Rehabilitation Psychology

0090-5550/16/$12.00 http://dx.doi.org/10.1037/rep0000108

Using Personality Traits to Construct Linear Growth Models of Mental Health in Family Members of Individuals With Severe Brain Injury

Michael Trujillo and Paul B. Perrin
Virginia Commonwealth University

Karoline Doser
Danish Cancer Society Research Center, Copenhagen, Denmark

Anne Norup
Rigshospitalet—Copenhagen University Hospital, Glostrup, Denmark

Objective: No studies have examined the impact of personality traits on mental health among caregivers of individuals with severe brain injury. Therefore, the purpose of the current study was to construct linear growth models to examine whether the personality traits of family members of individuals with severe brain injury could predict the trajectories of their own mental health-related quality of life (HRQoL), anxiety, and depression beginning in a neurointensive care unit through 1 year after injury. ***Method:*** Danish family members of individuals with severe brain injury ($n = 52$) completed the Short Form-36 assessing mental HRQoL (vitality, social functioning, role limitations–emotional, mental health), anxiety, and depression across 5 time points during the 1st year after injury. The measure of personality was administered 3 months after the patients' discharge. ***Results:*** All mental HRQoL, anxiety, and depression variables improved significantly over time. Caregivers who were less neurotic and less conscientious had higher vitality, social functioning, and mental health over time, whereas caregivers who were more agreeable had higher social functioning over time. Caregivers with lower neuroticism had lower anxiety and depression over time, as well as a more accelerated decrease in anxiety and depression. ***Conclusions:*** Caregivers' personality traits were strongly associated over time with mental HRQoL, anxiety, and depression, with neuroticism being especially important for trajectories of anxiety and depression. These results suggest that personality assessments for caregivers of individuals with severe brain injury could help identify those most at risk for poor mental health over the course of rehabilitation.

Impact and Implications
This article reports on data from the first longitudinal study examining the association between personality and mental health of caregivers of individuals with severe brain injury. The study adds to the existing literature by showing that caregivers with low neuroticism had a more accelerated decline in anxiety and depression across the first year after injury. Future intervention programs could benefit from including a brief personality assessment to identify caregivers who might have more difficulty coping over time and therefore need additional assistance in the adaptation process.

Keywords: severe brain injury, caregivers, personality, quality of life, mental health

Introduction

The costs associated with traumatic brain injury (TBI) in Europe have been estimated at 23.7 billion USD (US$37 billion; Wittchen et al., 2011), which is a major health concern considering TBI incidence is increasing due to road traffic accidents (European Commission, n.d.). Common sequelae after brain injury include psychosocial (Cunningham, Chan, & Jones, 1999), physical (Lynch, 1986), and cognitive impairments (Malkesman, Tucker, Ozl, & McCabe, 2013), as well as neuropsychiatric symptoms (e.g., depression, anxiety, irritability; Benedictus, Spikman, & van der Naalt, 2010). These impairments often necessitate an informal caregiver, and because of the sudden nature of TBI, caregivers are often unprepared to assume this role (Sinnakaruppan & Williams, 2001).

The caregivers of individuals with TBI are often uniquely challenged because of the variety of deficits that TBI patients may experience. Loss of function is typically seen in more than one domain (e.g., physical, cognitive), with the deficits impacting most areas of the patients' and caregivers' lives. Consequently, the role of the caregiver is complex and can range from providing daily care to navigating insurance companies and lawyers.

Michael Trujillo and Paul B. Perrin, Department of Psychology, Virginia Commonwealth University; Karoline Doser, Survivorship Unit, Danish Cancer Society Research Center, Copenhagen, Denmark; Anne Norup, Clinic of Neurorehabilitation, Traumatic Brain Injury Unit, Rigshospitalet—Copenhagen University Hospital, Glostrup, Denmark.

This study was supported in part by a grant from the National Science Foundation, DGE-1147383 (Trujillo).

Correspondence concerning this article should be addressed to Anne Norup, PhD, who is now in the Department of Neurology, Rigshospitalet—Copenhagen University Hospital, Nordre Ringvej 57, 2600 Glostrup, Denmark. E-mail: anne.norup@regionh.dk

As a result, adjusting to the role of informal caregiver, primarily assumed by parents and spouses (Knight, Devereux, & Godfrey, 1998), can be emotionally draining. Outcomes associated with being a TBI caregiver are well documented and include reduced quality of life (Livingston et al., 2010; Norup, Snipes, et al., 2013); poor social functioning, increased stress, and burden (Nonterah et al., 2013); and depression and anxiety (Doser & Norup, 2016; Manskow et al., 2014; Norup, Kristensen, Poulsen, Nielsen, & Mortensen, 2013; Norup, Siert, & Mortensen, 2010; Perrin et al., 2013).

Caregivers' psychosocial functioning is directly associated with the quality of care that they provide to the person with the brain injury (Vangel, Rapport, & Hanks, 2011), which suggests a need for further investigation to understand the influences on caregiver mental health. Prior research has indicated that caregivers' lower satisfaction with life is associated with greater caregiver burden and depression (Kreutzer et al., 2009), and poor family functioning is also associated with higher caregiver strain (Gan, Campbell, Gemeinhardt, & McFadden, 2006).

Specific impairments after brain injury are also associated with caregiver mental health. Cognitive and physical deficits have shown a strong association with caregiver distress (Anderson et al., 2009; Brooks, Campsie, Symington, Beattie, & McKinlay, 1987; Norup, Welling, Qvist, Siert, & Mortensen, 2012), even up to 5 years postinjury (Ponsford & Schönberger, 2010). Similarly, caregiver depression and anxiety have been associated with cognitive, behavioral, and emotional changes in individuals with brain injury (Ponsford, Olver, Ponsford, & Nelms, 2003). However, most of the findings have been reported in cross-sectional studies; few longitudinal studies have investigated mental health in caregivers over time, but those that do have suggested that symptoms of anxiety and depression decrease (Norup, Petersen, & Mortensen, 2015) and quality of life increases (Norup, Snipes, et al., 2013) during the first year after injury.

One facet of care that is receiving growing, albeit limited, attention is the association between caregivers' personality traits and their mental and physical health (Bookwala & Schulz, 1998; Hooker, Monahan, Shifren, & Hutchinson, 1992; Kim, Duberstein, Sörensen, & Larson, 2005; Löckenhoff, Duberstein, Friedman, & Costa, 2011). TBI caregivers are typically not prepared for their caregiving role because of the sudden onset of TBI, and consequently many caregivers may draw on preexisting psychosocial characteristics such as personality traits in order to adjust to the novel demands of their new role (McClendon & Smyth, 2013).

One of the more common conceptualizations of personality structure uses a five-factor model (Goldberg, 1990). In this model, personality can largely be described as consisting of five dimensions: neuroticism (tendency to experience negative emotions), extraversion (sociability, excitability, and tendency to experience positive emotions), openness to experience (appreciation for a variety of experiences), conscientiousness (self-discipline and organization), and agreeableness (altruism and willingness to cooperate with others; McCrae & Costa, 1987).

Research on caregivers of individuals with other types of conditions such as dementia, stroke, and cancer has reported that caregivers high in neuroticism have been shown to have more depression (Gallant & Connell, 2003), greater caregiver burden and distress (Markiewicz, Reis, & Gold, 1997), increased sensitivity to caregiver-related stressors (Bookwala & Schulz, 1998), dysfunctional coping strategies (Hooker, Frazier, & Monahan, 1994), and worse subjective mental health (Hooker et al., 1992). Caregivers high in extraversion display less depression (Kim et al., 2005), lower burden and strain (Gallant & Connell, 2003), more adaptive coping strategies (Hooker et al., 1994), and better mental and physical health (Hooker et al., 1992). Similarly, caregivers high in conscientiousness report greater adaptive coping strategies (Hooker et al., 1994), more benefit-finding in the caregiving experience (Hollis-Sawyer, 2003), and lower sensitivity to caregiver-related stressors (Koerner & Kenyon, 2007). And finally, caregivers with high agreeableness report less maladaptive coping strategies (Hooker et al., 1994) and more benefit-finding (Koerner, Kenyon, & Shirai, 2009), whereas those higher on openness to experience tend to experience positive perceptions of the caregiving experience (Hollis-Sawyer, 2003).

Most research on caregiver mental health within the field of brain injury has investigated the potential influence of impairments in the individual with TBI (Nonterah et al., 2013; Norup et al., 2010), as well as external factors such as social support (Stevens et al., 2013). However, no research has examined the relationship between personality traits and mental health outcomes among caregivers of persons with brain injury using cross-sectional or longitudinal methods. Therefore, the aim of the current study was to use hierarchal linear modeling to examine whether Danish caregivers' personality traits were predictive of their trajectories of mental health-related quality of life (HRQoL), anxiety, and depression beginning at the patients' stay in a neurointensive care unit through 1 year after injury. It was hypothesized that symptoms of anxiety and depression would decrease and health-related quality of life would increase during the first year after injury. Furthermore, it was expected that higher levels of neuroticism would be associated with more prolonged trajectories of anxiety and depression.

Method

Participants

Participants were 52 family members of patients with severe brain injury admitted for intensive neurorehabilitation in Denmark at the Clinic of Neurorehabilitation, Traumatic Brain Injury Unit, Rigshospitalet. All family members consented to participate in the Clinic of Neurorehabilitation, Traumatic Brain Injury Unit study. If more than one family member was present at enrollment, the family decided which family member should participate. Inclusion criteria were that participants had to be (a) at least 18 years old, (b) Danish speaking, and (c) without a current psychiatric diagnosis or progressive brain disease (e.g., dementia). Family members had a mean age of 49.44 years (SD = 12.78). Additional demographic information appears in Table 1.

All patients had been admitted to intensive neurorehabilitation and had severe brain injury (TBI or nontraumatic brain injury [NTBI]) as indicated by a Glasgow Coma Scale (GCS; Teasdale & Jennett, 1974) score between 3 and 9. Patients with a GCS above 9 were included only if their injury included severe focal neurological deficits such as aphasia, agitation, or hemiparesis. All patients had completed neurosurgery (if applicable) and were respiratorily stable. The mean age of patients was 40.97 years (SD = 19.38).

Table 1
Characteristics of Patients With Brain Injury and Their Family Members

Variable	*n* (%)	*M* ± *SD*	Range
Family members (*n* = 52)			
Gender			
Female	41 (78.8)		
Male	11 (21.2)		
Relationship			
Spouse	18 (34.6)		
Parent	22 (42.3)		
Children	6 (11.5)		
Siblings	2 (3.8)		
Boy- or girlfriend	2 (3.8)		
Others	2 (3.8)		
Occupational status			
Full-time work	45 (86.5)		
Pension	5 (9.6)		
Unknown	2 (3.8)		
Cohabitant status: Cohabiting with the patient	31 (59.6)		
Patients (*n* = 52)			
Gender			
Female	15 (28.8)		
Male	37 (71.2)		
Injury			
Traumatic	39 (75.0)		
Nontraumatic	13 (25.0)		
Infarction	5 (9.6)		
Cardiac arrest	2 (3.8)		
Subarachnoid hemorrhage	3 (5.8)		
Tumor	2 (3.8)		
Spontaneous intracranial hemorrhage	1 (1.9)		
GCS		11.34 ± 3.08	5–15
LOS		111.44 ± 50.32	12–210

Note. GCS = Glasgow Coma Scale; LOS = length of stay.

Measures

Short Form–36 (SF-36). The SF-36 (Stewart & Ware, 1992) is a widely used self-report measure of health-related quality of life (HRQoL). This 36-item measure has been used in both individuals with TBI (Guilfoyle et al., 2010) and in TBI caregivers (Arango-Lasprilla et al., 2011; McPherson, Pentland, & McNaughton, 2000). Only four subscales focusing on caregivers' psychosocial functioning were used for the purpose of this study: Vitality, Social Functioning, Role Limitations–Emotional (performance of role as affected by emotional factors), and Mental Health. Subscale scores range from 0 to 100, with higher scores indicating better HRQoL. Scores were evaluated in terms of Danish norms on the basis of gender (Bjorner, Damsgaard, Watt, & Bech, 1997).

Symptom Checklist-90–Revised (SCL-90-R). The SCL-90-R (Derogatis, 1994) is a 90-item self-report inventory used to assess psychological distress. Only the depression and anxiety subscales were used for this study, and higher scores indicate greater symptom severity. The scales have been validated in Danish, and a population study revealed high alpha coefficients on the depression and anxiety scales ($\alpha = .91$ and $\alpha = .86$, respectively; Olsen, Mortensen, & Bech, 2006).

Glasgow Coma Scale (GCS). The GCS assesses the degree of consciousness in individuals with brain injury (Teasdale & Jennett, 1974). Assessment factors include eye movement, motor ability, and verbal comprehension. Together these factors provide a total score of responsiveness and range from 3 (not conscious, indicative of severe brain injury) to 15 (full consciousness). Scores on the GCS were assessed at admission to early intensive rehabilitation.

NEO Personality Inventory Revised (NEO-PI-R). The NEO-PI-R is an empirically derived 240-item self-report measure of five major domains of adult personality (Costa & McCrae, 1992). The five traits and their corresponding facets (in parentheses) include neuroticism (anxiety, anger hostility, depression, self-consciousness, impulsiveness, vulnerability), extraversion (warmth, gregariousness, assertiveness, activity, excitement seeking, positive emotions), openness (fantasy, aesthetics, feelings, actions, ideas, values), agreeableness (trust, straightforwardness, altruism, compliance, modesty, tender-mindedness), and conscientiousness (competence, order, dutifulness, achievement striving, self-discipline, deliberation). Internal consistency of the Danish version across domains has ranged from .86 to .91 (Costa & McCrae, 2004). The NEO-PI-R was completed by all participants 3 months after the patients' discharge from rehabilitation in order to reduce the chances that coping with a family member's acute brain injury would cause dramatic changes in participants' scores on this measure.

Procedure

Participants completed the outcome measures, the SF-36, and the anxiety and depression subscales from the SCL-90-R across five waves. Time points included while the person with brain injury was (a) in the neurointensive care unit, (b) at admission to early intensive rehabilitation, (c) at discharge from rehabilitation, (d) at 3 months postdischarge, and (e) at 1 year postinjury. Caregivers completed the NEO-PI-R assessment at 3 months postdischarge. About half of the sample provided data in the neurointensive care unit, in part due to the chaotic nature of this time period, with many families and caregivers being unavailable, limiting the ability to substantively recruit participants at this time point. The Danish Data Protection Agency (2007-41-0583) and the Committees on Biomedical Research Ethics of the Capital Region of Denmark (S-KF-311150) provided study approval. All patients gave their informed consent according to the Helsinki Declaration.

Data Analyses

Six separate hierarchical linear models (HLMs) were performed to predict family members' four mental HRQoL SF-36, anxiety, and depression scores across 1 year after the patient's injury (see Table 2). All six models included time and the five NEO personality subscale scores as predictors, with the personality scores treated as continuous variables. Time and the NEO scores were all centered and entered simultaneously as fixed effects into each HLM. The four subscales of the HRQoL (Vitality, Social Functioning, Role Limitations–Emotional, Mental Health), as well as anxiety and depression scores, were examined separately as outcome variables. Intercepts but not slopes were included as random effects in all models, and within-subject residuals were treated as independent. Data collected at baseline (neurointensive care unit) were coded as 0, with each sequential follow-up coded in numerical order—admission to rehabilitation as 1; discharge from reha-

Table 2
Percentage of Caregivers Completing Outcome Measures at Each Time Point

Time point	Vitality	Social functioning	Role limitations–emotional	Mental health	Anxiety	Depression
Neurointensive care unit	38.5	40.4	38.5	40.4	40.4	40.4
Rehabilitation admission	92.3	96.2	75.0	92.3	98.1	98.1
Rehabilitation discharge	84.6	88.5	86.5	88.5	84.6	82.7
3 months post-discharge	86.5	88.5	84.6	84.6	69.2	67.3
1 year post-injury	82.7	80.8	80.8	82.7	82.7	82.7

bilitation as 2; 3 months postdischarge as 3; and 1 year postinjury as 4. Because of substantial individual variability in the time intervals between assessments, we coded time with equally spaced integers from 0 to 4. The analyses therefore reflect difference across waves of data collection but do not necessarily reflect actual time spacing between waves.

After each of the six primary HLMs, follow-up HLMs were run to examine whether any of the statistically significant fixed effects in the first models interacted significantly with time in the prediction of the outcome variable, which would indicate that the trajectories of the outcome changed differentially over time as a function of one of the NEO-PI-R personality subscales. As in the first set of analyses, only intercepts were included as random effects in all models, and within-subject residuals were treated as independent. All HLM analyses utilized the maximum-likelihood estimation method and were conducted using SPSS Version 22.0. Variance-explained effect sizes (similar to the R^2 in ordinary least squares regression for within-subject or repeated-measure level) proposed by Snijders and Bosker (1994) were computed for each model. This effect size is commonly reported in research with linear growth models (Snijders & Bosker, 1994).

Results

The sample consisted of caregivers for both TBI and NTBI patients, because both patient groups receive the same treatment and rehabilitation in the unit. No significant differences associated with etiology of the injury were found in relation to caregiver outcomes, and consequently, data were treated as being homogenous. All parameters estimates are unstandardized and should be interpreted within the context of the scale from which the predictor variable is derived.

Vitality

In the first HLM, with vitality as the dependent variable, time was a statistically significant predictor ($b = 5.50$, $SE = .83$, $p < .001$), such that vitality scores improved across all five time points. Neuroticism ($b = -.33$, $SE = .12$, $p = .010$) and conscientiousness ($b = -.40$, $SE = .17$, $p = .020$) were also significant predictors, indicating that caregivers who were less neurotic and less conscientious had higher vitality over time. The total within-variance accounted for by this model was 21.4%.

In order to examine whether any of the statistically significant fixed effects in the first HLM interacted with time in the prediction of the caregivers' vitality trajectories, we ran a follow-up HLM. In this model, neuroticism and conscientiousness, along with time and the interaction terms between time and each variable, were added. None of the interaction terms were statistically significant in the HLM (all $ps \geq .278$), suggesting that the slopes of caregivers' vitality trajectories did not differ as a function of either neuroticism or conscientiousness.

Social Functioning

In the second HLM, with social functioning as the dependent variable, time was statistically significant ($b = 7.66$, $SE = 1.07$, $p < .001$), such that across the five time points social functioning improved. Neuroticism ($b = -.34$, $SE = .15$, $p = .032$) and conscientiousness ($b = -.52$, $SE = .21$, $p = .016$) were also significant predictors, such that participants who were less neurotic and less conscientious had greater social functioning over time. Agreeableness also statistically predicted social functioning ($b = .50$, $SE = .21$, $p = .021$), indicating that caregivers who were more agreeable had greater social functioning over time. The within-variance accounted for by this model was 24.7%.

As before, a follow-up HLM was run in which the fixed effects were neuroticism, conscientiousness, and agreeableness, along with time and the interaction terms between time and each of these variables. None of the interaction terms was statistically significant (all $ps \geq .103$).

Role Limitations–Emotional

In the third HLM, with role limitations–emotional as the dependent variable, time was the only statistically significant predictor ($b = 10.38$, $SE = 1.69$, $p < .001$), such that role limitations due to emotional functioning improved across the five time points. All NEO predictors were nonsignificant (all $ps \geq .067$). The within-variance accounted for by this model was 20.1%.

Mental Health

In the fourth HLM, with mental health as the dependent variable, time was significant ($b = 11.09$, $SE = .87$, $p < .001$), such that mental health scores improved over time. Neuroticism ($b = -.37$, $SE = .09$, $p < .001$) and conscientiousness ($b = -.36$, $SE = .13$, $p = .007$) were also significant predictors, indicating that less neurotic and less conscientious caregivers had better mental health over time. The within-variance accounted for was 50.5% in this model.

A follow-up HLM was run in which the fixed effects were neuroticism and conscientiousness, along with time and the interaction terms between time and each of these variables. None of the interactions was statistically significant (all $ps \geq .146$).

Anxiety

In the fifth HLM, with anxiety as the dependent variable, time was a statistically significant predictor ($b = -2.81$, $SE = .46$, $p < .001$), indicating that anxiety levels decreased across time. Neuroticism was also statistically significant ($b = .11$, $SE = .05$, $p = .034$), such that participants who were more neurotic had greater levels of anxiety over time. All other predictors were nonsignificant (all ps $> .465$). The explained within-variance accounted for by this model was 19.4%.

As before, a follow-up HLM was performed with neuroticism as the fixed effect, along with time and the interaction of both variables The interaction of time with neuroticism was statistically significant ($b = .07$, $SE = .02$, $p < .001$), suggesting that although all individuals decreased in anxiety over time, there was a larger decline in symptoms of anxiety among caregivers with low levels of neuroticism (see Figure 1). This figure and Figure 2 are graphical representations of the model-based predicted values.

Depression

In the sixth HLM, with depression as the dependent variable, time was statistically significant ($b = -1.92$, $SE = .39$, $p < .001$), suggesting that symptoms of depression improved over time. Neuroticism was also a statistically significant predictor ($b = .14$, $SE = .05$, $p = .006$), indicating that caregivers who were more neurotic had greater levels of depression over time. The remaining predictors were not statistically significant (all ps $> .333$). The within-variance accounted for by this model was 14.1%.

Similar to the case in prior analyses, a follow-up HLM was conducted with neuroticism and time as the fixed effects, along with the interaction term of the two. The interaction term was statistically significant ($b = .04$, $SE = .02$, $p = .014$), suggesting that depression improved at a quicker rate over time in caregivers with low levels of neuroticism than in those with high neuroticism (see Figure 2).

Discussion

The purpose of the current study was to construct linear growth models to examine whether personality traits of Danish caregivers of persons with severe brain injury were predictive of caregivers' trajectories of mental HRQoL, anxiety, and depression beginning at patients' stay in a neurointensive care unit through 1 year after injury. All four HRQoL, anxiety, and depression variables improved significantly across the five time points. Caregivers who were less neurotic and less conscientious tended to have higher scores on measures of vitality, social functioning, and mental health over time. Additionally, caregivers with higher agreeableness had higher social functioning. Although the overall sample experienced a decrease in anxiety and depression over time, caregivers with low neuroticism decreased more quickly in both depression and anxiety.

Most research on caregivers within the field of TBI has investigated how patients' different characteristics predict caregivers' emotional state (Anderson et al., 2009; Brooks et al., 1987; Ponsford et al., 2003; Ponsford & Schönberger, 2010), but no research has investigated how caregivers' personality traits are associated with psychological adjustment to their family member's condition. Related research has been performed on coping styles (Calvete & de Arroyabe, 2012; Carnes & Quinn, 2005; Norup, Siert, & Mortensen, 2013) and resilience (Simpson & Jones, 2013) in caregivers, where both constructs have been found to correlate positively with positive affect (Simpson & Jones, 2013) and HRQoL (Norup, Siert, et al., 2013) and negatively with burden (Simpson & Jones, 2013). However, no study has investigated personality traits in TBI caregivers, especially in terms of their longitudinal associations, and thus the results of the current study are novel. Nevertheless, these findings are comparable to research focused on other neurological conditions such as dementia and stroke. Within the field of dementia research, Markiewicz and colleagues (1997) reported that caregivers with higher neuroticism experience more burden and distress, and in concordance with this finding, Gallant and Connell (2003) found that dementia caregivers with high neuroticism showed more negative emotional states and depression. Melo, Maroco, and de Mendonça (2011) also found that high neuroticism was a strong predictor of depression in dementia caregiver, and that, in contrast, extraversion and agreeableness were associated with decreases in both caregiver depression and burden. A similar finding was reported in stroke research, where caregivers with high neuroticism reported higher levels of

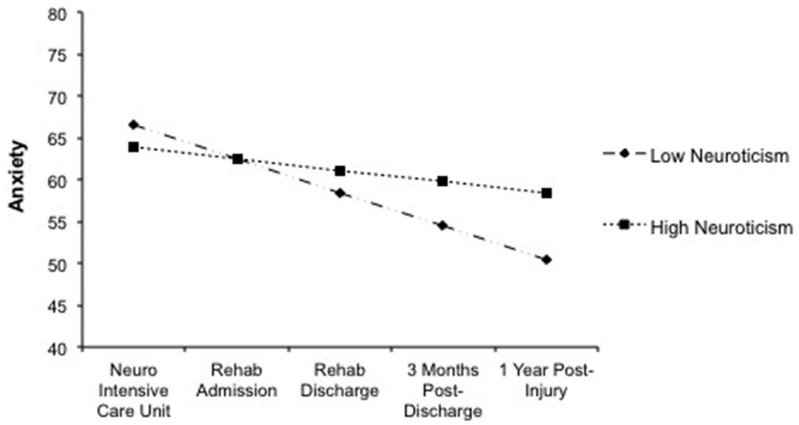

Figure 1. Trajectories of anxiety by caregiver neuroticism. Dichotomization of high vs. low neuroticism was calculated via a split median procedure. Rehab = rehabilitation.

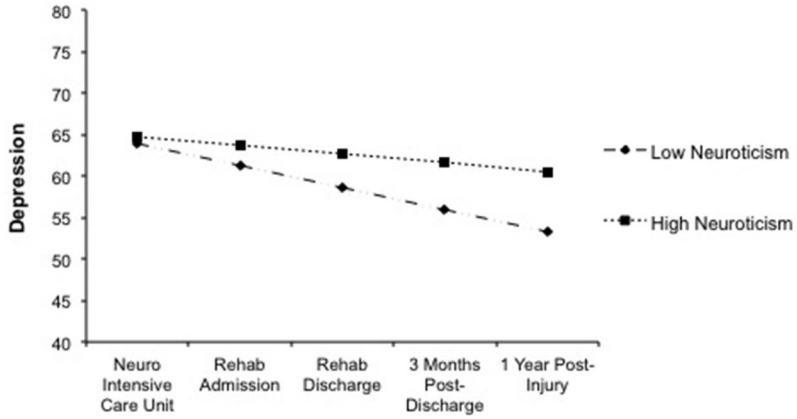

Figure 2. Trajectories of depression by caregiver neuroticism. Dichotomization of high vs. low neuroticism was calculated via a split median procedure. Rehab = rehabilitation.

behavioral and functional impairment in their spouse with dementia and experienced more strain and depressive symptoms relative to caregivers with lower neuroticism or higher mastery scores (Bookwala & Schulz, 1998).

Across different neurological conditions, and especially in the current study, there is evidence of neuroticism being an important personality trait in relation to coping with the adverse demands of a caregiver, with some indication that this trait is an indicator of how the individual experiences negative events. According to McCrae and Costa (2003), individuals high in neuroticism are prone to negative emotions that interfere with their ability to deal with problems. The literature well describes how being a caregiver is a time-consuming and physically and mentally draining task, and it is therefore easily imaginable how an irritable and hostile caregiver can find it hard to adapt to a chronically stressful situation. Caregivers high in neuroticism may also be prone to worry and dwell on what might go wrong (McCrae & Costa, 2003) instead of trying to deal with a distressing and demanding situation. In light of the current findings, neuroticism does seem to be related to how caregivers cope with the demands of brain injury and their own negative emotions. Caregivers high in neuroticism may be at risk of social isolation and depression over time, even as rehabilitation ends and patient impairments become more chronic.

The study also found that caregivers who were less conscientious tended to have higher levels of vitality, social functioning, and mental health over time. The personality trait of conscientiousness is defined by planfulness, organization, and diligence, which theoretically could protect the caregivers from feeling overwhelmed and burdened. One reason for this contrasting finding may be that caregivers who are more conscientious might feel helpless and a lack of control at the beginning of the recovery process, especially if they thrive best with order and planning. Many issues related to the patient are not in the hands of caregivers in the early stages of recovery. Consequently, highly conscientious caregivers may be anxious in anticipation of how to care for the individual with TBI early in the recovery process extending into the first year postinjury, which may lead to poorer well-being.

Despite the novelty of the current findings in the context of brain injury, they are comparable with results from other fields in neurology, with certain personality traits being robust predictors of caregiver outcomes. An important point to consider may be that different personality traits could be more important in different time periods. In the early stages of recovery from the event, characteristics related to the patients' condition are important (Anderson et al., 2009; Brooks et al., 1987; Norup et al., 2012); however, these associations might disappear with time, suggesting that personality traits of caregivers might be especially important later in recovery. Nonetheless, it is important not to view personality traits as an obstacle to providing interventions to families dealing with brain injury. The results of this study underscore the necessity of assessing caregiver personality in an effort to tailor family interventions. Consequently, future intervention programs will benefit from including brief personality measures and possibly an assessment of coping strategies or caregiver style in order to strengthen the adaptation process of caregivers and the rest of the family.

Study Limitations

Limitations of this study must be considered when interpreting the results. The study included caregivers of patients with TBI and NTBI because both patient groups were treated and received rehabilitation in the clinical ward. However, no group differences were found in relation to the six different outcome variables, and consequently data were treated as being homogenous. The single-center design is also a limitation, which warrants caution with respect to generalizing the results. However, because the Clinic of Neurorehabilitation, Traumatic Brain Injury Unit covers the eastern part of Denmark, that fact does expand the representativeness of the sample. Data on caregiver self-reported physical health, which may have had an effect on caregiver mental health and personality, were not assessed at each time point; this would be a ripe area for future research. Additionally, the limited sample size may have affected the power of the analyses and the accuracy of the parameter estimates. Results should therefore be interpreted with an appropriate degree of caution. Finally, caregivers' person-

ality traits were assessed after discharge, and although this approach decreased the potential of acute crisis to interfere with the personality assessment, data collection at this time period could limit the current results' generalizability to personality assessments conducted in a more acute phase of injury.

Conclusion

The results of this study emphasize the importance of including a personality measure when assessing burden and distress in caregivers and, even more important, when planning intervention programs for caregivers. The personality of the caregiver can be viewed as a resource and could be assessed and incorporated when providing interventions. So far, limited research has been conducted on different caregiver intervention programs within the field of ABI. Individualized intervention programs taking into account the acquired brain injury personality of the caregiver might be more beneficial and efficient. Such programs should attempt to hone more adaptive coping strategies in caregivers, which might enhance caregiver outcomes.

References

Anderson, M. I., Simpson, G. K., Morey, P. J., Mok, M. M. C., Gosling, T. J., & Gillett, L. E. (2009). Differential pathways of psychological distress in spouses vs. parents of people with severe traumatic brain injury (TBI): Multi-group analysis. *Brain Injury, 23,* 931–943. http://dx.doi.org/10.3109/02699050903302336

Arango-Lasprilla, J. C., Nicholls, E., Villaseñor Cabrera, T., Drew, A., Jimenez-Maldonado, M., & Martinez-Cortes, M. L. (2011). Health-related quality of life in caregivers of individuals with traumatic brain injury from Guadalajara, Mexico. *Journal of Rehabilitation Medicine, 43,* 983–986. http://dx.doi.org/10.2340/16501977-0883

Benedictus, M. R., Spikman, J. M., & van der Naalt, J. (2010). Cognitive and behavioral impairment in traumatic brain injury related to outcome and return to work. *Archives of Physical Medicine and Rehabilitation, 91,* 1436–1441. http://dx.doi.org/10.1016/j.apmr.2010.06.019

Bjorner, J., Damsgaard, M., Watt, T., & Bech, P. (1997). *Danish manual for SF-36. A health-related questionnaire*. Copenhagen, Denmark: Medif.

Bookwala, J., & Schulz, R. (1998). The role of neuroticism and mastery in spouse caregivers' assessment of and response to a contextual stressor. *Journals of Gerontology: Series B: Psychological Sciences and Social Sciences, 53B*(3), P155–P164. http://dx.doi.org/10.1093/geronb/53B.3.P155

Brooks, N., Campsie, L., Symington, C., Beattie, A., & McKinlay, W. (1987). The effects of severe head injury on patient and relative within seven years of injury. *Journal of Head Trauma Rehabilitation, 2,* 1–13. http://dx.doi.org/10.1097/00001199-198709000-00003

Calvete, E., & de Arroyabe, E. L. (2012). Depression and grief in Spanish family caregivers of people with traumatic brain injury: The roles of social support and coping. *Brain Injury, 26,* 834–843. http://dx.doi.org/10.3109/02699052.2012.655363

Carnes, S. L., & Quinn, W. H. (2005). Family adaptation to brain injury: Coping and psychological distress. *Families, Systems, & Health, 23,* 186–203. http://dx.doi.org/10.1037/1091-7527.23.2.186

Costa, P. J., & McCrae, R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Odessa, FL: Psychological Assessment Resources.

Costa, P., & McCrae, R. (2004). *NEO PI-R*. Copenhagen, Denmark: Psykologisk Forlag.

Cunningham, J., Chan, F., & Jones, J. (1999). Brain injury rehabilitation: A primer for case managers. In F. Chan & M. Leahy (Eds.), *Health care and disability case management* (pp. 475–526). Lake Zurich, IL: Vocational Consultants Press.

Derogatis, L. (1994). *Symptom Checklist-90-R (SCL-90-R): Administration, scoring, and procedures manual*. Minneapolis, MN: National Computer Systems.

Doser, K., & Norup, A. (2016). Caregiver burden in Danish family members of patients with severe brain injury: The chronic phase. *Brain Injury, 30,* 334–342. http://dx.doi.org/10.3109/02699052.2015.1114143

European Commission. (n.d.). *The International Initiative for Traumatic Brain Injury Research (InTBIR)*. Retrieved from http://ec.europa.eu/research/health/medical-research/brain-research/international-initiative_en.html

Gallant, M. P., & Connell, C. M. (2003). Neuroticism and depressive symptoms among spouse caregivers: Do health behaviors mediate this relationship? *Psychology and Aging, 18,* 587–592. http://dx.doi.org/10.1037/0882-7974.18.3.587

Gan, C., Campbell, K. A., Gemeinhardt, M., & McFadden, G. T. (2006). Predictors of family system functioning after brain injury. *Brain Injury, 20,* 587–600. http://dx.doi.org/10.1080/02699050600743725

Goldberg, L. R. (1990). An alternative "description of personality": The Big-Five factor structure. *Journal of Personality and Social Psychology, 59,* 1216–1229. http://dx.doi.org/10.1037/0022-3514.59.6.1216

Guilfoyle, M. R., Seeley, H. M., Corteen, E., Harkin, C., Richards, H., Menon, D. K., & Hutchinson, P. J. (2010). Assessing quality of life after traumatic brain injury: Examination of the Short Form 36 health survey. *Journal of Neurotrauma, 27,* 2173–2181. http://dx.doi.org/10.1089/neu.2010.1353

Hollis-Sawyer, L. (2003). Mother-daughter eldercare and changing relationships: A path-analytic investigation of factors underlying positive, adaptive relationships. *Journal of Adult Development, 10,* 41–52. http://dx.doi.org/10.1023/A:1020738804030

Hooker, K., Frazier, L. D., & Monahan, D. J. (1994). Personality and coping among caregivers of spouses with dementia. *Gerontologist, 34,* 386–392. http://dx.doi.org/10.1093/geront/34.3.386

Hooker, K., Monahan, D., Shifren, K., & Hutchinson, C. (1992). Mental and physical health of spouse caregivers: The role of personality. *Psychology and Aging, 7,* 367–375. http://dx.doi.org/10.1037/0882-7974.7.3.367

Kim, Y., Duberstein, P. R., Sörensen, S., & Larson, M. R. (2005). Levels of depressive symptoms in spouses of people with lung cancer: Effects of personality, social support, and caregiving burden. *Psychosomatics: Journal of Consultation and Liaison Psychiatry, 46,* 123–130. http://dx.doi.org/10.1176/appi.psy.46.2.123

Knight, R. G., Devereux, R., & Godfrey, H. P. (1998). Caring for a family member with a traumatic brain injury. *Brain Injury, 12,* 467–481. http://www.ncbi.nlm.nih.gov/pubmed/9638324. http://dx.doi.org/10.1080/026990598122430

Koerner, S. S., & Kenyon, D. B. (2007). Understanding "good days" and "bad days": Emotional and physical reactivity among caregivers for elder relatives. *Family Relations, 56,* 1–11. http://dx.doi.org/10.1111/j.1741-3729.2007.00435.x

Koerner, S. S., Kenyon, D. B., & Shirai, Y. (2009). Caregiving for elder relatives: Which caregivers experience personal benefits/gains? *Archives of Gerontology and Geriatrics, 48,* 238–245. http://dx.doi.org/10.1016/j.archger.2008.01.015

Kreutzer, J. S., Rapport, L. J., Marwitz, J. H., Harrison-Felix, C., Hart, T., Glenn, M., & Hammond, F. (2009). Caregivers' well-being after traumatic brain injury: A multicenter prospective investigation. *Archives of Physical Medicine and Rehabilitation, 90,* 939–946. http://dx.doi.org/10.1016/j.apmr.2009.01.010

Livingston, L. A., Kennedy, R. E., Marwitz, J. H., Arango-Lasprilla, J. C., Rapport, L. J., Bushnik, T., & Gary, K. W. (2010). Predictors of family caregivers' life satisfaction after traumatic brain injury at one and two

years post-injury: A longitudinal multi-center investigation. *NeuroRehabilitation, 27,* 73–81.

Löckenhoff, C. E., Duberstein, P. R., Friedman, B., & Costa, P. T., Jr. (2011). Five-factor personality traits and subjective health among caregivers: The role of caregiver strain and self-efficacy. *Psychology and Aging, 26,* 592–604. http://dx.doi.org/10.1037/a0022209

Lynch, R. (1986). Traumatic brain injury: Implications for rehabilitation counseling. In T. Riggar, D. Maki, & A. Wolf (Eds.), *Applied rehabilitation counseling* (pp. 262–270). New York, NY: Springer.

Malkesman, O., Tucker, L. B., Ozl, J., & McCabe, J. T. (2013). Traumatic brain injury—Modeling neuropsychiatric symptoms in rodents. *Frontiers in Neurology, 4,* 157. http://dx.doi.org/10.3389/fneur.2013.00157

Manskow, U. S., Sigurdardottir, S., Røe, C., Andelic, N., Skandsen, T., Damsgård, E., . . . Anke, A. (2014). Factors Affecting Caregiver Burden 1 Year After Severe Traumatic Brain Injury: A Prospective Nationwide Multicenter Study. *The Journal of Head Trauma Rehabilitation, 30,* 1–13. http://dx.doi.org/10.1097/HTR.0000000000000085

Markiewicz, D., Reis, M., & Gold, D. P. (1997). An exploration of attachment styles and personality traits in caregiving for dementia patients. *International Journal of Aging & Human Development, 45,* 111–132. http://dx.doi.org/10.2190/T4Q4-E8F0-JWT5-DBAG

McClendon, M. J., & Smyth, K. A. (2013). Quality of informal care for persons with dementia: Dimensions and correlates. *Aging & Mental Health, 17,* 1003–1015. http://dx.doi.org/10.1080/13607863.2013.805400

McCrae, R. R., & Costa, P. T., Jr. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology, 52,* 81–90. http://dx.doi.org/10.1037/0022-3514.52.1.81

McCrae, R. R., & Costa, P. T., Jr. (2003). *Personality in adulthood: A five-factor theory perspective* (2nd ed.). New York, NY: Guilford Press. http://dx.doi.org/10.4324/9780203428412

McPherson, K. M., Pentland, B., & McNaughton, H. K. (2000). Brain injury—The perceived health of carers. *Disability and Rehabilitation, 22,* 683–689. http://dx.doi.org/10.1080/096382800445489

Melo, G., Maroco, J., & de Mendonça, A. (2011). Influence of personality on caregiver's burden, depression and distress related to the BPSD. *International Journal of Geriatric Psychiatry, 26,* 1275–1282. http://dx.doi.org/10.1002/gps.2677

Nonterah, C. W., Jensen, B. J., Perrin, P. B., Stevens, L. F., Cabrera, T. V., Jiménez-Maldonado, M., & Arango-Lasprilla, J. C. (2013). The influence of TBI impairments on family caregiver mental health in Mexico. *Brain Injury, 27,* 1287–1293. http://dx.doi.org/10.3109/02699052.2013.812243

Norup, A., Kristensen, K. S., Poulsen, I., Nielsen, C. L., & Mortensen, E. L. (2013). Clinically significant changes in the emotional condition of relatives of patients with severe traumatic brain injury during sub-acute rehabilitation. *Journal of Rehabilitation Medicine, 45,* 820–826. http://dx.doi.org/10.2340/16501977-1190

Norup, A., Petersen, J., & Mortensen, E. L. (2015). Relatives of patients with severe brain injury: Growth curve analysis of anxiety and depression the first year after injury. *Brain Injury, 29,* 822–829. http://dx.doi.org/10.3109/02699052.2015.1016451

Norup, A., Siert, L., & Mortensen, E. L. (2010). Emotional distress and quality of life in relatives of patients with severe brain injury: The first month after injury. *Brain Injury, 24,* 81–88. http://dx.doi.org/10.3109/02699050903508200

Norup, A., Siert, L., & Mortensen, E. L. (2013). Coping strategies, emotional distress and quality of life in relatives of patients with severe brain injury in Denmark: One year after injury. *Australian Journal of Rehabilitation Counselling, 19,* 142–154. http://dx.doi.org/10.1017/jrc.2013.17

Norup, A., Snipes, D. J., Siert, L., Mortensen, E. L., Perrin, P. B., & Arango-Lasprilla, J. C. (2013). Longitudinal trajectories of health related quality of life in Danish family members of individuals with severe brain injury. *Australian Journal of Rehabilitation Counselling, 19,* 71–83. http://dx.doi.org/10.1017/jrc.2013.12

Norup, A., Welling, K.-L., Qvist, J., Siert, L., & Mortensen, E. L. (2012). Depression, anxiety and quality-of-life among relatives of patients with severe brain injury: The acute phase. *Brain Injury, 26,* 1192–1200. http://dx.doi.org/10.3109/02699052.2012.672790

Olsen, L. R., Mortensen, E. L., & Bech, P. (2006). Mental distress in the Danish general population. *Acta Psychiatrica Scandinavica, 113,* 477–484. http://dx.doi.org/10.1111/j.1600-0447.2005.00743.x

Perrin, P. B., Stevens, L. F., Villaseñor Cabrera, T., Jimenez-Maldonado, M., Martinez-Cortes, M. L., & Arango-Lasprilla, J. C. (2013). Just how bad is it? Comparison of the mental health of Mexican traumatic brain injury caregivers to age-matched healthy controls. *NeuroRehabilitation, 32,* 679–686.

Ponsford, J., Olver, J., Ponsford, M., & Nelms, R. (2003). Long-term adjustment of families following traumatic brain injury where comprehensive rehabilitation has been provided. *Brain Injury, 17,* 453–468. http://dx.doi.org/10.1080/0269905031000070143

Ponsford, J., & Schönberger, M. (2010). Family functioning and emotional state two and five years after traumatic brain injury. *Journal of the International Neuropsychological Society, 16,* 306–317. http://dx.doi.org/10.1017/S1355617709991342

Simpson, G., & Jones, K. (2013). How important is resilience among family members supporting relatives with traumatic brain injury or spinal cord injury? *Clinical Rehabilitation, 27,* 367–377. http://dx.doi.org/10.1177/0269215512457961

Sinnakaruppan, I., & Williams, D. M. (2001). Family carers and the adult head-injured: A critical review of carers' needs. *Brain Injury, 15,* 653–672. http://dx.doi.org/10.1080/02699050010025759

Snijders, T. A., & Bosker, R. J. (1994). Modeled variance in two-level models. *Sociological Methods & Research, 22,* 342–363. http://dx.doi.org/10.1177/0049124194022003004

Stevens, L. F., Perrin, P. B., Gulin, S., Rogers, H. L., Villaseñor Cabrera, T., Jiménez-Maldonado, M., & Arango-Lasprilla, J. C. (2013). Examining the influence of three types of social support on the mental health of Mexican caregivers of individuals with traumatic brain injury. *American Journal of Physical Medicine & Rehabilitation, 92,* 959–967. http://dx.doi.org/10.1097/PHM.0b013e31828cd549

Stewart, A., & Ware, J. (1992). *Measuring functioning and well-being: The medical outcomes study approach*. Durham, NC: Duke University Press.

Teasdale & Jennett, B. (1974, July 13). Assessment of coma and impaired consciousness. A practical scale. *Lancet, 2,* 81–83.

Vangel, S. J., Jr., Rapport, L. J., & Hanks, R. A. (2011). Effects of family and caregiver psychosocial functioning on outcomes in persons with traumatic brain injury. *Journal of Head Trauma Rehabilitation, 26,* 20–29. http://dx.doi.org/10.1097/HTR.0b013e318204a70d

Wittchen, H. U., Jacobi, F., Rehm, J., Gustavsson, A., Svensson, M., Jönsson, B., . . . Steinhausen, H. C. (2011). The size and burden of mental disorders and other disorders of the brain in Europe 2010. *European Neuropsychopharmacology, 21,* 655–679. http://dx.doi.org/10.1016/j.euroneuro.2011.07.018

Received July 1, 2015
Revision received July 6, 2016
Accepted September 5, 2016 ■