle age, processes related to occupational and leisure activities involvement are moderated by internal individual variables such as individual coping strategies. Specifically, people placed in highly congruent occupational settings are more likely to feel more self-confident not only about their career but also about their cognitive ability to deal with similar cognitively stimulating activities. On the contrary, people placed in low congruence occupational settings, could experience possible negative feelings or experiences associated with the degree of mismatch between occupation and their interests

(Lupien, 2009). As a result, these individuals are not expected to have the same level of involvement professionally as do the high congruent individuals.

Regardless of the existing evidence of an association between cognitive lifestyle and occupational variables with cognitive outcomes in healthy aging, there is scarce evidence in combining these factors within a proposed single model. Furthermore, there is a limited number of studies that have separately examined factors outside such common models, including early life activities or coping with stress that may affect brain function or structure throughout the lifespan. Therefore, the major contribution of this study was to present an expanded construct of CR by further investigating the possible patterns of associations between environmental (occupation, leisure activities) and cognitive outcomes during various adult life stages.

Present Study

Recently, markers of cognitive reserve such as premorbid intelligence have emerged as important predictors of neuropsychological performance. Cognitive reserve is often conceptualized as a capacity that is progressively built through cognitively demanding and stimulating experiences, such as education (Reed et al., 2010). Regardless of the fact that the reserve construct is becoming more sophisticated, gaps in knowledge continue to persist (Fritsch et al., 2007). Building on previous research, we have considered some understudied questions about reserve: Is there any optimal point in life or time periods—such as early life, midlife, or late life during which the contribution of such factors to CR crucially affect current or later cognitive performance? Does participation in leisure activities in combination with occupation during the early, mid and late life, generate different patterns of cognitive performance in older adulthood? A series of hierarchical regression analyses were performed to explore the relative contribution of these factors on cognitive performance.

In the present study, we aimed to extend the cognitive reserve construct by examining the potential contribution of both occupational factors (type and degree of professional attainment and congruence) and leisure activities to cognitive performance. Specifically, the aim was to identify the most potent factors amongst the ones examined associated with cognitive performance and specifically with executive functioning, verbal memory and measures of CR in a healthy sample of Greek Cypriot adults.

The first objective was to investigate whether the leisure activities during each life stage (early life, midlife and late life) as measured by LEQ scale were related to cognitive test outcomes of executive functioning, and verbal memory. We intended to investigate the patterns of associations of leisure activities, occupational factors and cognitive outcomes at 2 different stages of adulthood. It was first expected that there will be different patterns of contribution of leisure activities and of occupation on cognitive outcomes at different stages of adulthood. It was also expected that for both stages of middle age (40-65 years old) and of old age (>65 years old) the level of education would be the strongest contributor for both EF and Verbal Episodic memory performance. As reported in the current existing literature, both occupational attainment and leisure activities individually relate to cognition and also to late life cognition (Andel et al., 2007). Secondly, regarding the leisure activities, it was expected that cognitive and physical leisure activities during the middle age stage of life (LEQ middle age) would have a significant contribution in explaining the variance for cognitive outcomes in the EF, verbal memory domains for both age groups. With regards to occupational factors, different patterns of contribution were expected to be noted between the two age groups. Occupational related variables (type, attainment and congruence) tend to be more enduring than patterns of leisure activities which are more prone to change across life. Therefore, it was expected that especially for the older adult group, higher occupational attainment and greater participation in cognitive leisure activities would independently relate and predict better late life cognitive scores for

both EF and VM. Lastly, it was expected to find significant differences in executive

functioning tasks that require graphomotor processing ability (e.g. TMT and SDMT)

among the high and low occupational attainment groups and with lower patterns of

performance for Realistic versus other types of occupation types across life course.

The current study is innovative as it is to the best of our knowledge, the first ones to

consider simultaneously occupational and leisure activities on cognition during middle and

old age. Such investigation enables us to incorporate into our models a broader range of

life-course activities from what is usually considered in similar lines of research of this

type. An additional innovation of the current study is that it includes a wider age variation

starting from the age of 40 years old. The investigation of patterns of associations of

occupational and leisure activities is important for the development of strategies to help

middle aged individuals maintain cognitive function. Furthermore, leisure pursuits are

likely to continue until late in life, providing many points of possible intervention along the

leisure life course. It would be of great benefit for the individuals who work in realistic

types of occupations or with low occupation attainment to be encouraged to use leisure

activities to possibly substitute for lack of occupational engagement to support cognitive

function in old age.

Method

Participants

Participants in this study consisted of 150 healthy adults between 40 and 89 years

of age. For the purposes of the data analyses, separate statistical analyses were conducted

for the middle aged group of participants (aged 40-64), for the elderly group (older than 64

years of age) and for the whole sample of participants (n=150).

Data Analyses

Correlation analyses were initially conducted to detect the pattern of associations between leisure activities, occupational variables (attainment and type) and cognitive outcomes (EF and Verbal Memory). Additionally, a series of Multiple Regression Analyses were conducted for each age group and for the whole sample. To do this, it was necessary to reduce the Episodic Verbal Memory, Executive Function and CR variables to single composite scores. Initially, for each of the relevant tests, a z score was calculated. The resulting z scores afterwards were summed to form the composite scores. The Verbal Episodic memory composite, therefore, was calculated as the sum of the z scores for the Logical Memory Story A from the Wechsler Memory Scale–Revised: Immediate and Delayed recall, The Greek version of the Hopkins Verbal Learning Test–Revised (HVLT: Learning trials (first trial: HVLT1 and the total score of the three learning trials: HVLTimmediate), delayed recall (HVLTdelayed). Likewise, the EF composite was calculated as the sum of the z scores obtained from the Symbol Digits Modalities Test (SDMT; Smith, 1982), Trail Making Tests (TMT) A and B , two verbal fluency tasks: Animal Recall and Words from the letter F modified from the Controlled Oral Word Association Test (COWAT; Kosmidis, Vlahou, Panagiotaki, & Kiosseoglou, 2004). The CR composite was similarly estimated from scores obtained from the Greek Version of the Peabody Picture Vocabulary Test (PPVT–III; Simos, Kasselimis, & Mouzaki, 2011) and a reading measure test of pseudowords in Greek (Simos, Sideridis, Kasselimis, & Mouzaki, 2013).Both of these measures introduce important information about the quality of education (Manly, Jacobs, Touradji, Small, & Stern, 2002) and could be used as estimates of "premorbid" cognitive ability.

Additional statistical transformations were performed in order to deal with categorical variables that served as predictors for the multiple regression model. Specifically, we used dummy coding and created 5 new dummy variables for the

Occupational type variable (from initial 6 RIASEC occupational types) and 3 new dummy variables for the Occupational Congruency variable (from initial 4 levels of Congruence). For the dummy coding procedures, values of 1 and 0 were assigned to each of the new groups representing either types of occupations or level of occupational congruency. All the related dummy variables that have recoded the same categorical variable were entered in the same block into the regression analysis. For example, we entered in the same block the three new dummy variables that recoded the Congruency variable and in a different block the five new dummy variables that recoded the Occupational type variable.

Furthermore, in order to assure that the models generalized beyond the specific sample, some of the assumptions of regression were checked. We looked for cases that could be influencing the regression model by estimating and checking values for Cook's distance (any value above 1 could influence the model) and for Mahalanobis distance (a crude check for values above 15 for smaller sample of about 100; Field, 2005). 2 cases were identified as problematic and were excluded. To check for the assumption of no multicollinearity, the VIF values were screened and they were all less than 10, indicating no cause for concern.

Initially, regression analyses were run and all predictors were entered into the model to examine which predictors contribute substantially to the model's ability to predict the outcome. Once established which variables were important, the analyses were conducted again including only the important predictors.

The predictor variables for each of the regression models for both groups were educational level, LEQ leisure activities for each life stage, types of leisure activity (cognitive, physical, social, artistic), occupational type (the 5 new dummy variables of Realistic (R) vs Investigative, R vs Artistic, R vs Social, R vs Enterprising, R vs Conventional), Occupational Attainment (high vs low), Occupational Congruency (3 new dummy variables of High vs No Congruency, High vs Moderate Congruency, and High vs

Low Congruency). For each analysis, the outcome(s) or the dependent variable(s) were EF, and VM. Based on previous research, education was first entered as a predictor on the first step and then the LEQ scores during each life stage (young age and middle age separately). For the second step types of activities and the rest of occupation types and level of congruence were entered as predictors along with Occupation Attainment. The method enter was applied. The R square change for the regression model was used as an index of the association of each set of predictor variables. Standardized β weights were used to assess the contribution of each of the variables entered. One way analysis of variance (ANOVA) analyses were carried out to compare for mean scores on the cognitive tests within the occupational group types. The results were as described below.

Results

After running a multiple regression analysis for each case as described above, we examined which of the predictors contributed substantially to the model's ability to predict the outcome, which were the EF and the Verbal Memory. The participants' performance on neurocognitive tests is presented in Table 9.

Table 9. Participants' Scores on Neuropsychological Measures

Measure	Mean	SD	Range
MMSE	28.32	1.65	24-30
HVLT1	6.46	2.20	1-12
HVLT Immediate	24.32	6.26	6-35
HVLT Delayed	8.01	3.23	0-12
LM Immediate	15.24	5.37	2-24
LM Delayed	13.38	5.81	0-23
TMTA(s)	57.29	28.84	16-153
TMT B(s)	124.16	71.42	35-421
SDMT (correct)	36.96	14.79	6-64
Semantic Fluency	13.96	9.08	2-24
Phonemic fluency	11.54	3.59	3-25

Vocabulary (PPVT)	25.51	6.20	5-32
Reading pseudo	37.66	10.33	14-62

Note. MMSE: Mini Mental Status Examination score; HVLT1: the number of recalled words in the first trial; HVLTimmediate: the total number of words immediately recalled in the three learning trials; HVLTdelayed: the number of words recalled in the delayed recall trial; LM: Story A of Logical Memory subtest from Wechsler Memory Scale–Revised (Wechsler, 1997); LMimmediate: the score in the immediate recall; LMdelayed: the score in the delayed recall; TMT: Trail Making Test; TMTA: time in seconds for the TMT Part A; TMTB: time in seconds for the TMT Part B; SDMT: the correct responses in 90 s in the Symbol Digit ModalitiesTest (Smith, 1982); Semanticfluency: the number of the correct words generated in 60 s for the category animals; Phonemic fluency: the number of correct words starting with the letter F generated in 60 s.Vocabulary: number of correct responses in the Greek version of the Peabody Picture Vocabulary Test (PPVT–III; Simos et al., 2011); Reading pseudo: the number of total pseudowords read correctly in 45s (Simos et al., 2013).

The number of participants in each occupational category and their mean test scores for both verbal memory and executive function tests are presented in Table 9. There were significant differences between types of occupational groups with regards to their scores on almost all tests of EF and verbal memory and there were no significant differences on CR tests as measured by Reading Pseudowords (Simos et al., 2013) and vocabulary test (PPVT–III; Simos et al., 2011) . The strongest differences were observed for tests of EF (including SDMT ($p<.001$). Specifically, when testing for the differences between groups for the SDMT, there was a significant effect of type of occupation on the level of performance in the SDMT, $F (5,144) =5.50$, $p<.001$. Similarly, for the verbal memory test HVLT Trial 1, there was a significant effect of type of occupation on the level of performance, $F (5,144) =3, 73$, $p< 0.05$. The lowest mean scores for both executive functioning and for verbal memory tests were found in the Realistic occupations. Multiple comparisons in post hoc tests indicated that there were significant differences specifically between the Realistic with Enterprising, and Realistic with Conventional types of occupations where Enterprising and Conventional types scored significantly higher than the Realistic types ($p <0.001$). For the verbal learning test scores, the differences were

mainly between the Realistic, Enterprising, Conventional and Social with the latter three

scoring significantly better than the Realistic types.

There were no statistically significant changes between occupational groups for

none of the two verbal fluency tasks: Animal Recall and Phonemic Fluency Words from

the letter F, modified from the Controlled Oral Word Association Test (COWAT;

Kosmidis,Vlahou, Panagiotaki, & Kiosseoglou, 2004). Specifically, the Anova results

indicated no statistically significant differences among occupational types for Animal

Recall test with F (5,145) = .96 , p =.44 and for Phonemic Fluency Words from F test with

F (5,145) = 1.83 , p =.11. For the Reading Pseudowords test there were no significant

differences among occupational types, F (5,145) = .1.53, p =.18. The same pattern applied

for the performance on the PPVT test of passive vocabulary, F (5,145) = .1.92, p =.09.

Table 10. Differences between occupational groups in EF and Verbal Memory tests (N=150)

	Occupation Group					
	R	I	A	S	E	C
	(n=37)	(n=9)	(n=4)	(n=42)	(n=24)	(n=34)
Test Score Mean (SD)						
SDMT**	27.62	42.33	46.75	36.78	43.37	40.26
	(12.33)	(15.59)	(18.31)	(15.12)	(12.05)	(13.72)
TMTA* (time in sec)	79.45 (48.62)	48.00 (29.64)	38.33 (18.00)	57.54 (28.04)	49.66 (28.37)	48.09 (26.02)
TMTB* (time in sec)	176.16 (114.95)	118.71 (94.80)	82.66 (23.11)	123.66 (72.22)	101.00 (65.29)	104.60 (73.13)
HVLT1*	5.29 (2.02)	6.44 (1.81)	6.25 (2.98)	6.57 (2.10)	7.50 (2.48)	6.88 (1.85)
HVLT* Delay	6.35 (3.41)	8.00 (3.69)	10.66 (1.15)	8.41 (3.27)	9.45 (2.47)	8.51 (2.89)

HVLT* Total	21.45 (5.64)	25.14 (5.08)	28.33 (3.21)	24.61 (6.64)	26.95 (5.88)	25.24 (6.00)
LMImm*	12.86 (5.32)	15.00 (6.53)	19.66 (2.51)	15.52 (4.99)	17.12 (4.95)	16.39 (4.94)
LMDelay*	11.02 (5.56)	13.71 (6.42)	16.00 (3.60)	13.71 (5.57)	15.29 (5.19)	14.57 (5.94)

Significant difference between occupational groups, * p <0.05; ** p <0.01.
SDMT: the correct responses in 90 s in the Symbol Digit Modalities Test (Smith, 1982);
HVLT1: the number of recalled words in the first trial of Hopkins Verbal Learning Test..
HVLT: Greek version
of the Hopkins Verbal Learning Test–Revised (Benedict et al., 1998; adapted in Greek by
Constantinidou upon permission from the publisher); HVLTdelayed: the number of words
recalled in the delayed recall trial; LM:
Story A of Logical Memory subtest from Wechsler MemoryScale–Revised (Wechsler,
1997); LMimmediate: the score in the
immediate recall; LMdelayed: the score in the delayed recall; TMT: Trail Making Test;
TMTA: time in seconds for the TMT Part A; TMTB: time in seconds for the TMT Part B.

Following, patterns of contribution for level of education, occupational variables

(attainment and congruence level), level of involvement on leisure activities (LEQ) on

Executive Functions (EF) , Verbal Memory and Cognitive Reserve (CR) were investigated

for both middle aged (40-65years old) and older adults (older than 65 years old) .

The results of the multiple regression model for the whole sample on EF suggested

that the level of education had a significant contribution and accounts for 59% of the

variation in SDMT test performance scores. When the involvement in leisure activities as

predictors was included in the model (model 2), this value changed to 63% with the leisure

activities accounting for a small amount of the variation in SDMT test scores with a

statistically significant level of p <0.001. It appears that both education (t (144) =6.53,

p<.001) and the level of involvement in leisure activities (t (144) =3.90, p<.001) make a

significant contribution to the model. The addition of the occupational predictors did not

add significantly to the variance of the test scores. It is worth mentioning that the adjusted

R^2 is quite close to the value of R^2, especially for the first and second model when

education and LEQ total activities were included in the prediction. This is an indication of

how well the data generalizes and assesses the accuracy of the models' predictive power to

a different sample. Table 11 presents the Multiple Regression results for each of the steps

in the model.

Following, we tested for the ability of a multiple regression model with predictors

or independent variables being the education, level of leisure activities, types of leisure

activities, occupational attainment and congruence to predict cognitive outcomes for each

of the two groups.

Additional multiple regression analyses further investigated prediction patterns of

leisure activities and occupation variables for the EF, verbal memory and CR outcomes,

separately for the middle aged and older adult group.

Table 11. Multiple Regression Results (N=150)

	B	SE B	β
Dependent Variable: SDMT			
Step 1			
(Constant)	6.30	2.25	
Years of Education	2.49	.17	.77**
Step 2			
(Constant)	-6.72	3.93	
Years of Education	1.88	.23	.58**
LEQ total score	6.63	1.67	.27**
Step 3			
(Constant)	-5.85	7.23	
Years of Education	1.71	.26	.53**
LEQ total score	6.73	1.72	.27**
Occupation Attainment	1.10	1.93	.04
Occupation Type	.65	.42	.08
Occupation Congruency	.09	.83	.01

Step 1: R^2 = .59; Step 2: R^2 = .63; Step 3: R^2 = . 64
*p<.05; **p<.001

Table 12 presents these results for the older adult and Table 13 for the middle aged

group. First, the first line of multiple regression results for the older group (Table 12)

indicated that education only could explain about 37 % of the variance within the EF test

scores. The inclusion of occupational attainment provided a small but significant contribution to the model's ability to predict the EF outcomes, t (47) = 2.11, $p<.05$. The rest of the predictors did not provide a significant contribution for this group of participants in the EF domain. Second, when predicting the verbal memory scores, the most potent contributor was education accounting for 23 % of the variance among older adult group test scores. When each of the additional contributors was entered into the model, there was not a significant change noted. A more detailed investigation of each of the parameters indicated that leisure activities during young age , t (46) = 2.95, $p<.01$ and specifically the cognitive, t (46) = 2.64, $p<.05$, artistic, t (46) = 2.35, $p<.05$ and social activities, t (46) = 2.05, $p<.05$ significantly contributed in predicting the verbal memory scores within the older adult group as compared to the younger adults where the education was the only and most potent contributor for the same cognitive domain. Thirdly, it was noted that when predicting test scores for the CR domain, physical leisure activities, t (46) = 3.02, $p<.05$ had a significant contribution to the model along with occupational attainment, t (46) = 2.33, $p<.05$ in addition to education, t (46) = 2.97 $p<.01$ and leisure activities involved during the old age t (46) = 2.17, $p<.05$. It was generally observed that there was a reduced contribution of the education on the CR outcomes after adding occupational attainment and specific types of leisure activities within the older adult group.

Table 12.   Multiple Regression Results predicting EF, VM and CR outcomes (N=50)Older Adults

	B	$SE\ B$	β
Model 1			
Dependent Variable: EF			
(Constant)	.57	5.53	
Years of Education	.19	.16	.24
LEQ Young	1.90	1.42	.47
LEQ Middle	1.13	1.83	.23
LEQ Old	.52	1.02	.10
LEQ cognitive	1.38	.99	.57
LEQ physical	.61	.71	.13
LEQ artistic	2.15	.89	.73*

LEQ social	2.52	1.31	.29
CongruenceHighvsNoCong	3.15	1.48	.34*
CongruenceHighvsModCong	.97	1.19	.14
CongruenceHighvsLowCong	.26	1.10	.04
Occupation Attainment	3.19	1.53	.40*

Model 2
Dependent Variable: Verbal Memory

(Constant)	13.16	5.83	
Years of Education	.27	.13	.33*
LEQ Young	4.25	1.46	1.02*
LEQ Middle	1.38	1.70	.27
LEQ Old	.27	1.04	.05
LEQ cognitive	2.74	.99	1.11*
LEQ physical	.11	.68	.02
LEQ artistic	2.15	.85	.72*
LEQ social	2.61	1.27	.29*
CongruenceHighvsNoCong	.37	1.76	.04
CongruenceHighvsModCong	.44	1.42	.20
CongruenceHighvsLowCong	.24	1.31	.03
Occupation Attainment	2.12	1.82	.25

Model 3
Dependent Variable: CR

(Constant)	.27	1.47	
Years of Education	.13	.04	.52 **
LEQ Young	.86	.38	.83
LEQ Middle	.04	.49	.03
LEQ Old	.60	.27	.38*
LEQ cognitive	.33	.26	.44
LEQ physical	.58	.19	.40*
LEQ artistic	.74	.24	.81*
LEQ social	.50	.35	.17
CongruenceHighvsNoCong	.19	.40	.06
CongruenceHighvsModCong	.40	.32	.18
CongruenceHighvsLowCong	.16	.30	.07
Occupation Attainment	.98	.42	.38*

Model 1: $R^2 = .62$; Model 2: $R^2 = .41$; Model 3: $R^2 = .72$ *p <.05   ** p <.001

As it was suggested from second line of multiple regression results (Table 13) for

the middle aged group, the LEQ scores added a small but significant contribution to the

variance of the total EF outcomes. Consequently, the regression analyses were conducted

in order to investigate the contribution of each of the subscales of the LEQ scores (young

age, middle age) and for the rest of the other 2 outcomes, verbal memory and CR. The

results indicated that education had a significant amount of contribution in predicting the

EF outcomes, specifically counting for 36% of the variation of the EF outcomes. However

the inclusion of the leisure activities as predictors in the model, provided a small (7%) but

significant contribution to the overall model (p <.05). Specifically, the contribution of the

LEQ activities during the middle age was t (98) =2.45, p <.05. There was no significant

contribution made by the inclusion of middle age leisure activities or other occupational

predictors in the model. Following, when testing for the contribution of LEQ young age

and LEQ middle age activities in predicting verbal memory outcomes the results

suggested that education was the only significant contributor of the verbal memory

outcome scores with t (98)=4.56, p <0.001. There was no significant contribution of leisure

activities or occupational variable in the verbal memory test performance for the middle

aged group of participants (p >.05). Finally, similar results were noted when predicting the

CR outcomes, with the education level initially counted for a considerable and significant

amount of 38% of the variance scores of the model. The addition of leisure activities did

not cause a significant change in the model's ability to predict the CR scores, t (98) = .65, p

=.52.

Table 13. Multiple Regression Results predicting EF, VM and CR outcomes
                   (N=100) Middle Aged

	B	*SE B*	*β*
Model 1			
Dependent Variable: EF			
(Constant)	2.51	1.76	
Years of Education	.39	.08	.44**
LEQ Young	1.90	.53	.24*
LEQ Middle	.57	.60	.08
LEQ cognitive	.17	.88	.05
LEQ physical	.31	.51	.06
LEQ artistic	.69	.67	.24
LEQ social	.75	.83	.08
CongruenceHighvsNoCong	2.80	1.54	.14
CongruenceHighvsModCong	.16	.66	.02
CongruenceHighvsLowCong	.13	.69	.01
Occupation Attainment	.33	.70	.05

Model 2
Dependent Variable: Verbal Memory

(Constant)	1.92	3.13	
Years of Education	.23	.08	.37*
LEQ Young	.06	1.11	.01
LEQ Middle	.15	1.10	.03
LEQ cognitive	.57	.72	.24
LEQ physical	.13	.41	.04
LEQ artistic	.02	.56	.01
LEQ social	.41	.71	.06
CongruenceHighvsNoCong	.58	1.25	.04
CongruenceHighvsModCong	.67	.58	.13
CongruenceHighvsLowCong	.05	.65	.01
Occupation Attainment	.07	.58	.01
Model 3			
Dependent Variable: CR			
(Constant)	1.33	.33	
Years of Education	.08	.01	.56 **
LEQ Young	.05	.10	.05
LEQ Middle	.07	.11	.06
LEQ cognitive	.08	.17	.13
LEQ physical	.06	.09	.07
LEQ artistic	.12	.13	.23
LEQ social	.11	.16	.07
CongruenceHighvsNoCong	.01	.29	.01
CongruenceHighvsModCong	.26	.13	.21
CongruenceHighvsLowCong	.17	.15	.13
Occupation Attainment	.01	.13	.01

Model 1: R^2 = .49; Model 2: R^2 = .37; Model 3: R^2 = .46   *p <.05   ** p <.001

In order to determine which types of leisure activities as measured by LEQ scale (cognitive, physical, social, artistic) better predicted the cognitive performance for the whole sample of participants, hierarchical regression analyses were conducted with the EF as a dependent measure and education, types of activities (physical, cognitive, social, artistic) and occupation variables as predictors. Table 14 and 15 present the Multiple Regression results for the whole sample for EF and VM respectively.

Table 14. Multiple Regression Results for LEQ types of activities (N=150) on EF

	B	SE B	β
Step 1 Dependent Variable: EF			
(Constant)	2.53	.72	
Education	. 77	. 05	.76**
Step 2 Dependent Variable: EF			
(Constant)	1.50	3.58	
Education	.59	.08	.58**
LEQ cognitive	.58	.29	.14 *
LEQ physical	.05	.35	.00
LEQ artistic	.51	.22	.12*
LEQ social	.00	.69	.00
Occupation Attainment	.68	.67	.07

Step 1: R ^{2} = .58; Step2: R ^{2} = . 61 ;   *p <.05   ** p <.001

Table 15. Multiple Regression Results for LEQ types of activities (N=150) on VM

	B	SE B	β
Step 1 Dependent Variable: Verbal Memory (VM)			
(Constant)	7.46	.63	
Education	. 60	.04	.71**
Step 2 Dependent Variable: VM			
(Constant)	7.07	3.31	
Education	.50	.06	.60**
LEQ cognitive	.45	.25	.13
LEQ physical	.04	.32	.01
LEQ artistic	.26	.20	.08
LEQsocial	.35	.63	.03
Occupation Attainment	.14	.24	.03

Step 1: R ^{2} = .51; Step2: R ^{2} = . 53 ;   *p <.05   ** p <.001

Cognitive/mental types of activities (such as book reading, speaking a foreign

language) with *t* (145) = 2.32, *p* <.05 and artistic activities (such as writing, painting or

drawing) with t (145)= 2.15, *p* <.05 were significant predictors of the performance for the

EF outcomes. However, the level of involvement in physical and social types of activities

did not add a significant contribution to the model. As indicated by the results, the level of involvement in cognitive activities accounted for 36 % of the variance on the test scores. When the other predictors were added to the model, this value increased to 41 % of the variance of test scores. We can assume that the rest of the variables accounted for an additional 5 %, which represents quite a small amount of variation for the test scores. Education was the most and significant predictor for VM and the rest of the variables did not have a significant contribution.

The present study also aimed to test the hypothesis that more frequent participation in leisure activities could moderate the effects of limited education on cognitive functioning. For the older group the interaction of education and leisure activities significantly predicted EF performance. However, not for the VM outcomes. Specifically, there was a significant main effect of total leisure activities (LEQ) on EF for the old aged group, $F (31,51) =3.39$, $p <.05$ as well as there was significant interaction effect between the frequency of involvement in leisure activities and educational level on EF, $F(4,51) =3.69$, $p <.05$. There was non- significant effect of education on EF, $F (2,51) =3.49$, $p =.06$.

On the other hand, for the middle aged group, there was no such interaction effect, $F (3,92)=1.17$, $p=.32$. Specifically, for the younger adult group, there was only a significant main effect of education on EF, $F(3,92)=13,20$, $p<.001$ and there was a non-significant main effect of leisure activities on EF, $F(1,92)=. 15$, $p =.70$. However, for the younger adult group there was a significant interaction between the LEQ leisure activities and occupational congruency level for both EF, $F (3,92)=13,20$, $p<.001$ and verbal memory outcomes. Such pattern also applied for the older group, where the interaction of leisure activities and occupational congruency was still significant for the EF outcomes.

Regarding the type of leisure activities involved, our study results indicated that being involved in cognitive types of leisure activities had a significant effect on both EF

and verbal memory outcomes. Specifically, frequent involvement in cognitive activities had a significant effect on EF performance, $F(17, 132) = 5.67, p < .001$, as well as on the outcomes of the verbal memory test performance, $F(17, 131) = 4.46, p < .001$, Additionally frequent involvement in physical activities had a significant effect only for the EF outcomes, $F(8, 141) = 2.09, p < .05$. Involvement in social or artistic types of leisure activities did not present a significant effect on any of the dependent variables (EF, VM) $p > .05$ for the whole sample of participants.

Discussion

The aims of the present study was first to investigate the potential contribution of occupational factors (type, attainment and congruence) and leisure activities to cognitive outcomes; second, to further examine which types of leisure activities as measured by LEQ scale could predict executive functioning and verbal memory performance across age groups. To our knowledge, this is one of the few studies to consider both occupational congruency and leisure activities variables in predicting cognitive outcomes.

As initially hypothesized, the level of education was one of the strongest contributors to cognitive performance for our sample. In addition to education, level of activities involved during the lifespan, was an additional significant predictor of EF performance, although it did predict the verbal memory test performance. There were specific findings for each of the age groups as divided into middle aged (40-65) and older adults (older than 65). For the older adult group of participants, both education and level of activities involved during their middle age years were the strongest predictors of cognitive performance with a significant contribution of mainly cognitive and physical types of activities. While for the middle aged group, both education and level of activities involved during their young age, were the strongest predictors of cognitive performance.

The findings suggested that there were both common and different patterns of contributions of independent variables on EF, VM and CR outcomes. There was a common pattern of significant contribution of education in predicting EF, VM and CR outcomes for both middle aged and older adults. Although there was a stable pattern of a significant amount of contribution in predicting each of the three outcomes, small differences were noted with regards to the value /amount of contribution of some of the predictors to the model prediction. It was noted specifically that the contribution of Occupational Attainment was especially significant in predicting both EF and CR outcomes for the older group of adults and not for the younger adult group.

Secondly, the results indicated that there were significant differences between the types of occupations as categorized by Hollands' theory (RIASEC) for both verbal memory and executive functioning tests. In previous findings, the lowest test performance and highest prevalence of dementia were found in the Realistic occupations which involve skill trades, technical and service occupations (Form et al, 1998). The realistic occupations involve greater use of manual skills and less use of literacy and other intellectual skills. In the present study, participants involved in Enterprising and Conventional types of occupations tended to score significantly better than people involved in Realistic types of occupations. As hypothesized, there were statistically significant differences among occupational types with regards to EF and VM outcomes with Realistic types generally scoring lower as compared to other types of occupation. On a general note, the Realistic types of occupations are the ones requiring or associated with a lower level of education.

Finally, the level of involvement in leisure activities and their types had some different patterns of contribution across domains of EF, verbal memory and CR. Specifically, leisure activities during young age significantly contributed in the prediction of EF scores for the young adult group only. Leisure activities and in particular artistic and

physical activities   along with occupational attainment seem to be significant contributors in predicting CR for the older adult group.

Overall, it was notable that despite the significant contribution of educational level across domains and age groups, there was a small decrease in the amount of contribution in predicting both CR and Verbal memory outcomes. During the old age such contribution was slightly less as compared to middle age years. The results also emphasize that during the old age in addition to a reduced amount of the contribution predicted by educational level, there is a small but significant contribution of cognitive, artistic and physical leisure activities in old age and of occupational attainment in predicting CR and memory outcomes. It was also noted that the type of occupation (realistic vs non realistic) or occupation congruence level (high vs all other levels) were not significant contributors in predicting of the CR outcomes during the old age. Instead, from various occupational related variables, the occupational attainment was the only significant contributor of CR outcomes during the old age. Similarly, from all the leisure activities measures, the significant contributors after education were the leisure activities during the old age (older 65); specifically, the physical and artistic types of activities that best predicted the CR for the same group.

In conclusion, our findings support the current literature on cognitive reserve and cognitive performance as they confirm the significant and ongoing contribution of education. Furthermore this study extended the construct of cognitive reserve by providing evidence on the small but significant contribution of physical, cognitive, and artistic types of leisure activities throughout life and with specific patterns of contributions in certain cognitive domains (executive function vs verbal memory). The current study also has the advantage of investigating cognitive function not only in older adults as it has mostly been studied until now, but for a sample of younger group of adults, providing more insight into the patterns of change before, during, or shortly after retirement and how such patterns

may relate to late cognition. Information about occupation or leisure activities is easy to be recorded and it may serve as possible proxy measures of cognitive reserve and have further clinical and theoretical implications within the cognitive aging perspective.

Understanding the different patterns of contribution that leisure and occupational activities have in predicting later life cognitive outcomes may assist in developing cognitive protocols and interventions that encourage reserve building leisure activities early in adulthood. Furthermore, leisure pursuits are likely to continue until the late life stages, providing as such many points for possible interventions along the leisure life course (Andel et al., 2014). It would be of specific interest for future studies to investigate longitudinally whether an increase in leisure engagement could be a useful strategy to compensate for the cognitive disadvantage associated with low educational level or low occupational attainment. The present findings should be replicated with a larger sample of participants and ideally with a longitudinal design.

CHAPTER 4

Modeling the contributing role of Occupation, Leisure Activities and Coping on CR

Introduction

The associations between proxy measures of cognitive reserve (CR) and cognition vary across studies and cognitive domains (Opdebeeck, Martyr &Clare, 2015). CR has been recently considered in terms of three key measures including educational level, occupational status and engagement in cognitively stimulating activities. The aforementioned measures have been mostly investigated individually and not quite often in combination. For example, a recent meta-analysis study on CR and cognitive function among healthy older people representing findings from 135 relevant studies, reported that 109 studies have used a measure of education, 31 have used the measure of participation in cognitively stimulating activities, 19 a measure of occupation and only 6 studies have used a combination of these (Opdebeeck et al., 2015). Findings indicated that the three proxy measures had a positive association with cognition and that cognitive activities and occupational status showed the most variation across cognitive domains (executive function, memory and language), thus suggesting that the commonly used measures of CR may share an underlying process but each additionally provides a unique contribution to CR. Importantly, CR has been characterized as modifiable throughout life and cognitively stimulating activities in adults over the age of 65 are associated with a reduced risk of dementia (Wilson et al., 2010; Norton et al., 2012) and age related cognitive-decline . As such, it is worth considering the potential change in patterns of participation in various types of leisure activities over time and its relation with cognitive status.

Given the large number of indices that could represent the construct of CR, the present study focused on the investigation of the underlying structure of CR concept. Furthermore, this study aims to investigate the specific associations and contribution of a

combination of individual and external proxy measures as mainly supported by the current

CR literature.

Present Study

        Specifically, the present study examined the CR construct within the normal

cognitive adult development context. Based on a vast number of related studies two major

CR domains have been identified. These included occupational variables (occupational

attainment and occupational type) and engagement in leisure activities. The current study

additionally investigated the role of coping strategies on level and type of leisure activities

across life and on CR. Furthermore, since the current study's population included both

middle aged and older adults, it aimed to examine whether occupation variables and leisure

activities at midlife could predict cognition in advanced old age. Understanding the

structure of CR is necessary for further investigations of its construct validity in similar

studies and for identifying significant factors that may modify the healthy aging process.

For such purposes, Structural equation modeling (SEM) approach was used to identify the

structure of CR.

        Past studies have suggested that the effects of leisure activities are independent of

both education and of occupation. However, further details on relationships of these

variables to each other and to the overall construct of CR are not well defined. This study

aims to use a modeling approach to test hypotheses about the determinants of reserve.

Three overall potential formative indicators were considered, specifically, involvement in

leisure time activities (LEQ), occupational congruence and personal coping strategies

(Brief Cope).

        It was initially hypothesized that there would be modest positive associations

between all the indicators of CR (LEQ engagement in leisure activities, occupation,

task/problem coping strategies, emotion/support seekign) and cognition in the domains of EF, verbal memory (Opdebeeck et al, 2015).

Secondly, when testing for models hypothesized to best represent CR, (one factor versus two factor models) it was expected that the two factor model of CR would represent separate domains and would not reflect a unitary construct, based on findings from latent variable models of reserve (Levi et al, 2013). It was additionally expected that a two factor model would better fit the data as compared to the one factor model tested. It was also expected that CR would moderate the relation between age and cognitive outcomes as it has been suggested by previous CR studies on aging (Giogkaraki et al, 2013).

It is suggested that the coping style strategies have the potential to build reserve through a suggested mechanism of frequent involvement in cognitive, physical or artistic leisure activities. It was finally expected that the leisure cognitive activities, would have the strongest independent relationship with reserve (Wilson, Mendes De Leon, et al., 2002).

Method

Participants

Participants in this study consisted of 150 healthy adults between 40 and 89 years of age. Three separate statistical analyses were conducted: one for the middle aged group (aged 40-64 n =100), one for the elderly group (older than 64 years of age, n = 50) and a third one with the entire sample of participants (n=150).

Data Analyses

Initially, Pearson bivariate correlations were calculated to examine the correlations among the EF, verbal memory CR and occupational, coping and leisure activities variables. Initially, we tested for the measurement model which is the part of the SEM that relates the

measured variables to their latent factors. Following, the structural model which relates the latent factors to one another was examined and different models were tested. A one-factor model was initially tested and afterwards a two-factor model with three latent variables as three separate constructs was tested as suggested by previous findings in the CR literature. The SEM analyses were conducted   with AMOS 20 (Arbuckle, 2011), and maximum likelihood estimation was applied on the covariance matrix of the data. Model fit was evaluated with the chi-square test, as well as the following approximate fit indices: Bentler's Comparative Fit Index (CFI) an incremental fit index that measures, using maximum likelihood solution. In this study we have reported the three commonly reported indices: the $\chi 2$, the CFI, and the RMSEA. A good fitting model is typically indicated by a non-significant chi square, CFI values .0.90 and RMSEA values smaller than 0.08 (Hu & Bentler, 1999). Additionally, to select a better model from the alternatives with non-nested models we used the model comparison criterion for the Akaike's Information Criterion (AIC). The preferred model is the one with the minimum AIC value. Such value is founded on information theory and it offers an estimate of the relative information and it mainly tells about the quality of the model as related to other models, although it does not tell us something about the absolute quality of the model.

Results

The correlation coefficients between all the indicator variables appear on Table 15. As expected, there were positive moderate to strong significant associations among most of the EF, verbal memory, CR and LEQ and variables. Specifically, there were significant positive moderate to strong correlations between LEQ cognitive and CR composite scores with $r =. 45$, $p<.001$. Among the types of leisure activities, the cognitive and artistic activities were the ones that had strongest significant association with CR and EF and verbal memory outcomes. There were also significant positive correlations between CR

composite scores and Occupation Attainment $r =. 44, p<.001$, LEQ activities during

middle age, $r =. 43, p<.001$ and young age, $r =. 38, p<.001$ but not a significant

correlation with LEQ old age. Furthermore, with regards to coping strategies, there were

positive weak but significant correlations between emotion focused and EF, $r =. 22, p<.001$

and CR, $r =. 21, p<.05$. Further significant correlations were mainly noted for the

avoidance coping strategies with specific negative moderate correlations between avoidant

coping and occupation attainment, $r =. -22, p<.001$ and between avoidant coping and EF,

verbal memory and CR. It was also observed that religious coping strategies were

negatively correlated with LEQ involvement in cognitive activities as well as with EF,

verbal memory and CR outcomes. Also there were significant negative associations

between LEQ involvement in leisure activities during middle age and religious coping

strategies $r = -.28, p<.001$.   Previous correlation results had indicated the total level of

involvement in leisure activities (LEQ Total) was significantly correlated with both EF (r

$=.52$) and with verbal memory outcomes ($r =. 34$). The LEQ total score however was not

related to CR outcomes.

Also, it is worth mentioning that on average the educational level for younger

adults was higher ($M=14.16, SE=.36$) than the educational level of the older participants

($M=8.62, SE=.56$) and this difference was significant $t (148) =8.57, p<.001$); it represented

a medium sized effect $r =. 57$.

Initially the CFA for each of the latent structures and their respective measured

variables were performed. For the VM construct all the measured variables loaded

significantly into their respective constructs. For the EF construct all the measured

variables (SDMT, TMT A and B, Phonemic fluency) loaded significantly while for the

LEQ the results indicated that the tested specified model was supported by the sample data

and fitted the data well with Chi-square 52.69 based on 38 degrees of freedom ($p = .05$,

chi-square/d.f. = 1.38. Indices of fit were CFI = .95 and RMSEA = .05. It also appeared

that almost all of the indicators had moderate loadings on their respective latent variable.

Figure 3 illustrated this model for LEQ scale.

Following, alternative models for CR were specified and tested. The one factor

model was tested first and as it was indicated in the Figure 4, many of the indicators did

not load significantly on the respective latent variable CR. The one factor model provided

not such a good fit to the data, Chi-square $\chi2$ (35, n=150) =70.06, p < .01, CFI = 0.86,

RMSEA = .08. There were only some indicators (years of education, type of occupation,

occupation attainment, LEQ cognitive activities and religion) with moderate loadings on

their respective latent variables, and they were significant at the 0.01 level.

Table 16. Pearson Correlations between LEQ, Brief Cope, Occupation Attainment, Cognitive Outcomes & CR variables

|	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 .EmotionFocus	-	.22**	.17*	.11	.03	.12	.03	.11	.09	.06	.22**	.12	.21*	-.05	.04
2. TaskFocused		-	.22**	.12	-.10	.01	-.11	-.05	-.09	-.10	-.13	-.12	-.01	.16*	.29**
3. AvoidanceCope			-	.05	-.15	.16	-.22**	-.03	-.04	-.17	-.24**	-.26**	-.17**	.18	.16*
4. LEQPhysical				-	.16	.31*	.11	.29*	.42**	.45**	.08	.07	-.22	.11	.16
5. LEQCog					-	.16*	.58**	.75**	.70**	.55**	.59**	.54**	.45**	-.01	-.29**
6. LEQArtistic						-	.02	.60**	.58**	.39**	.30**	.25**	.24**	.02	-.15
7. Occup.Attainment							-	.37**	.44**	.42**	.52**	.46**	.44**	.10	-.31**
8. LEQYoung								-	.67**	.55**	.62**	.53**	.43*	.01	-.27**
9. LEQMiddle									-	.74**	.52**	.45**	.38**	-.05	-.28**
10.LEQOld										-	.47**	.33**	.14	.02	-.05
11.EF											-	.81**	.74**	-.26**	-.39**
12.VerbalMemory												-	.69**	-.11	-.37**
13.CR composite													-	-.16*	-.30**
14. Occupation Congruence														-	.08
15. ReligiousCope															-

Note.   *p <.05; **p<.001
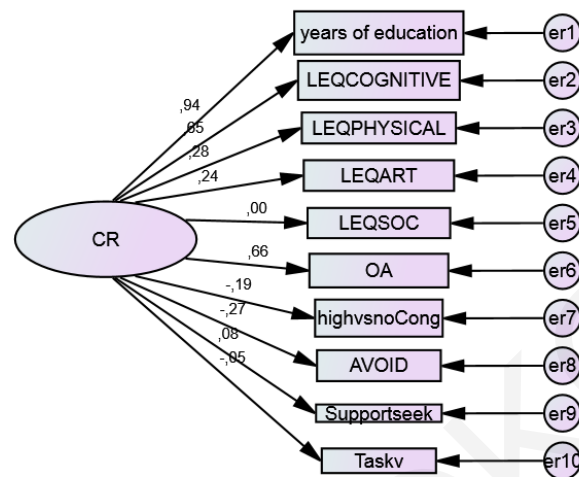
Figure 4. Initial Schematic representation of CR as a single latent variable.

Variables representing Leisure activity, Occupation attainment and Congruence, Years of Education and Coping strategies. Circles represent latent variables, and rectangles represent measured variables. Values are standardized regression weights

As the correlation and previous regression results had indicated, out of the types of leisure activities involved, the most significant were cognitive, artistic and physical. Also, for COPE we used emotion/support seeking, task/positive and avoidance coping strategies as measured variables of the latent Cope variable. As a first step in specifying the CR model, the moderating role of CR in the relationship between age and cognitive outcomes EF and VM was tested. It was noted that the first model of the relationship between age, verbal memory, and executive function had an adequate model fit, Chi-square $\chi2$ (40) = 59.18, p = .02, CFI = .98, RMSEA = .06. The estimated coefficients revealed significant negative effects of age on both latent cognitive factors (<.001). This model was presented in Figure 5.
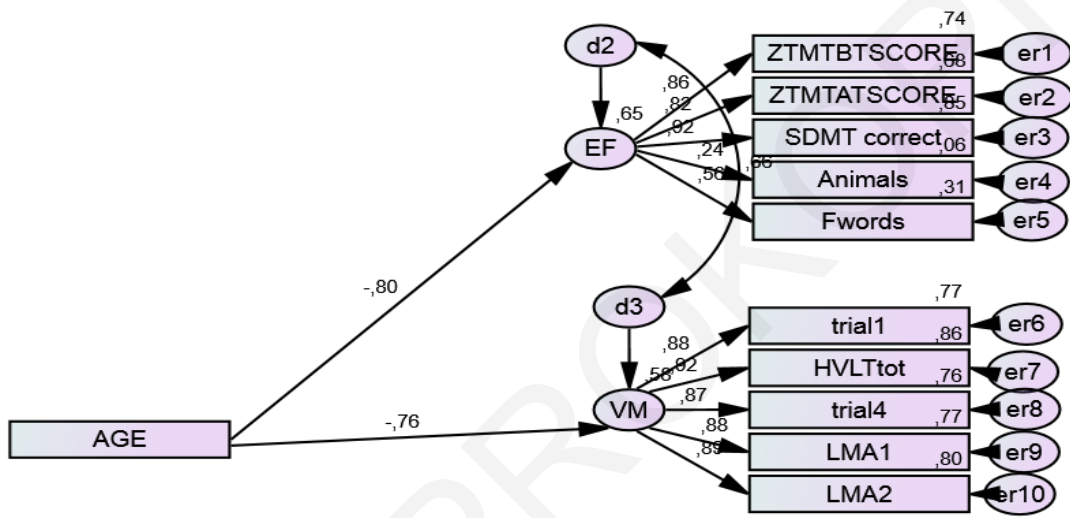
Figure 5. Schematic representation of the AGE with EF and VM.

HVLT = Hopkins Verbal Learning Test; trial 1: the number of recalled words in the first trial; HVLT total: the total number of words immediately recalled in the three learning trials; trial 4: the number of words recalled in the delayed recall trial; TMTA = Trail Making Test Part A; TMTB = Trail Making Test Part B; SDMT = Symbol Digit Modalities Test

The second model investigating the moderating role of CR, also had almost acceptable fit

indices $\chi2(67) =147.50$, $p < .001$, CFI = .95, RMSEA = .09 (Figure 6).
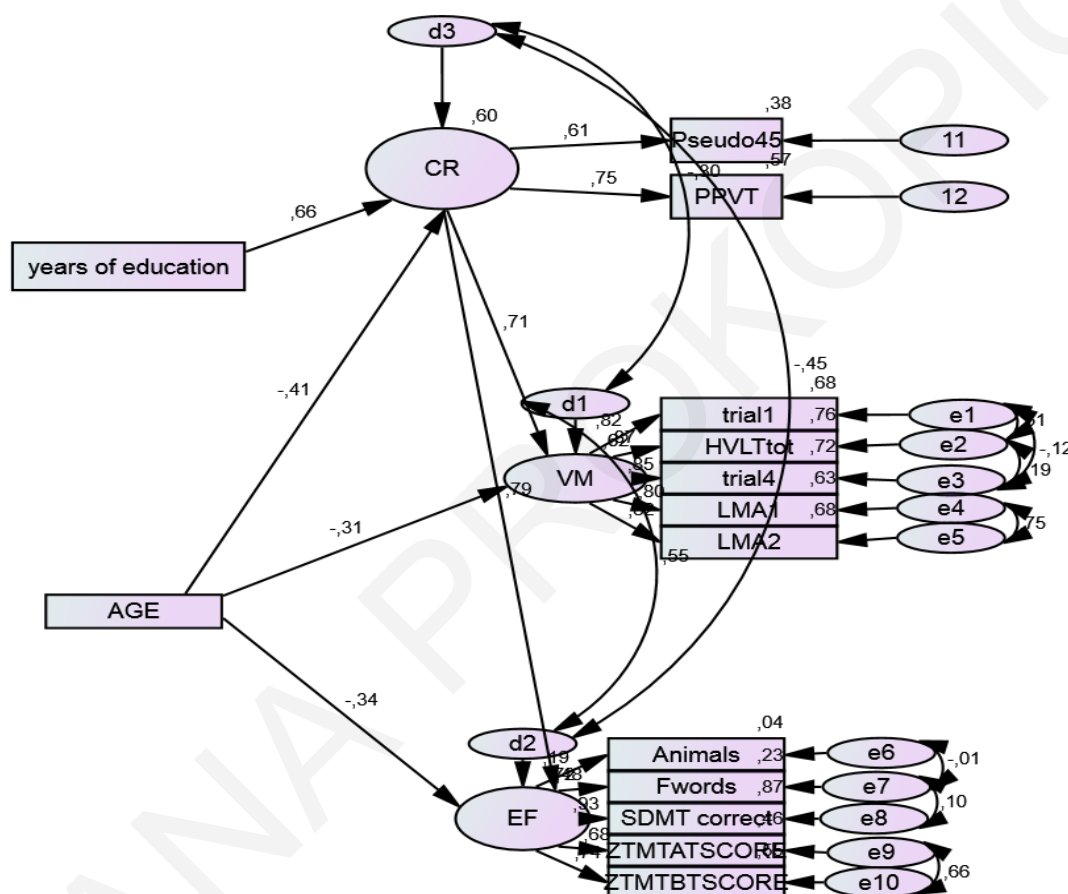

Figure 6. Schematic representation of the CR moderating the effect of Age on EF and VM.

HVLT = Hopkins Verbal Learning Test; HVLT1: the number of recalled words in the first
trial; HVLT immediate: the total number of words immediately recalled in the three learning
trials; HVLT delayed: the number of words recalled in the delayed recall trial; TMTA = Trail
Making Test Part A; TMTB = Trail Making Test Part B; SDMT = Symbol Digit Modalities
Test.

The following models specified the relationships between the latent variables and specifically the first proposed CR model included only LEQ leisure activities and Occupational –Personality Congruence . This model presented in Figure 7, had good fit indices specifically $\chi 2(98) =126.84$, $p =02$, CFI = .98, RMSEA = .04. The AIC value for this model was 270.84.
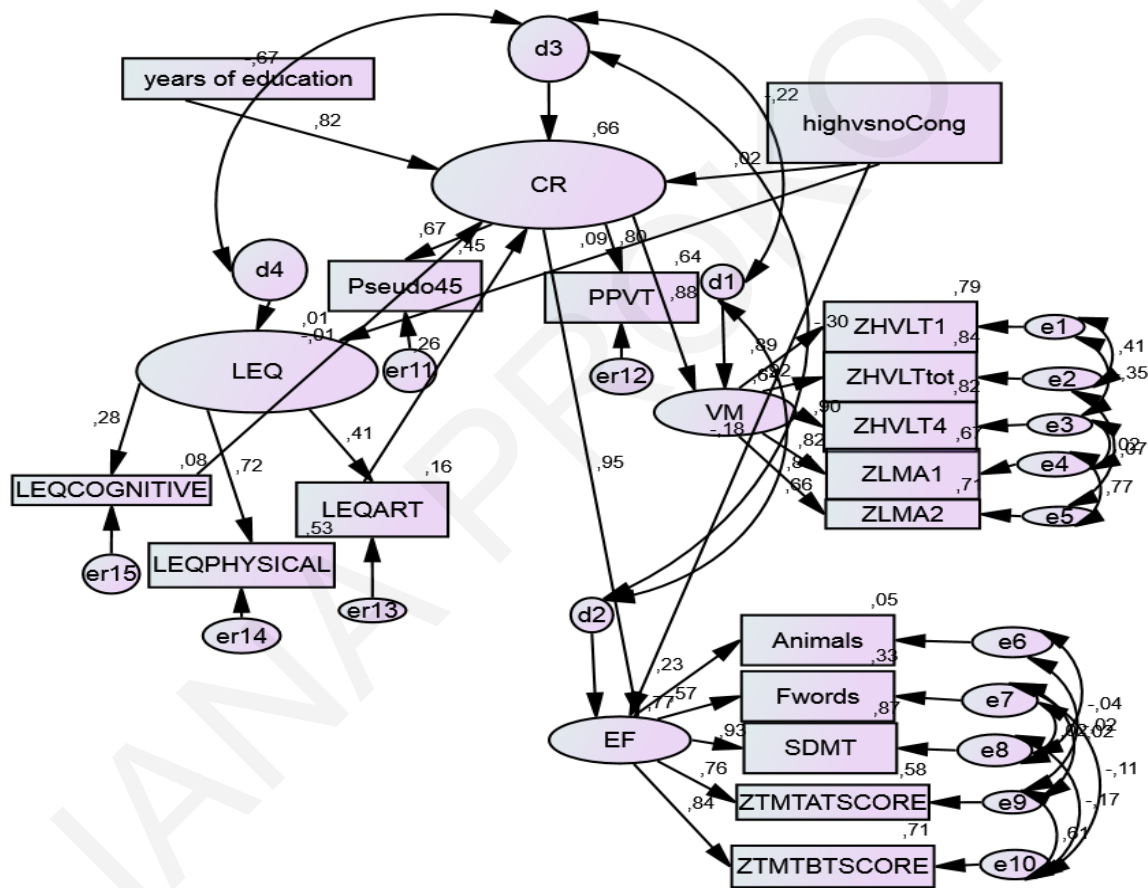

Figure 7. CR model with LEQ and Occupation- Personality Congruence as formative indicators

Finally, a two factor model was tested which included both Coping, and Leisure activities and Congruence. This model which suggests a mechanism through which level of congruence affects CR through coping strategies and that leisure activities directly contribute to CR, had fit indices of chi-square $\chi 2$ (134) =212.10, p <.001, CFI = 0.97, RMSEA = .05 and AIC =378.60. Figure 8 is a diagram representing the 2 Factor model of CR. The last suggested model including coping strategies has acceptable fit as well however the second model had better fit indices. Table 16 presents the estimates of the standardized regression weights of the last 2 factor SEM model.
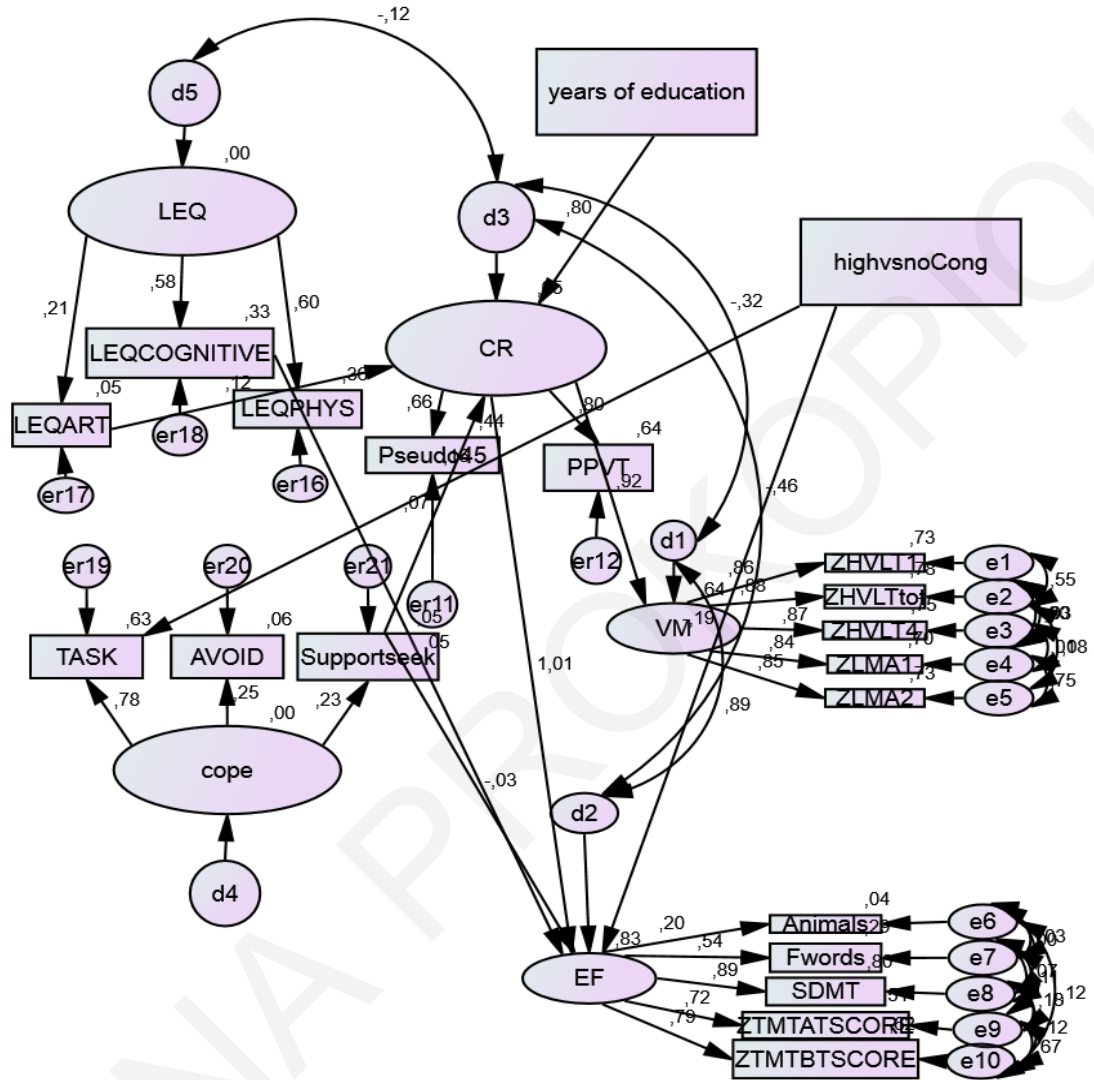
Figure 8. CR model with COPE, Occupation- Personality Congruence and LEQ variables

Table 17. Standardized Estimates of the Regression Weights for the last 2 factor SEM model

SEM Model	Standardized Estimates	Standard Errors	p
Education ⟶ CR	.799	.04	< .001
LEQart ⟶ CR	.120	.13	.02
Congruence ⟶ EF	.177	.66	.02
Congruence ⟶ Task (COPE)	.158	.19	.04
CR ⟶ VM	.922	.03	<.001
CR ⟶ EF	1.012	.27	.02

Note: SEM =structural equation modeling; LEQart: LEQ artistic; EF: latent variable representing executive function; VM: latent variable representing verbal memory; CR: latent variable representing cognitive reserve

Discussion

The current findings indicated that the level of participation in leisure activities (mainly cognitive and artistic) was correlated with cognitive outcomes (EF and verbal memory and language tests). In most of the cases, the overall level of involvement in leisure activities during the young and middle age was associated with better performance on EF, verbal memory and CR. For the old age, the level of involvement in leisure activities during old age was also correlated with EF and memory but was not significantly associated with CR outcomes.

As the results indicated, the two age groups of adults (middle aged and older) differed significantly on average on the educational level with the middle aged group having significantly higher educational level as compared to the older group of participants. For CR measures we used the receptive vocabulary and reading tests (PPVT; Simos et al., 2013). In similar studies, these two measures of receptive vocabulary and reading ability, have been considered reflective indicators of CR construct (Giogkaraki, Michaelides & Constantinidou,

2013) as they provide important information about the quality of education. The current findings emphasize the importance of measuring the leisure activities when estimating CR, especially during the old age. Such finding is probably an indication that the level of education (lower versus higher) and level of involvement in leisure activities can represent a more accurate measure of CR, which is a theoretical construct. Practically, this might also suggest that involvement in leisure activities is crucial especially when the educational level is low. Furthermore, the current findings coincide with results from other CR studies ((Levi, Rassovsky, Agranov & Vakil, 2013) indicating that CR is not a unitary structure but instead a multi-dimensional one, with formative variables including leisure activities, and occupational variables.

Secondly, it was hypothesized that CR would moderate the effect of age on cognitive outcomes, EF and VM. The second model assessed and confirmed the moderating role of CR. The findings revealed that CR moderated the direct negative effect of aging in cognitive aging and both CR models had adequate fits. CR was found to especially moderate the effect of age on EF in similar studies investigating its moderating role, however in the current study the effect of CR was not specifically obvious for the EF. This could be attributed to the fact that the sample was mainly middle aged and the moderating advantage of CR on EF is not yet evident.

Finally, unlike the initial hypothesis, the present study did not result in a direct association between coping styles and cognitive performance, except for significant and weak correlations with emotional/support seeking and avoidance coping strategies. The current study highlighted the need to further investigate how coping strategies could moderate cognitive outcomes and affect CR across life stages. The findings specifically identified certain coping styles including avoidant and religious coping as being negatively associated

with both cognitive function and CR outcomes as and it also indicated the emotion focused/support seeking style to being positively associated with both EF and CR outcomes. Religious coping style, on the other side was identified to be negatively associated with lesser involvement in leisure activities as well as with lower cognitive outcomes (EF, memory) and CR. One possible explanation is that people who tend to use more religious coping styles are less involved in other types of leisure activities and this could result in lower cognitive outcomes. Such an assumption deserves future investigation of how the religious or avoidant coping patterns in association with involvement in leisure activities could relate to and predict cognitive outcomes. Such findings can have further impact on better estimation of CR.

The results also suggested moderately strong associations of reserve with cognitively stimulating activities both during young and the middle age. Past research has suggested that the effects of cognitive activities at age 40 (i.e. middle age) were stronger than the effects of activities performed at earlier stages, suggesting that cognitive activity during middle age is especially important to cognitive reserve (Reed et al, 2011). Leisure activity is associated to cognitive performance and such finding can be explained in view of evidences indicating that environmental effects of social advantage can benefit cognitive development (Duncan, Brooks-Gunn, & Klebanov, 1994) and affect leisure activity patterns.

Consistent with our findings, prior studies, have additionally reported that cognitively stimulating leisure activities are associated with lower rates of dementia (Gatz, Prescott, & Pedersen, 2006) and slower cognitive decline (Wilson, Bennett, Bianias, et al., 2003).

The current findings suggest that involvement in leisure activities (especially cognitive and artistic) were more significantly associated with reserve than did the coping styles. Indeed, occupation attainment along with the level of involvement in leisure activities across life were more closely related to CR and other cognitive outcomes than the actual coping styles. This

suggests that the effects of coping on reserve could be mediated by involvement in leisure activities in life. As some reviewers suggest, persons whose cognitive activity exceeds the average may have levels of motivation, curiosity drive or persistence that effectively build reserve. Consequently, higher level of involvement in leisure cognitive activities would be positively associated with reserve (Reed et al, 2011).

The association between cognitive activity and reserve does not directly speak to the issue of genetic versus exposure factors in creating cognitive reserve. There is evidence that cognitive stimulation late in life can increase the thickness of the cortical mantel, which may in turn contribute to reserve (Engvig et al., 2010). However, whether naturally occurring levels of cognitive activity reflect nature, nurture, or both, is not known (Gatz et al., 2006).

With regards to level of involvement in leisure activities it is worth mentioning that most of the measures from earlier periods of life are retrospective and they may be influenced by and consequently distorted by current activity levels. However, it seems that the results of the study suggest a model of reserve in which the effects of coping could be mediated through ongoing lifetime experiences that have a more direct effect on reserve. We should be careful when interpreting such results as all the above findings are correlational in nature and that any causal inference should be made with caution.

It would be of great interest to further expand the current proposed CR model within the normal aging context with the future potential to reflect dynamic change to CR due to new life experiences. Such findings might hold promises for developing operational measures that could provide an estimate of change in CR due to exposure to new experiences and interventions that aim to increase CR in later life.

CHAPTER 5

General Discussion

To date, the majority of research on reserve has focused mainly on single point measures that have been used as estimates of CR, including longitudinal designs that have considered only one time measures of cognitive activities (Ward et al., 2015). In the absence of a modifying agent against cognitive decline associated with healthy aging, alternative approaches are proposed to increase our understanding of how to improve the brain's ability to sustain effective cognitive function to counteract the effects of biological aging. A number of investigations have identified education, participation in cognitively stimulating leisure activities as being lifetime contributors to CR (Stern, 2009). For example, more frequent late-life cognitive activity as well as early life cognitive activity have been associated with slower cognitive decline (Wilson et al., 2013). There is also growing evidence that more education, greater cognitive demands of work, and involvement in intellectually stimulating activities in leisure time protect against dementia (Fratiglioni & Wang, 2007).

Occupational characteristics are controlled less commonly in most of the studies and education has been the most investigated factor. Nevertheless, up to date and to the best of our knowledge, evidence on the relationships among these variables and their contribution to the construct of CR is very limited in healthy aging. Furthermore, it seems that there is no research to date to inform hypotheses about the combined role of occupational, leisure activities and coping styles in cognitive outcomes and CR. More importantly, the contribution of these variables has not been tested within cohorts of healthy middle- aged adults.

In addition to the above considerations, lifetime experience in cognitively engaging activities may provide benefits through a direct modification of detrimental age or disease processes. Specifically, there is evidence suggesting that lifetime cognitive engagement is

related to reductions in *β*- amyloid deposition (Landau et al., 2012) and rates of hippocampal

atrophy (Valenzuela et al., 2007). Such findings emphasize the importance of the assessment

of multiple proxies and over the lifespan.

As expected, educational level was the most potent predictor of EF and VM in middle aged

and older adults. It was also expected in this study that in addition to education, leisure

activities and occupational factors would provide a strong contribution to cognitive outcomes

and CR. The results of the study specifically indicated that amongst types of leisure activities,

physical leisure activities had the strongest significant contribution to the model in predicting

CR, along with occupational attainment and education. In fact, the present study revealed that

the greater engagement in specific leisure activities (cognitive, artistic and physical types) and

occupational attainment although it did not eliminate the role of education, it reduced its

contribution in late life cognition. This finding was prominent in the older adult group which

overall, had fewer years of education.

The present findings also provide evidence to the notion proposed by Reed at al., 2011

that leisure cognitive activities throughout adulthood are more important than education in

determining reserve in older adulthood (Reed et al, 2011). Therefore, the present investigation

included cognitive leisure activities when aiming at defining CR. The current dissertation

additionally investigated how the theoretical construct of CR should include multiple types of

life experiences including occupational, leisure activities and coping strategies for both middle

age and older adulthood. The contribution of leisure activities could be more relevant in older

adults with lower education as it was the case in this present cohort.

The present study also aimed to test the hypothesis that more frequent participation in

leisure activities could moderate the effects of limited education on cognitive functioning. For

the older group of participants was noted that there was a significant interaction of education

and leisure activities for the EF but not for the verbal memory outcomes. Specifically, there were significant main effect of total leisure activities (LEQ) on EF for the old aged group as well as there was a significant interaction effect between the frequency of involvement in leisure activities and educational level on EF but there was a non-significant effect of education on EF for the old group.

On the other hand, for the middle aged group, there was no such interaction effect on EF. Specifically, for the middle aged, there was only a significant main effect of education on EF and there was a non-significant main effect of leisure activities on EF. However, for the middle aged there was a significant interaction between the LEQ leisure activities and occupational congruency level for both EF and verbal memory outcomes. Such pattern also applied for the older group, where the interaction of leisure activities and occupational congruency was still significant for the EF outcomes.

In the present study, occupation attainment was associated with both EF measures (including SDMT), verbal memory tests and CR measures for the whole sample. Education however has not always demonstrated to be a predictor of cognitive outcome. Therefore, discrepancies between leisure and occupational activities and education may be informative in estimating late life reserve. Possibly, the diverse life experiences including occupational factors (occupational congruence) that influence cognitive reserve individually impact different neuropsychological functions to varying degrees.

Additional support for this notion may be found in a few earlier studies reporting associations of cognitive reserve markers with performance on the PASAT (a measure of processing speed and working memory but not on the SDMT (a measure of EF) (Sumowski et al., 2009). In the latter study, occupational attainment was not associated with the SDMT yet was an important predictor of the PASAT. Both measures are considered indices of

information processing speed. Dissociation between the SDMT and PASAT with respect to cognitive reserve has been suggested to relate to the former mobilizing a more limited range of cognitive strategies (Sumowski et al., 2009). The PASAT, in contrast, tests not only processing speed and working memory but also requires numeric calculation (Lezak et al., 2012). It is amenable to different cognitive strategies such as ''chunking'' of stimulus dyads.

Regarding the type of leisure activities involved, this study results specifically indicated that frequent involvement in cognitive activities had a significant effect on EF performance   as well as on the outcomes of the verbal memory test performance. Furthermore, frequent involvement in physical activities had a significant effect only for the EF outcomes. On the other hand, involvement in social or artistic types of leisure activities did not present a significant effect on any of the dependent variables (EF, Memory) for the whole sample of participants. As the results of the study 2 demonstrated, frequent involvement of artistic activities (along with physical activities) was only significant for the older aged group. It is not difficult to understand why physical activity would be beneficial for the old adults. A very recent study suggested that while physical activity preserves neuronal structure integrity and brain volume (hardware), cognitive activity strengthens the functioning and plasticity of neural circuits (software) (Cheng, 2016). This leads to the conclusion that both types of activities probably support the cognitive reserve in different ways. Actually comparisons between cognitive and physical activity probably have more academic rather than practical value, as the general population would be recommended to do both. In fact, despite these research findings, it would be not wise to conclude that cognitive activity is necessarily more important than physical activity. While physical activity and especially aerobic exercise supports neuronal structural integrity and preserves brain mass, cognitive activity strengthens the functioning and plasticity of neural circuits. So, it seems that these two activities go

together because without healthy neuronal structures, one's ability to participate in or respond to cognitive training is undermined (Cheng, 2016). Also, the fact that the role of both physical and cognitive activity was more significant during the older age, it probably suggests that perhaps there are the long term patterns and the intensity of involvement that matter the most as people age.

The current findings could be interpreted within the framework of the Socioemotional Selectivity Theory predicting that people of different ages prioritize different types of goals. As people age, they attach less importance to goals that expand their horizons and greater importance to goals from which they derive emotional meaning. For example, although older people might have smaller social networks and reduce their spheres of interest, they are still as happy as younger people. This makes sense if motivational changes with age lead people to place priority on deepening existing relationships and developing expertise in already satisfying areas of life (Carstensen, 2006).

A few studies have used the amount/intensity of physical activity at one point in time as the predictor of future dementia risk, assuming that this one time measure reflects a more stable habit (Cheng, 2016). However, an additional line of studies suggested that an increase or decrease of physical activity over time changes the odds of getting dementia in the expected direction (Tolppanen et al., 2015). As such it would be of interest for future purposes to investigate such changes of patterns of involvement in either physical or cognitive leisure activities within healthy cohorts longitudinally starting from middle age.

In the present study, the Lifetime Experiences Questionnaire (LEQ; Valenzuela & Sachdev, 2006) was used as a self-report scale to determine both the current mental activity levels and how active one had been over the lifetime. The internal coherence of LEQ items was overall mostly adequate, with an overall alpha coefficient of .79. The Midlife subscale

showed the least coherence although we should keep in mind that the value of *a* moderate to

strong average correlations depends on the number of items in the scale (Cortina, 1993). In

terms of dimensionality of LEQ, it was suggested that LEQ assesses a multidimensional

construct, which conforms to previous findings (Valenzuela et al, 2007).

The inter-correlation analyses of the full range of mental activities at each stage of life

were moderate to highly correlated with the highest correlation between the Mid Life and Late

Life subscales (.74) and the lowest between Young and Late life (.54). This result is not in line

with previous findings, which have found stronger correlations between early and midlife as

compared to midlife and late life. (Valenzuela & Sachdev, 2007). Nevertheless, these results

still present the ability of LEQ to predict the level of involvement in complex mental activity

in another life stage.

Furthermore, there is evidence in the aging and dementia literature suggesting that

premorbid IQ may furnish a more robust measure of reserve than education (Giogkaraki et al.,

2013). General intelligence (g), has been reported as an important construct of cognitive

reserve. Actually, the construct g is strongly linked to intracranial and brain volume, especially

prefrontal volume (Christensen, Anstey, Leach, & Mackinnon, 2008). General intelligence,

unlike fluid ability, is also stable across the lifespan and is associated with cognition,

education, occupation, mental activities, and survival (Sternberg, 2008).

The present dissertation project aimed to provide a better understanding of the patterns

of contribution of each of the abovementioned variables on CR in middle age and older

adulthood within the Greek Cypriot sociocultural context. Such investigation was achieved

through the application of self-reported scales that were adapted in Greek (LEQ, Valenzuela &

Sachdev, 2007) and were also validated the SDS in Greek speaking participants over 45 (SDS,

Holland 1994). Therefore, one of the contributions of the study was the investigation of

psychometric properties for each of the self-report scales used within this specific sociocultural context.

In summary, the present findings emphasize the importance of considering additional variables when determining cognitive reserve and its moderating role in cognitive aging as measured by neurocognitive performance. Based on theoretical evidence, we have tested a simple construct of cognitive reserve including data that can be acquired through easily administered questionnaires as part of a general population screening protocol. This project uniquely incorporated occupational congruence, specific leisure activities and coping strategies to the list of variables that define the theoretical construct of CR. The current dissertation project is considered an extension of the CR model earlier investigated by Giogkaraki, Michaelides & Constantinidou (2013). Giogkaraki et al., (2013) examined the CR hypothesis on a large cohort of healthy aging adults in association with age and cognitive functions, as part of the first longitudinal project on cognitive aging in Cyprus, the Neurocognitive Study on Aging (Constantinidou, Christodoulou, & Prokopiou, 2012). The authors developed a multiple indicators multiple causes (MIMIC) latent construct of CR using years of education, receptive vocabulary and reading ability. Years of education functions as a formative indicator for CR and was considered to represent prior experience, while the receptive vocabulary and reading ability were the reflective indicator measures. These two last measures present important information about the quality of education (Manly et al., 2002) and, therefore, educational attainment, receptive vocabulary, and reading level are considered good proxies for cognitive reserve (Stern, 2011). The present findings are in agreement with the findings by Giogkaraki et al., 2013 demonstrating that the executive function and verbal episodic memory were correlated. In fact several aspects of executive function have indirect impact on memory: the organization and elaboration of material of encoding, strategic

retrieval of information, and the ability to avoid the effects of interference (Stuss & Alexander, 2000). Furthermore, as indicated by the magnitude of standardized regression coefficients, the association between markers of reserve and cognition was weakest for the measure of verbal memory and strongest for the measure of EF. It is possible that adults with higher levels of CR apply more efficient cognitive strategies, which may be more directly relevant to executive function abilities and

more indirectly related to verbal memory performance.

The study findings also indicate that years of education influence the type of coping strategies deployed by study participants. Participants with college or university education tended to report less frequent use of religion coping strategies as compared to the participants with only elementary education. A similar pattern was followed for the Denial, Self-Blame and Substance Use coping strategies. Additionally, education had a significant effect on the patterns of involvement in leisure activities across life, starting from young age until middle age. The most significant differences were noted between education groups with 6 or less years of education and those with more than 12 years of education, all $p<.001$. Specifically, the results of study 1 suggested the presence of broader underlying dimensions of coping and are so in line with previous factor analytic findings . Our findings suggested religion and substance use scales as independent factors. Later correlation analyses indicated that specifically the use of humor was positively and significantly associated with the three aspects of cognitive outcomes as measured in our study; EF, verbal memory and also with a low but significant correlation with CR measures. The use of humor was also related to better occupational attainment.

With regards to occupational types and according to Holland's model, types that are next to one another on the hexagon are most closely related, for example Realistic and

Investigative, Artistic and Social, Enterprising and Conventional. The results of the present

study indicated that for the Greek Cypriot older adult population the same pattern of the model

applies. The results corresponded with previous findings showing that there is a strong

association between the Social and Artistic types as well as between the Conventional and

Enterprising types. Additionally, while we expected occupational congruence to be also a

strong predictor of cognitive outcomes and CR, the results did not support such finding for our

sample. This could be explained due to cultural differences within our Greek-Cypriot adult

sample that tend to focus more on career advancement rather than on career change during

midlife. In the US or other western nations, career change to better fit individual needs and

interests especially during the middle age could be more common. The present study was only

a preliminary study which investigated the properties of the Holland's RIASEC model within

a sample of healthy older adults. The association found between the Investigative and

Enterprising as well as between the Conventional and Investigative types, although not typical

of the Holland's suggested model of interests, could be interpreted as an expression of the

Greek Cypriot sociocultural characteristics needed to be further replicated in the future.

This study also aimed to investigate patterns of associations between coping styles and

involvement in various types of leisure activities that could relate to better cognitive outcomes

and better CR across life. However, there are issues related to the fact that the concept of

coping is defined and operationalized differently in the literature and this may lead to

difficulties in comparing and interpreting results from different studies (Skinner, Edge,

Altman, & Sherwood, 2003). The emotion support seeking scale in the present study resulted

as a combination of items on emotional support and instrumental support. Generally, social

support is supposed to act as a positive coping resource (Thoits, 1995). Consequently, social

support items loading on support seeking (emotional and instrumental) scale of Brief Cope

could denote self-efficacy in dealing with stressful situations. Social support has been suggested to combat the effects of stress and anxiety (Panayiotou & Karekla, 2013). In the present study, there were only a few coping styles that were associated with leisure activities. Specifically, active coping style was positively associated with higher level of involvement in physical leisure activities but not with an overall higher level of involvement in leisure activities at each life stage. Furthermore, we expected to find that coping strategies would be associated with patterns of involvement in leisure activities and so when testing for the mediating effect of the coping styles to the level of involvement in leisure activities it was expected to find significant correlations between coping and level of involvement in cognitive activities, between Occupation and level of involvement in cognitive activities and between Occupation and coping. Indeed, some coping strategies were associated with occupational attainment such as the avoidance coping negatively associated with occupational attainment. Also there were significant negative associations between LEQ total involvement in leisure activities and religious coping strategies. Our previous correlation results had indicated that total level of involvement in leisure activities (LEQ Total) was significantly correlated with both EF and with verbal memory outcomes. In fact, physical inactivity and lack of stimulating cognitive activities are considered to be the two most significant modifiable risk factors for dementia in previous literature. Therefore their effects on developing CR are worth investigating.

In summary the current findings could be applicable to and assist the existing CR literature to have a more comprehensive estimation of CR. Inclusion of coping patterns and their possible interaction with occupational attainment and leisure activities could be further investigated as this might have both theoretical and practical implications for better conceptualization of the CR construct. The currently proposed CR model might be of interest

to be further developed and replicated longitudinally with the purpose of evaluating and

exploring the potential benefits of CR- based interventions starting well before the onset of

age related neuropathology.

Study Limitations and Future Research

        The present study has several limitations that should be noted.

While age was investigated along a continuum, a smaller number of older adults was recruited

in comparison to middle aged adults. . Furthermore, in our study the older adults, as a group

had a lower level of education. While the level of education is a representation of the

education practices of that particular age group (Constantinidou et al., 2012), it influenced

neurocognitive test performance and could limit the generalizability of findings outside of

Cyprus.

        In the current study, the contributing role of various type of leisure activities was

investigated but for future studies it would be interesting to standardize assessment of leisure

activities for example by frequency, intensity and duration of each type of activity.

Furthermore, the inclusion of brain measures could offer a more reliable evaluation of CR to

brain reserve and their interaction. Future studies need to further investigate the causal

mechanisms and multi-directional pathways that may exist between the proposed CR

variables, as this still remains undefined. Theories of work adjustment should be further

investigated in relation to cognitive aging. Tenure, is closely linked and can be predicted from

the correspondence of an individual's work personality with the work environment (Dawis &

Lofquist, 1984). Constructs such as tenure, as a principal indicator of work adjustment,

satisfaction and sastisfactoriness, can provide useful insights for better understanding the role

of occupational constructs in cognitive development and within the aging context. Constructs

and measures of work adjustment, can be explored as possible relevant tools to improving

cognitive performance starting from the middle age. Such investigation could have further benefits and be applicable within the area of vocational rehabilitation counseling in Cyprus and internationally.

Further replication of the study could be necessary to test for the generalizability of the findings within similar contexts. It would be of specific interest for future studies to investigate longitudinally whether an increase in leisure engagement could be a useful strategy to compensate for the cognitive disadvantage associated with low educational level or low occupational attainment. The present findings should be replicated with a larger sample of participants and ideally with a longitudinal design.

Study Contribution

Theoretical Implications. Past evidence has suggested that various demographic and environmental factors (work complexity, leisure activities, and cognitive engagement) across the life course appear to make unique contributions to cognitive function during the late stages of middle age (Turrell et al., 2002). Related evidence also indicates that when the research data is stratified by age (young adults, middle aged adults, and elderly) the middle aged adult group shows a higher level of cognitive reserve than both the young and the elderly groups (Nucci, Mapelli & Mondini, 2012). Thus, investigation of additional factors that may contribute in the formation and enrichment of cognitive reserve across lifetime may offer a better understanding of the construct itself. Such knowledge could be helpful in further expansion and validation of predictive theoretical models and hypotheses of cognitive aging. Furthermore, this study offered further insights into the pattern(s) of the protective mechanisms for each age group including younger adults and older adult. Finally, the current study investigated for the first time the applicability of Holland's hexagonal model of occupation-personality and the validity of a recently introduced instrument (LEQ) across life

within a population of Greek-Cypriot adults. As such it provided a specific socio-cultural

contribution to the CR as an evolving and not stable construct.

　　　　Practical Implications. The present study supports the theory that cognitive reserve

starts to be shaped by early adult years and it continues to be affected by personal and

environmental factors later in life. Coping strategies in relation to occupational and leisure

activities was incorporated into a CR model. The results of the study have implications in

targeting midlife interventions (level and pattern of involvement, lifetime occupation

congruence and coping strategies) that could increase the accumulated level of cognitive

reserve and improve cognitive aging.

　　　　We believe that findings related to measures and contributing factors of cognitive

reserve could be directly applicable to better vocational counseling techniques starting from

educational, occupational and day care settings and during the middle age. Specifically, the

identification of the preferred spectrum of leisure cognitive activities post retirement could

assist in higher level of involvement in cognitive leisure activities that best match the current

interests and competencies in late adulthood. Exploration of Vocational and Leisure activities

counseling could be incorporated in day care centers for elderly. Additionally, identification of

patterns of involvement in cognitively stimulating activities during middle age can directly be

implemented in early informational or CR boosting programs for adults. Additionally, coping

styles undergo genetic and environmental changes with increasing age (Tomotsune et

al. 2009), and the role of environmental influences becomes increasingly important during

adulthood. Furthermore, the identified coping strategies that seem to associate with better CR

and cognitive outcomes (EF, memory and language) could be promoted and integrated in

cognitive interventions across life, starting from early adulthood.

The present study is the first study that investigated a model of CR within a specific cultural context by incorporating theoretically relevant multiple contributing variables of CR in healthy aging. Therefore, one of its major contributions was that it attempted to provide a comprehensive theoretical evaluation of a CR model that integrated occupational attainment and congruency as well as coping variables in relation to the well-established CR proxies. Findings from the present study deepened our understanding of the role of education on CR during middle age and old age. More importantly, it emphasized how each of the CR proxies can contribute differently during each middle and older adulthood.

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