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Affective and Cognitive Correlates of Interpersonal Dependency in Neurologic Populations

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AFFECTIVE AND COGNITIVE CORRELATES OF INTERPERSONAL DEPENDENCY IN NEUROLOGIC POPULATIONS

by

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All requirements for graduation with Honors in the
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Abstract

This project investigates the relationships between some of the interpersonal traits and neuropsychological functions which are observed to deviate following a brain insult, with a focus on patients with temporal lobe epilepsy. More specifically, this study investigated the associations of interpersonal dependency with anxiety, depression, and executive function (due to their documented relationship to the temporal lobe and their subservience as simple, direct measures of quality of life) following assorted brain insults. Results displayed strong associations and comorbidity between these traits, yet no strong predictive or causal evidence, leading us to reaffirm the concept of the Temporolimbic Personality, as described in separate studies by Aycicegi-Dinn and Trimble, which suggests that these traits coexist in a psychopathologic web of symptoms. Results also showed the efficacy of the temporal lobectomy in curtailing the progressive deterioration of function within these behavioral domains. Within the context of clinical neuropsychological populations, this study provided strong evidence of relationships between these characteristics. Thus, we suggest that interpersonal dependency should be studied as an area of focus in therapy and interventions to improve the quality of life of neurologic populations.

Keywords: epilepsy, interpersonal dependency, anxiety, depression, executive function

Introduction:

Brain insults often result in an inconsistent array of behavioral changes between patients. Multiple factors, including the type, severity, localization, and duration of the injury, as well as the use of interventions can impact the behavioral changes observed following the onset of a brain insult. Due to the breadth of possible behavioral changes following such onsets, many behavioral domains, such as interpersonal dependency, have not yet been given the attention they deserve from the medical community for their effects on wellbeing and relation to dysfunctions in other behavioral domains. In this paper, we examine the effects that various brain disorders take on the psychosocial wellbeing and cognitive ability of neurologic patients, how these traits relate to each other following brain insult, and the effectiveness of surgical intervention in the remedy of these behavioral changes.

Due to the nature and prognosis of many neurological disorders as being difficult to treat and remit, the quality of life of the patient often becomes of utmost importance, not only to the patient, but also their families and clinicians when discussing treatment options. Because coping with cognitive and emotional states that may not be improvable due to brain damage is an extremely challenging task to endure, making life as enjoyable and manageable for patients in these circumstances should be a top priority of clinicians. One of the most simple and straightforward methods of proxying the quality of life of patients is to investigate their affective state. While this is not to say that measures of depression and anxiety should serve as measurements of quality of life, they are highly related and take a substantial toll on the quality of life of the patient (Boylan et al., 2004). In fact, across multiple clinical populations, they are seen to be strong predictors of quality of life (Huppert et al., 2001, Amato et al., 2001). While they may only capture the emotional and psychological aspects of a patient's quality of life, understanding the long-lasting emotional state of a patient can provide much explanation into how and why they view their lives negatively, thus creating an opportunity to alleviate this burden. Because of the frequency and obvious clinical significance of anxiety, depression, and executive deficits within neurologic populations, regardless of lesion type and location (Barrash et al., 2000, Jorge et al., 2004), they should be a primary clinical target in cases of intractable neurologic illness.

Executive functions are a collection of mental processes necessary for the effective control of behaviors involving attention and thought processes. Three foundations of this construct include inhibition, working memory, and cognitive control (Diamond, 2013). Executive functions are collectively used in self-management and goal-directed behaviors, making them crucial to everyday life. While this is more of a cognitive rather than emotional concept, deficits can make daily life an extreme struggle, leading to dissatisfaction with one's quality of life, due to frustration and disappointment with oneself and the mood changes caused by the loss of basic motivations. While executive dysfunction is largely associated with the frontal lobe, studies have shown that brain insults affecting other regions, including Temporal Lobe Epilepsy, can cause these deficits as well (Hermann & Seidenberg, 1995). In this study, executive deficits are defined as the collection of one's *lack of planning, perseverativeness, lack of initiative, lack of persistence, impulsivity, poor judgment,* and *indecisiveness,* which is how the concept is constructed within the Iowa Scales of Personality Change (Barrash et al., 1997).

Patients suffering from executive deficits often struggle to gain insight into their problems and are often left frustrated, exhausted, misunderstood, and isolated due to their condition. Therefore, it is unsurprising that individuals with acquired executive dysfunctions also often suffer changes to their quality of life (Sherman et al., 2006, Ness et al., 2008), due to their restricted ability to handle everyday tasks and its repercussions on self-image. Because executive deficits harm quality of life in a manner which is qualitatively different than emotional disturbances, patients struggling with both are of significant risk to declines in their quality of life. In a study examining the executive and psychosocial changes spurred by traumatic brain injuries, Rochat and colleagues (2009) found that internalizing changes, such as depression, anxiety, and social withdrawal are associated with executive deficits. meaning that these detriments often are observed as a collection of symptoms in neurologic populations. This is not to say that they cause each other, but that they are often comorbid. Moreover, the indirect, psychosocial effects of brain injuries, such as the changes to an individual's relationships, self-image, and daily lives can exacerbate these changes and produce additional problems.

The consequences of brain damage can be explicitly observed in at least two ways. Damage to neural tissue can lead to immediate and long-lasting changes in the control and expression of affect and emotion. This change is most commonly observed in patients with

injuries to the limbic system and the cortical areas associated with emotional regulation (Macchi, 1989). Also, damage to areas serving visuospatial and language processing as well as executive functions can affect the cognitive processes of which some components of personality are dependent. Consequently, these changes harm the understanding of the emotions of oneself and others, making it difficult for patients to both convey and understand the feelings of themselves and others. Changes in executive functions, such as decision-making ability and motivational forces, in accordance with affective changes in the production and maintenance of moods create the perfect storm for the development of mental illnesses such as depression. For instance, repeated failures on various tasks which could have been completed prior to injury may lead patients to feel anxious or depressed. They may become hopeless or apathetic solely on the basis of the psychosocial consequences of their brain injury (Prigatano, Pepping, and Klonoff, 1986), worsening their presented scores on executive measures and creating a circular problem of failures leading to affective problems. Because affective and executive changes are the two most explicit behavioral changes following brain insults, it would be logical to coordinate treatments which target these constructs together when dealing with neurologic populations. However, due to the proverbial distance between the constructs, bridging this gap is easier said than done.

As mentioned previously, due the enormous amount of behavioral changes that are observed following brain insults, not all have been studied adequately, both in their deviances and as targets of therapeutic behavioral rehabilitation. Interpersonal dependency is one such trait that is often seen to change following brain insults, leading to pronounced differences in the relationships and perceived abilities of patients. The Iowa Scales of Personality Change (ISPC), used to assess and quantify dependency in this study, defines its measure of dependence as the extent to which one relies on those around them to take care of them, make them feel better, and do things for them that they are capable of doing for themselves (Barrash, 1997). While at first glance, a trait such as this may not deserve significant clinical interest, dependency is an excellent predictor of the quality of life of not only the patient, but also their families and caregivers (Nabors et al., 2002). As these patients become more reliant on those around them for emotional support and assistance, their self-image worsens, increasing their risk for mood disorders while increasing the frustration and burdens placed on their caretakers (Lezak, 1988).

The consequences of this increased need for feelings of connection, safety, and attachment are clear: because they cannot be intrinsically fulfilled as they were before, patients turn towards those closest to them to make them feel better, which creates frustration within both parties. Over time, these needs may not be able to be repeatedly met, resulting in feelings of isolation, hopelessness, and despair for the patient, while their families and spouses will also feel hopeless and beyond their wits in their continuous attempt to assist their loved one. Interpersonal dependence, in psychiatric populations, has been associated with behavioral problems such as depression and anxiety, as well as deficits in executive functions (Aycicegi-Dinn et al., 2008). In this study, we first examine the relationship of interpersonal dependency with anxiety, depression, and executive function in a general neurologic sample, in attempt to highlight the clinical importance of this trait, and then address the effectiveness of surgical interventions in curtailing the deterioration of these symptoms.

Patients with temporal lobe epilepsy are often treated for a specific constellation of symptoms, with interpersonal dependency being a key characteristic of the behavioral changes observed in this disorder (Bear & Fedio, 1977). While this result is consistent with prior literature regarding brain injuries and disorders in general, this population stood above the rest in terms of their increased dependency. While not conclusive, research has suggested that the collection of symptoms seen in TLE, often called the Temporolimbic Personality, is due to hyperactivity within the mesial temporal lobe causing behavioral change, even within the absence of a neurological disease. When disorders causing hyperactivity, such as TLE, are accounted for, these changes are more pronounced (Aycicegi-Dinn et al., 2008). Because of this, a sample of temporal lobe epileptics was used as our population of interest within this study, both as part of our general sample which is used to observe the relationships between behavioral traits, and as the focus group when investigating the behavioral effects of the temporal lobectomy on the progression of behavioral changes following the onset of the disorder.

This study evaluates the relationships between interpersonal dependency and anxiety, depression, and executive function within neurologic populations, for the purpose of gaining information on the clinical significance of interpersonal dependency as it relates to traits pertinent to quality of life and daily functioning. With this information, we hope to form a testable theory on the remission of these traits via surgical and therapeutic interventions geared

toward promoting independent behavior and self-sustenance, modeled after CBT for Excessive Interpersonal Dependency (Overholser & Fine, 1994).

Methods

General Methods:

Participants:

207 individuals within the clinical populations used in this study (patients with brain tumors, ischemic and hemorrhagic strokes, temporal lobe epilepsy, anoxia, herpes simplex encephalitis, or a traumatic brain injury) with complete ISPC data were tentatively included into the study population. Further inclusion criteria consisted of an age of 18 years, a disorder duration of three months, and IQ scores reflective of normal functioning, which were met by all participants. Individuals were only excluded from this sample due to invalid ISPC results, such as exaggerated or severely underestimated scores which were identified using control scales.

Procedures:

All data in this study was obtained via the Neurology Division of the University of Iowa Hospitals and Clinics' Lesion Patient Registry. As part of The University of Iowa's ongoing research database all clinical information used in this study had been previously obtained and documented for prior studies. All participants provided informed consent when joining this program. No IRB approval was needed due to the reuse of patient data which had already been collected and entered into the database for this purpose.

Materials:

The ISPC is a psychometric scale developed in 1997 at the University of Iowa by Joseph Barrash and colleagues. The ISPC is used to provide ratings of the behavioral, social, and affective changes that occur after the onset of a brain lesion or disorder. The test is typically administered to a spouse or close relative of the patient, who is able to see the behavioral changes that may occur following insults of the brain. The ISPC provides twenty-six clinical scales to address differences in personality, as well as four control scales to detect biases in reporting. With the data provided by the ISPC, clinicians and researchers can observe both the severity of differences, as well as the degree of change from the patient's premorbid state. This distinction is crucial, as it annotates the detriment caused by the onset of the brain injury, rather than only the current level of functioning, as done by other tests, which does not account for premorbid personality.

The reliability and validity of the Iowa Rating Scales of Personality Change (an earlier version of the ISPC) were measured in 1997 (Barrash et al., 1997) and delivered very strong results: interrater reliability for each of its scales were between .80-.96, and chance-corrected agreement (CCA) was analyzed with Kappa, with a mean for all scales at .48; a fair CCA score.

Concurrent Validity was examined for 9 dimensions of the ISPC, which found an average Spearman correlation of .55, in which 8 of the 9 categories were significant at the 0.01 level. Previous studies have also supported the construct validity of the ISPC by its sensitivity to expected group differences and the specificity of the group differences (Barrash et al 2018).

Statistical analyses in this report were accomplished using SPSS and RStudio. SPSS Statistics is a software package developed by IBM used for interactive statistical analyses (IBM 2017). RStudio is an open-source integrated development environment for the programming language R (R Team, 2016). In this paper, these programs were used to conduct descriptive statistics, bivariate statistics including regression, t-tests, and chi-square tests, and the assembly of charts and figures representative of the data.

Variables:

The control variables used in this study included age, sex, years of education, IQ, and disorder duration. Treatment groups differed significantly only in their gender distribution. In each experiment within this study, the independent variable involved patients' interpersonal dependency ratings on the ISPC. The dependent variables of the study were anxiety, depression, and executive function ratings. Ratings on the ISPC in each domain were given by close relatives (spouses, siblings, children, or parents) of subjects. Within each experiment, these variables were manipulated differently, which will be explained individually at later points.

Experiment 1

Groups:

For each of the three experiments within this study, the sample of participants were divided into different groups which were then analyzed and compared. For Experiment 1, subjects remained in one large group which served to define the relationship of these traits in a general neurological population, allowing results to be more broadly generalizable.

Variables:

In the first experiment, patients' current ISPC Dependency ratings (DEP-N) served as a predictor for their present Anxiety (ANX-N), Depression (DPRSN-N), and Executive Function (DM-N).

Aims:

The purpose of Experiment 1 was to analyze the general relationships of dependency with anxiety, depression, and executive functions. The hypothesis of Experiment 1 is that there is a linear relationship between dependency and executive function, anxiety, and depression, in which increases in dependency are associated with increases in anxiety and depression and decreases in executive functioning. The general relationships between dependency and anxiety, depression, and executive function in neurological populations were examined using a linear

regression. To falsify this hypothesis, the results of the experiment needed to report nonsignificant regression equations for each of the variables, while a significant regression equation with meaningful effect sizes would lead us to support the hypothesis.

Table 1: Participant Demographics

	Mean	SD
Age	53.867	13.914
Education	13.810	2.373
FSIQ	100.320	13.774
Duration	60.580	73.437
Age of Onset	48.836	14.670
Years Known Scorer	33.670	14.302
N = 55 for FSIQ, else 208		

Table 2: Descriptive Statistics

	Mean	SD
DEP.B	2.4	1.27
DEP.N	3.38	1.632
EF. B	18.06	6.331
EF. N	25.46	8.793
DPRSN.B	2.59	1.356
DPRSN.N	3.52	1.464
ANX.B	2.94	1.453
ANX.N	3.75	1.644
N = 208		

Results and Discussion:

Basic demographic and clinical characteristics of the participants in this study are presented in Table 1. In addition, 114 of our 208 participants were male while 94 were female. Mean values of the target variables within the study are also provided in Table 2. Participants were within the range of normal functioning as a group within these domains prior to onset, but fringed on clinical significance in each category following their brain insults.

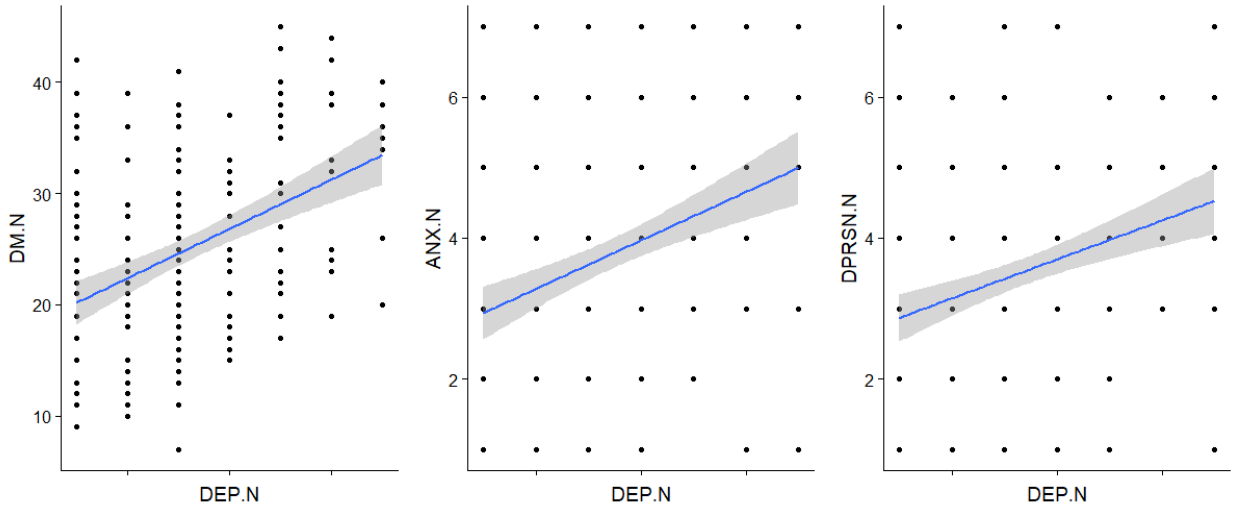
The initial step in analysis was the evaluation of the overall relationship of interpersonal dependency with anxiety, depression, and executive functions. The results of Hypothesis 1, which stated that Dependency is a significant predictor of levels of Anxiety, Depression, and Executive Function, were observed using a linear regression model. Effect sizes were then calculated using Cohen's *f*, which allows for the evaluation of local effect sizes within regression models.

A simple linear regression was calculated to predict present anxiety, depression, and executive functioning based on present dependency. A significant regression equation was found for each. Results for Experiment 1 are presented in Table 3 and Figure 1. Results indicated that there are relationships between each of the three pairs of traits. Coefficients provided certainty that there is a trend between these variables; as dependency increases (gets worse), so does depression, anxiety, and executive function. It must be addressed that the adjusted R^2 values from these models were less than ideal. While more causal inference between these variables would've provided better supporting evidence of the hypothesis, it would be naïve to assume that a significant proportion of the variability in any personality trait could be subject to the levels of other traits. Regardless, these results present a simple, yet strong argument for the strength of associations between these characteristics in clinical populations. Moreover, with only one predictor variable in the model, this becomes even less likely. In addition, the f^2 values calculated from their respective R^2 values indicated a large effect on executive function, a near-medium effect on anxiety, and a small, yet acceptable effect on depression, according to Cohen (1998).

The results from Experiment 1 supported the hypothesis that there is a relationship between dependency with anxiety, executive function, and depression in neurologic populations. After establishing that there is a conceptual relationship between these variables, attention was then shifted toward the potential pragmatic relationship between these variables; more specifically, whether or not there is a co-occurrence of high levels of these traits within clinical populations.

Table 3: Results of the Linear Regression Analyses

Model	**t**	**p**	**β**	**F**	**df**	**p**	**Adj. R^2**	***f*²**
Anxiety	5.407	<.001	0.358	29.232	200	<.001	0.128	0.147
Executive Function	8.899	<.001	0.527	79.198	207	<.001	0.278	0.385
Depression	4.697	<.001	0.316	22.06	200	<.001	0.1	0.111



Experiment 2

Groups and Variables:

In Experiment 2, subjects were divided into groups via a high/low split of ISPC ratings. Individuals with a rating of 4-7 were included into the clinically relevant score group, while individuals with a rating of 1-3 were placed into the normally functioning group for each trait. This method of assignment was used for all four of the ISPC variables, which allowed for a crosstabulation of the subgroups, which was used to conduct a chi-square test for independence to analyze the comorbidity of disturbances within these domains.

Aims:

The purpose of Experiment 2 was to attempt to further accentuate the associations between these traits within clinical populations. The hypothesis for Experiment 2 stated that clinically elevated (ISPC rating of 4) or higher in dependency scores are associated with clinically impaired depression, anxiety, and executive functioning scores. Simply put, it was

hypothesized that the expected number of individuals reported to be either high or low in both traits within each test to be large, while the number of individuals with (for example) high dependency and low anxiety to be low. The associations between these variables were measured using a Chi-Square test for independence, which would hypothetically conclude that improper functioning in these traits are in some way comorbid. To reject this hypothesis, results needed to show a nonsignificant Chi value. To support the hypothesis, results needed to display significant Chi values and strong phi values.

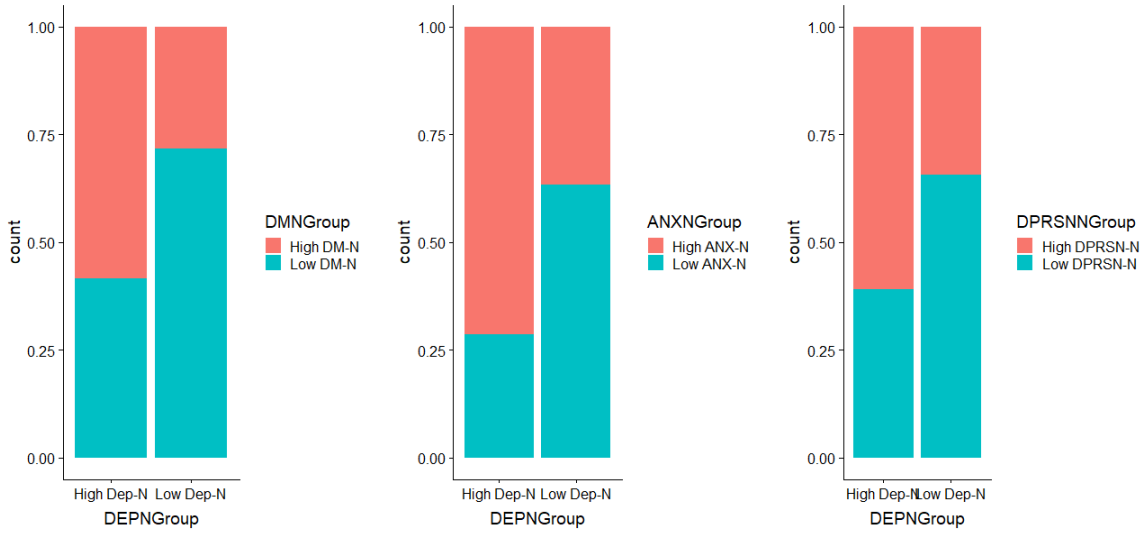
Results and Discussion:

The next step in analysis was to examine the relationship of these traits on the individual level. To do this, a Chi-square test was used to show that these traits are not independent of each other and that elevated scores in dependency are associated with elevated scores in the other areas. For each trait, a significant relationship was found, as displayed in Table 4.

Table 4: Results of the Chi-Square test for Independence

Model	X^2	Cramer's V	Phi
Anxiety	22.11***	0.336	0.336
Executive Function	17.27***	0.298	0.298
Depression	12.94***	0.259	0.259
*N = 208, *** p < 0.001*			

The relationships were evaluated using both Chi and phi values, in order to test for observed differences in the disbursement of the samples as well as strength of correlations between the high and low groups of each characteristic. As displayed in Figure 2 below, the results indicated a moderately strong relationship between high OR low levels across these traits. Thus, the hypothesis was supported that these traits are interconnected and that clinically relevant levels of anxiety, executive function, and depression are more likely to be observed in patients with clinically relevant dependency.



In summary, these results indicated not only strong correlations between the variables (to further validate the strength of the relationship which was questioned in hypothesis 1), but also provided strong evidence for these traits functioning homogenously. The disproportionate number of individuals who were categorized as high or low on both traits, in comparison to those who suffered high dependency but low anxiety, depression, and executive functioning affirms this idea

Experiment 3

Groups:

For Experiment 3, patients with epilepsy were compared against all other patients from our sample (those with brain tumors, hemorrhagic or ischemic strokes, TBIs, anoxia, or HSE), effectively making diagnosis the variable of interest. Individuals with Temporal Lobe Epilepsy were the primary focus of this experiment, with the goal to observe the effects of the removal of the amygdala and temporal pole on mood and executive functions (if they improve after the diseased tissue is removed). This is possible because while the comparison group's ISPC measures were pre-and-post- disorder onset, the TLE group's data was pre-and-post temporal lobectomy surgery, to subdue their seizures and other symptoms. Therefore, for the sake of TLE patients, the ISPC served as a proxy for behavioral improvements following surgery. Individuals with other neurological disorders provided a means of comparison for the behavioral effects of the temporal lobectomy against individuals without interventions which manipulate tissue associated with social and behavioral functions. This provided an opportunity to observe the potential behavioral benefits of surgeries which remove localized brain tissue whose hyperactivity causes behavioral changes (de Oliveira et al, 2012).

Variables:

For the last hypothesis, both the past and present (i.e. DEP-B and DEP-N) ISPC ratings for the two groups were measured on each trait, to search for significant differences over time within each group. These differences were then converted to change scores (i.e. DEP-C), which were then used for further analyses.

Aims:

The purpose of Experiment 3 was to gain insight into the effectiveness of the Temporal Lobectomy surgery's alleviation of behavioral and personality problems. To do this, t-tests were run to compare subjects' changes over time in each of the four behavioral domains of the ISPC already mentioned, and then followed up with additional between-groups comparisons to search for a significant difference in postoperative behavioral changes.

Pre- and post- ISPC scores for each group were examined using within-subjects t-tests to identify significant differences in personality traits over time in each group. For the TLE group, these scores signified their behavioral differences from before their surgical interventions to after it, meaning that scores were expected to stagnate or potentially show improvement. For the

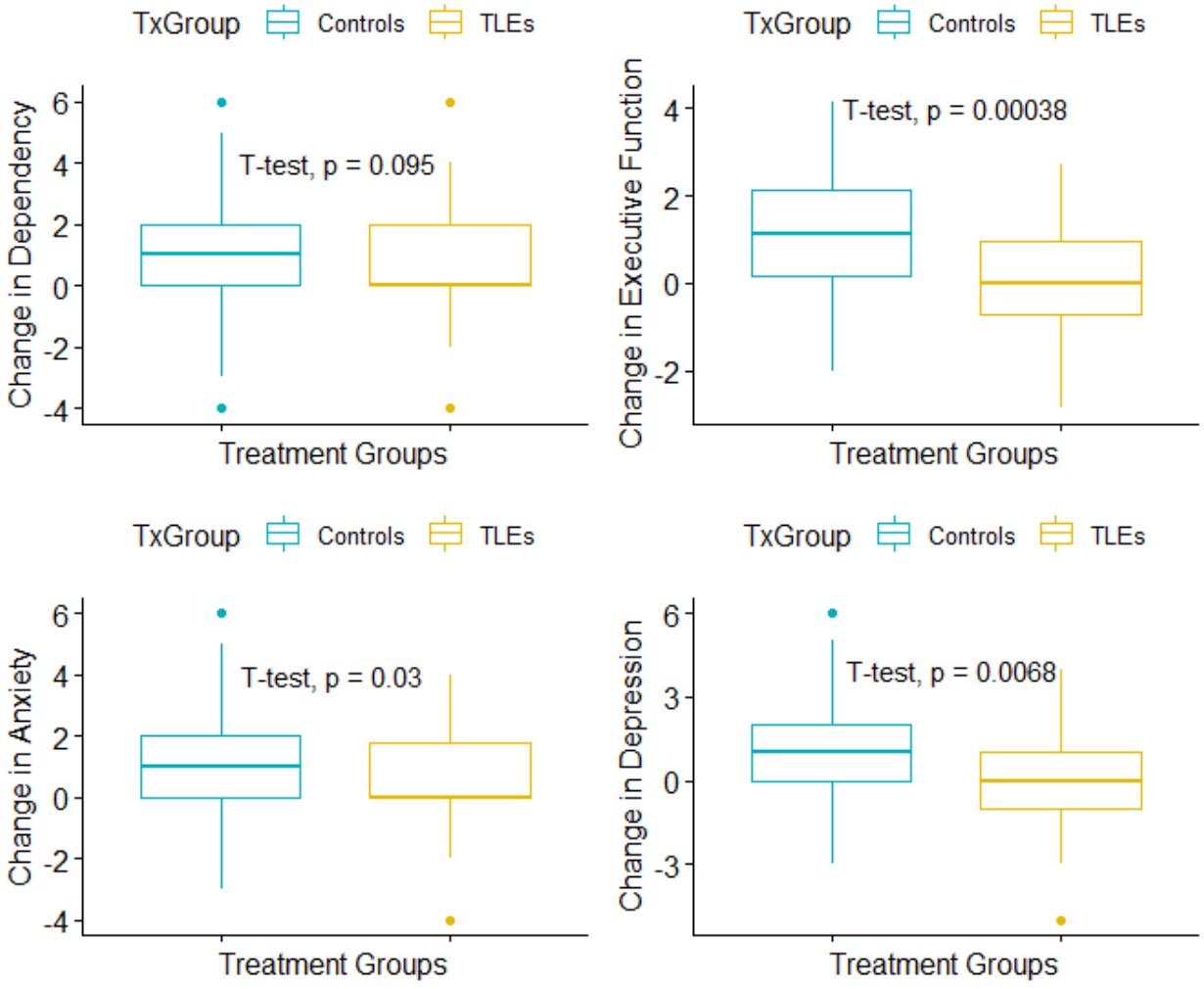
comparison group, this meant their normal functioning before their disorder was compared to their changed behaviors after the onset of said disorder. The hypothesis for this experiment was a two-step process, with the second being contingent on the success of the first. The hypothesis stated that corrective interventions moderate the relationships of dependency with anxiety, depression, and executive functions in such a way that the TLE group would not show significant differences in their pre/post scores (Post score – Pre score), but that the comparison group would. Then, when compared against each other, there would be a significant difference between the two groups, meaning that the surgery was at best an effective form of behavioral modification and at worst a means of preventing further personality deviance. More simply explained, it was hypothesized that the change scores in each domain to be significantly greater in the comparison group, for two reasons. First, as displayed in Table 5, patients with TLE had much higher ISPC ratings at T1 because these ratings display their scores after the onset of their brain disorder, but before their corrective surgery; the comparison group, however, were scored here in regard to their premorbid state. Thus, after the onset of their disorders, it would be expected that their T2 ISPC ratings would be more comparable to the original T1 ratings of the patients with temporal lobe epilepsy. In addition, because increased brain activity in the temporal lobe is specifically associated with increased dependency (Aycicegi-Dinn et al., 2008), the resolution of this physiological problem may coincide with the resolution of its associated behavioral problems. For patients whose brain insults are not localized to behaviorally-implicated regions like the temporal pole and amygdala (yet displayed a decrease in these abilities following onset), it was expected that any surgical interventions they had would not contain this additional benefit. Therefore, we expected no significant differences over time for the TLE group, but significant changes for the comparison group, and that there would be a significant difference in their change scores within each domain.

If at any point in the analyses the TLE group had a significant difference over time, the hypothesis would be rejected. For the comparison group, nonsignificant pre/post test differences would cause a rejection of the hypothesis. If the between-subjects t-test of change scores resulted in nonsignificant differences, the hypothesis would again be unsupported. However, if these three points return positively, then the hypothesis can be supported.

Results and Discussion:

Table 6: Descriptive Statistics							
TxGroup	**Trait**	**Mean**	**SD**	**TxGroup**	**Trait**	**Mean**	**SD**
1, n = 30	DEP.B	2.87	1.548	2, n = 178	DEP.B	2.32	1.204
	DEP.N	3.3	1.601		DEP.N	3.39	1.641
	ANX.B	3.47	1.795		ANX.B	2.85	1.374
	ANX.N	3.57	1.455		ANX.N	3.79	1.675
	DM.B	22.4	7.802		DM.B	17.33	5.76
	DM.N	23.3	8.445		DM.N	25.82	8.822
	DPRSN.B	3.4	1.38		DPRSN.B	2.45	1.306
	DPRSN.N	3.43	1.431		DPRSN.N	3.54	1.473

The final step in this process was to analyze the differences over time in these traits for the target populations, and then to compare their results between groups based off diagnostic groups. Group means for each trait can be seen in Table 6, and t-test results for each group's difference scores can be observed in Figure 3. Results from Experiment 3 indicated that there were no significant differences in dependency, anxiety, depression, or executive functions following surgical intervention for patients with temporal lobe epilepsy, but that the comparison group did experience significant changes to each variable. Therefore, the first half of Hypothesis 3 was fully supported—our control group, with no direct intervention, did see their symptoms worsen over time. Meanwhile, the temporal lobectomy did prevent symptoms from worsening in the TLE group. While this group would ideally have seen a remission of their morbid symptoms, the fact that the surgery alone, without behavioral intervention, can stagnate neurologic behavioral changes is reason enough to be optimistic for outcomes including both behavioral and surgical intervention.



To complete the analyses, we compared subjects' change scores within each behavioral domain. Significant differences were observed between the groups in their anxiety, executive function, and depression ratings (meaning that the controls conditions worsened significantly more), but not dependency. It was suspected that this may have been due the already heightened dependency scores in the epileptic population. Moreover, the control group, whose brain insults did not affect the temporal pole and amygdala, would not be expected to have as great of changes to this behavioral domain.

General Discussion

The purpose of this study was to gain information on the dynamics of personality changes following the onset of various brain disorders. In the first and second experiments within our study, it was found that interpersonal dependency, a personality trait which is known to be elevated in neurologic populations, especially patients with temporal lobe epilepsy, is related to levels of anxiety, depression, and executive function. The final experiment within this study displayed that the temporal lobectomy was effective in preventing further progression of behavioral changes following the onset of temporal lobe epilepsy. These patients observed no significant differences to their scores following the intervention and scored significantly lower post-operatively than patients without this intervention.

The most important takeaway from the first two experiments was that interpersonal dependency is critically relevant to the assessment of patients' quality of life due to its ties with anxiety, depression, and executive functions. The final experiment highlighted the importance of the temporal lobectomy as a method of the tempering of behavioral changes in addition to its obvious purpose in the prevention of seizures in TLE patients. This creates hope not only for the wellbeing of the individual with temporal lobe epilepsy, but for their loved ones as well. While executive functions and some behavioral traits may not stress relationships, it is expected that chronic dependency and depression due to neurological disorders will.

These findings are in accordance with those of Rochat and colleagues, who identified conceptual relationships between interpersonal dependency and anxiety and depression, as well as Aycicegi-Dinn, who observed poor scores on many aspects of executive function in patients rated highly in interpersonal dependency.

In summation, this experiment displayed further evidence that interpersonal dependency, anxiety, depression, and executive functions are liable to worsen following brain insult. Moreover, these changes appear to occur together, although the common denominator which causes these changes has yet to be identified. When patients with TLE underwent surgeries to stop epileptiform discharges within their temporal lobe, they saw no further significant changes in the subsidence of their interpersonal dependency, anxiety, depression, or executive deficits and saw significantly less change than controls. These results together provide evidence that these traits may be able to be remitted by a combination of the surgery and proper therapeutic treatment.

As do all, this study had its share of limitations. First, the use of a convenience sample denied us the opportunity to compare patients who have undergone the temporal lobectomy to epileptics yet to receive the procedure. Also, additional measures of the constructs of interest may have been valuable, as internal symptoms of mental illness may be more difficult for a family member to reliably score than interpersonal dependence, which is much more of an outgoing sign. Because aspects of executive function and some depressive symptoms may not be recognizable by everyone, additional measures of these constructs would add reliability to results.

Future studies should implement a longitudinal approach, to compare behavioral changes of epileptics following surgery against epileptics yet to undergo the procedure, to further validate the findings as relative to temporal lobe function. They should also include a sample of individuals receiving both the temporal lobectomy and a form of behavioral modification therapy, such as CBT for Excessive Interpersonal Dependency, as described by Overholser and colleagues (Overholser & Fine, 1994). Therapy directed at decreasing dependency would provide the opportunity to assess whether legitimate improvements toward independence can be made in neurologic populations, and if it could in turn alleviate associated deficits in anxiety, depression, and executive function. Also, implementing MRI or fMRI methods would be beneficial in such a study, due to their ability to identify differences in behavior and cognitive ability causes by differences in brain structure and function. Within such a study, disorder duration would likely be incredibly important, to discern any points in which behavior is not malleable following brain insults.

In conclusion, this study highlights the potential of the temporal lobectomy as a measure for preventing behavioral changes, as well as its obvious purpose in the prevention of seizures in patients with TLE. It also displays the relationships between traits commonly changed by the onset of brain disorders, which poses an opportunity for future clinical studies to target interpersonal dependency in hopes of improvement across other domains which lead to marked improvement in the quality of life of patients.

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