CHAPTER 5

EMPIRICAL INVESTIGATION

Based on the reviews in the preceding chapters the following deductions can be made: Firstly, that noncognitive symptoms are common in Alzheimer's disease patients and lead to psychological morbidity among caregivers, and secondly one of the factors, which may contribute to the manifestation of specific noncognitive symptoms, is likely to be the premorbid temperament disposition of the individual. While the researcher acknowledges that there is a danger in reducing the complexity of expressions of neurological disease to one component, this is done as an attestation to the irreducible uniqueness of individuals that are forced to share an inextricable neurological dilemma. Several studies explicate the possible causes and correlations of this disease and its symptomatology, but few focus on the possibility of an association between disposition and disease (brain) symptoms.

This study aims to contribute to the latter and in so doing acknowledge another possible dimension amongst the vast possibilities, which may account for the occurrence of specific noncognitive symptoms in individuals. It poses the following research questions: what is the nature and frequency of noncognitive disturbances in Alzheimer's disease, and on which dimensions are premorbid disposition and noncognitive symptoms related in Alzheimer's disease?

The goal of this study, therefore was to elucidate the relationship between noncognitive functional deterioration and distinct biological premorbid temperament traits in a group of Alzheimer's patients.

This chapter addresses the design of the study, procedures followed for sample selection, the rationale for the use of specific measuring instruments, and the analyses techniques used to interpret the data and shed light on the possible relationship between disposition and disease symptoms in a community based sample of Alzheimer's patients.

5.1 Design

This study utilised a correlational design. Data was obtained from Alzheimer's disease caregivers regarding the noncognitive symptoms and premorbid temperament traits of their wards. A noncognitive inventory (Behavioural Rating Scale for Dementia) was utilised to elicit information about current pathology and a temperament inventory (Formal Characteristics of Behaviour-Temperament Inventory) was used to gather information about premorbid temperament before the disease process. A primary caregiver completed the noncognitive inventory and the temperament inventory. In order to minimise retrospective bias, a secondary informant (who knew the patient before disease onset) completed the temperament inventory as well. The secondary informant was available for all of the Alzheimer's patients included in this study (63 secondary informants). The answers from the two information sources were correlated to determine if current behaviour biased judgement of premorbid disposition.

A screening schedule (Appendix A) and the CERAD Diagnostic Impression Protocol was administered telephonically to all interested participants, and those caregiver's that fulfilled the eligibility criteria (discussed below), thereafter completed a biographical questionnaire (Appendix B) about the patient's age, level of education, and gender. Caregivers were also asked about any other family members of the patient who may have had Alzheimer's disease. The cognitive status/functional state of the patient was determined using

caregiver information obtained from the Blessed Rating Scale. Biographical data, cognitive status, and premorbid temperament were correlated with noncognitive symptoms in order to determine whether premorbid temperament is related to the occurrence of specific noncognitive symptoms and may thus contribute to the heterogeneous profile observed in the noncognitive manifestations.

5.1.1 Sample

The sample in this study alludes to the primary caregivers of Alzheimer's patients who act as collateral sources of information, and Alzheimer's patients about whom the information and data is analysed and presented.

Over a period of two and a half years caregivers of Alzheimer's patients were contacted to participate in the study. The sample of caregivers was drawn from lists provided by the support group network of the Alzheimer's and Related Dementias Association (ARDA), names provided by neurologists, and other interested persons who volunteered after receiving information from third parties. The ARDA groups meet on a monthly basis and provide information and support to caregivers of patients with Alzheimer's and other dementias. During the time of data collection, the groups were active in seven South African provinces, Namibia, and Zimbabwe. On average four groups were active in the Eastern Cape, one in the Free State, nine in Gauteng, eight in Kwazulu-Natal, two in Mpumalanga, nine in the Western Cape, two in the North West province, one in Namibia, and two in Zimbabwe. The researcher contacted all group facilitators in order to obtain a large national sample. The groups from Namibia and Zimbabwe were excluded from the study because of cost and proximity dilemmas, although the participants from these groups showed a willingness to participate.

For each caregiver (primary informant) contacted, the researcher enquired about the availability of a secondary informant who knew the Alzheimer's patient before the disease onset. This was done to compensate for the challenge of retrospective bias that may be inherent in a study design of this nature.

5.1.2 Interrater concordance

One of the most challenging factors in studies dealing with premorbid temperament is the issue of retrospective bias. The relationship between premorbid temperament and noncognitive symptoms in Alzheimer's disease could either reflect "a premorbid diathesis for …symptoms or a retrospective bias among the informants in which the current characteristics of the patient coloured the recollections of caregivers" (Strauss et al., 1997, p. 257). Studies show that the current behaviour or temperament often clouds judgment of previous traits either in the form of higher ratings on negative traits or higher ratings on positive traits, with caregivers idealizing the past relative to the present (Petry et al., 1988; Swearer et al., 1996). Alzheimer's disease is also characterised by an insidious disease onset and this compounds the issue of reliability of retrospective information because caregivers have difficulty distinguishing the disease characteristics from inherent disposition.

Various methods were used to counter the consequences of retrospective bias. Firstly, two informants were utilised. The primary informant is the person who lives with the Alzheimer's disease family member and knew him/her well in the past and thus, qualifies as a primary caregiver. In most cases, the person also lived with the patient prior to the diagnosis of Alzheimer's disease. The primary informant also provided information on the

current noncognitive symptoms. On the other hand, the secondary informant was chosen because of his/her knowledge of the person before the disease and is currently not living with the person. In this manner, the reliability of retrospective data could be ascertained.

Secondly, half of the primary informants were given the Behaviour Rating Scale for Dementia as the first instrument and the rest of the informants were given the Formal Characteristics of Behaviour-Temperament Inventory as the first instrument so that the order of completion was counterbalanced. This was done to counter the effects of current and premorbid bias as one instrument solicits information about the present (disease course) and the other about the past. Finally, when both informants were administered the Formal Characteristics of Behaviour- Temperament Inventory, they were asked to recall when the first symptoms appeared and thereafter, had to chose a time period several years (5 years) before that to describe what the patient was like. In this way, informants were given a specific grounding in terms of the recall period with all informants sharing some consistency in the period of recall.

It is important to note that caregiver characteristics such as gender, temperament, age may also influence their impressions of the Alzheimer's patients behaviour. However, the focus of this study is to inter alia explore the relationship between patients premorbid temperament and current noncognitive symptoms and the use of two informants was included in the design to minimise the influence of this confounder (caregiver characteristics).

5.2 Procedure

For the participants involved in the ARDA groups the researcher together with the national director of ARDA contacted all ARDA support group facilitators from the seven provinces, notified them of the study, and received the names of group members who were willing to participate. Participants referred by neurologists were also contacted and screened. After follow-up calls to 141 caregivers, 108 were available for the initial screening interview. Thirty-three caregivers from the original sample of 141 were not available or declined to participate.

The initial idea was to draw lists from the many groups and thereafter, use systematic sampling to obtain the target group. However, this would have reduced the sample to fewer than 30 people. Due to the nature of this study (community-based) and the research questions posed, a nonprobability convenience sampling technique was used. The lack of a registry of Alzheimer's patients and the stringent exclusion criteria that applied to this study necessitated the use of this technique.

The use of random sampling is strongly advocated in the methodology texts, however most neuropsychological studies use non-random samples of highly specialised subpopulations, because of the amorphous nature of brain-behaviour relationships. Although a significant level of generality is demanded from research output, which is achievable through the use of random sampling, there is a lack of consensus as to the necessity of this method of sampling in psychological research (Bordens & Abbott, 2002). Psychological studies aim to apply their findings implicitly through the models and theories and the necessity of using random samples is a moot point and less of a concern for the degree of generality beyond the sample.

5.2.1 Sample selection

The criteria for caregiver participation included the number of contact hours spent with the patient. Caregivers had to be staying with the patient because the requirement for this study was a sample of Alzheimer's patients who were community-based and not living in a nursing home.

The criteria for inclusion of the Alzheimer's patient was set out in the Screening Schedule (Appendix B), which elicited the following information from caregivers: a previous history of a medical, neurological and/or psychiatric condition, the nature of the diagnosis, the date of diagnosis, the confirmation of an Alzheimer's disease diagnosis, and pharmacological history.

5.2.2 Exclusion criteria

Implementation of the exclusion criteria minimised the influence of extraneous variables on the results, and included the following rationale:

- The basis for exclusion on a medical, neurological, or psychiatric condition was determined by the various ailments and their contribution to dementia. These conditions may lead to a differential diagnosis and contaminate the disease profile of the sample.
- Patients with advanced age were also excluded from the study (i.e. patients older that 80) because comorbid conditions associated with older people can complicate the clinical picture. Moreover, in this older patient group a wider range of pharmacotherapies are used and side effects may enhance or mask the noncognitive symptoms accompanying Alzheimer's disease.

- The primary caregiver had to live with the patient because knowledge about the patient's behaviour on a daily basis had to be comprehensive. The instrument used to elicit information about noncognitive symptoms included items that were specific in content and frequency of occurrence.
- For the reasons stated above patients who were involved in drug trials, and patients who were on a myriad of drugs for longer than a year were also excluded from the study. It must be noted that many patients are on one or two prescribed medications, however, this was factored into the study by asking caregiver's the reason for certain drug choices, eliciting information about the period of use, and using a measuring instrument that contains response choices spanning the disease course.
- Finally, a diagnosis of probable Alzheimer's disease was integral to achieving the study aims. Other studies analysed hospital records, brain scans, or EEG's to confirm a probable Alzheimer's disease diagnosis. This was not possible because of the community-based sample of Alzheimer's patients. The researcher involved only caregivers with family members who had two diagnoses of probable Alzheimer's disease from different health professionals. All participants included in this sample obtained a second opinion, which corroborated the first diagnosis of probable Alzheimer's disease. Furthermore, the researcher questioned caregivers about the presentation of symptoms using the CERAD Diagnostic Impression Protocol, which elicited general information about the patients overall cognitive manifestations and other illnesses that could have contributed to the dementing process. These impressions were collated with the information received on the Blessed Dementia Scale and a decision was made about inclusion in the sample using these varied information sources. This rigorous process was applied to compensate for the absence of neuroimaging records and laboratory tests, which were not available for all of the

community- dwelling sample. Moreover, in developing countries with limited resources, neurological scans (MRI) are not easily obtainable for all patients.

After the completion of the screening interviews, 63 caregivers who lived with an Alzheimer's patient were eligible for participation in the study. The forty-five caregivers of the listed 108 provided information about the Alzheimer's patient that excluded them as collateral sources of information. This included caregivers whose family member was in a nursing home, those who had no secondary informant, Alzheimer's disease patients who had a previous history of illness, patients who were older than 80 years, and those patients with a mixed diagnosis (e.g., Parkinson's and Alzheimer's disease), an unconfirmed diagnosis of Alzheimer's disease, and a general diagnosis of dementia.

In sum, 141 caregivers communicated an interest in the study by providing their contact details. An initial cohort of 108 communicated their willingness to participate. After the screening schedule, a final sample of 63 caregivers qualified from the list of 108. The latter were included in the study because they lived with the Alzheimer's patient, identified a secondary informant, and their wards had no previous record of major illnesses, were younger than 80 years of age, were not on any regimented drug trials, and had a second diagnosis of Alzheimer's disease. Sixty-three secondary informants were contacted to complete the temperament inventory and this information was used as a reliability check for premorbid estimation of a patient's temperament.

5.3 Data collection

Due to time and resource constraints, only participants in the Gauteng and Kwazulu-Natal were personally interviewed. All other participants were telephonically interviewed. Interviewees provided the time and date for the interview and the sessions were completed in approximately 55 minutes. Twenty-seven primary caregivers and 20 secondary informants were visited at their homes, and the instruments were administered personally. Thirty-six primary caregivers and thirty-one secondary informants completed the instruments telephonically. Three follow-up visits to Gauteng and KwaZulu-Natal were made to complete the data collection, and in some cases, an average of four follow-up calls were made to secondary informants telephonically obtain data from them.

Although all of the 63 participants provided details for a secondary informant, in 12 cases the secondary informant was not available to provide information. Data from 51 secondary informants were used in this study. The attrition rate for the secondary informant was to be expected as these informants were not primarily caring for the patient and often lived in another town, and their participation was subject to their availability.

The researcher was aware that these different techniques may have an impact on the responses elicited. To minimise any differences, the instruments chosen for the study were suitable for either type of interview and had been used in research employing both techniques (Tariot et al., 1996; Tariot et al., 1995). An attempt was also made to be consistent in the use of interview method thus, one method was used for both the primary and secondary informant of an individual patient and the time limit imposed in the telephonic interview was adhered to in the personal interview. Due to the instruments used (the questions are not prone to issues of social-desirability bias) and the nature of the

sample (caregiver's who voluntarily agreed to be part of the study), the use of these two techniques should have minimal effect on the results.

5.3.1 Measuring Instruments

Three instruments were used in this study namely the CERAD Behaviour Rating Scale for Dementia, the subscales from the Formal Characteristics of Behaviour-Temperament Inventory, and the Blessed Dementia Scale. In the following sections the above-mentioned instruments are discussed in terms of their reliability and validity, and their relevance to this study.

5.3.1.1 Behaviour Rating Scale for Dementia

This is a rating scale developed by the Behavioural Pathology Committee of the Consortium to establish a Registry for Alzheimer's disease (CERAD). This consortium consists of 24 medical centers and is involved in the standardisation of procedures for the evaluation and diagnosis of Alzheimer's disease (Neurology, 2002). The researcher communicated with the coordinator at CERAD to obtain the scale. Before permission was granted a concise summary and proposal for the study was submitted to the coordinator at Duke University Medical Center. After evaluation of the proposal, the consortium granted permission for the use of the CERAD protocols.

The Behavioural Rating Scale for Dementia is a standardised scale for caregivers of Alzheimer's patients and is conducive to either personal or telephonic administration. Due to its specificity, selected behavioural characteristics of Alzheimer's disease can be correlated with clinical aspects such as functional status, cognitive decline, gender, etc.

The instrument is considered appropriate for this sample as most studies show that it is designed for non-institutionalised Alzheimer's disease patients (Mack, Patterson, & Tariot, 1999). Furthermore, the scale was derived from components of the Behavioural Pathology of the Alzheimer's disease Rating Scale, the Columbia University scale for Psychopathology, and the Cornell Scale for Depression. The combined use and adaptation of items from three established questionnaires makes the Behavioural Rating Scale for Dementia a comprehensive evaluative instrument. Thus, in comparison to other similar instruments this scale is a comprehensive assessment tool for the spectrum of neuropsychiatric and neurobehavioural pathology in Alzheimer's disease patients, and is suitable for the investigation of the nature and frequency of a spectrum of noncognitive disturbances (Mack & Patterson, 1993; Mack et al., 1999; Tariot et al., 1995; Tractenberg et al., 2000).

5.3.1.1.1. Item composition

The scale was developed for the solicitation of information from observers, and the rating of scores are based on frequency rather than severity judgments. According to Tariot et al (1995) severity judgements are more challenging to determine and provide unreliable scores. The items represent relatively discrete aspects of behaviour and are worded in objective language to avoid bias and judgement on the part of the informant and examiner (Mack & Patterson, 1993). The long form of the this instrument, which was used in this study, consists of 46 items. The instrument is subdivided according to the following:

i) Thirty-eight items are rated according to frequency of occurrence.

If a respondent answers YES to occurrence during the one-month window period, the following scores can be given:

- 1 - occurred 1-2 days in the past month.
- 2- occurred 3 to 8 days during the past month.
- - occurred 9-15 days in the past month.
- - occurred 16 or more days in the past month.

If a respondent answers NO or unable to rate, the following scores are assigned to the response:

- 0 – has not occurred since illness began.
- 9 - unable to rate.

If the respondent answer NO to behaviours observed during the window period, the interviewee inquires about the occurrence prior to the window period and assigns the following score:

- 8- occurred since illness began, but not in the past month.

Examples of questions that require these frequency ratings include:

a) Has {S} said that {S} feels anxious, worried, tense, or fearful? For example, has {S} expressed worry or fear about being left alone? Has {S} said {S} is anxious, afraid of certain situations? If so, describe.

b) Has {S} shown physical signs of anxiety, worry, tension, or fear? For example, is {S} easily startled? Does {S} appear nervous? Does {S} have a tense or worried facial expression? If so, describe.

c) Has {S} shown sudden changes in emotion? For example, does {S} go from laughter to tears quickly?

In all test items, the term {S} is replaced by an appropriate substitute as it denotes the individual with Alzheimer's disease. The examples provided are only presented to the caregiver if clarity of a particular question is obscured. If a respondent understands the question, the examples are not given.

ii) Eight items, which deal with symptoms related to diurnal confusion, interest and motivation, weight and appetite changes, and clingy behaviour, do not require a frequency estimate and are rated as absent or present since illness began, and can be scored as:

- 0 - No, has not occurred.
- 1 – Yes, has occurred in past month.
- 8 - Occurred since illness began, but not in past month.
- 9 - Unable to rate.

Examples of questions that require these frequency ratings include:

a) Does {S} seek out more visual and physical contact with caregivers than before {S's} dementia began? For example, has {S} seemed 'clingy'? Does {s} follow you about and seem to want to be in the same room with you?

iii) Fourteen items of the inventory have a probe because the frequency ratings do not adequately address ideational items. This follow-up question is used to determine whether the misperception is a clear fixed distortion of reality or a vague, transient perceptual experience. The items concerning hallucinations also have an additional component that

requires the informant to describe the behaviour thus enabling the examiner to rate in terms of clarity of the hallucinatory experience.

Examples of questions that require these frequency ratings include:

a) Has {S} done or said anything that suggests {S} thinks {S's} spouse is unfaithful?

Probe: *If yes, ask*: If you try and correct {S}, will {S} accept the truth?

b) Has {S} seen things or people that were not there? *If yes, describe.*

If yes, rate for clarity: Vague 0, Clear 1

iv) Finally, item 46 is an open ended question and is used to elicit information that is not otherwise represented in the scale.

5.3.1.1.2 Reliability and Validity

Two total scores and six subscale scores represent the scoring estimates of the BDRS. The sum of all the ratings of items (0-4 for 26 items, 0-5 for 11 items, and 0-1 for 8 items) comprises the total weighted score. The open-ended item 46 is the only exclusion from this total. The value of the total weighted score ranges from 0-167, and this score provides an overall picture of the frequency and severity (11 items) of psychiatric and behavioural symptoms in Alzheimer's disease. The second total score represents the total number of items rated as present in the past month and does not reflect the frequency but rather the number of varying behaviours shown by a subject. This continuum ranges from 0-45. The subscales comprise the additional six ratings and are scored as follows:

- The D*epressive* symptom subscale is made up of seven items scored 1-4 and 1-5 with the value ranging from 0-29.

- The *Inertia* subscale comprises three items and has a range of 0-3.
- The *Vegetative* subscale score is obtained by summing the ratings on four items and scores range from 0-4.
- The *Irritability/Aggression* subscale score is the sum of ratings of items 18-22 and the value ranges from 0-20.
- *Behavioural Dysregulation* is the sum of ratings attributed to five items and the scale has a range of 0-17.
- The *Psychotic* symptom subscale comprises six items scored on a scale from 0-5 and the value of this ranges from 0-30.

Mack et al. (1999) found that the subscales correlate significantly with the total weighted scores, the total weighted score is significantly associated with the number of items rated present. A high internal consistency is reflected by the α values of .87 and .85 for the total weighted score and total of items rated from 1-4, respectively. The test-retest total estimates among differentially impaired Alzheimer's disease groups range from .70 to .89 thus, demonstrating the reliability of the instrument across severity parameters. Due to the community-dwelling sample and the selection process in this study, it was not possible to obtain information from a cross section of differentially impaired subjects therefore, this instrument was chosen because of its robustness in terms of moderate disease severity and noncognitive symptoms.

In terms of consistency between subscales, three (Depressive, Irritability/aggression, and Psychotic subscale) show a moderate to high internal consistency, whereas the Inertia, Behavioural Dysregulation, and Vegetative subscales have low α coefficients (Mack et al., 1999). Furthermore, the correlations between the scales are significant and range from

.10 to .44. The criterion for the inclusion of the three scales with low consistency is based on their clinical significance.

Using factor analysis to investigate inter-item relationships, Tariot et al. (1995) show that 4 factors (depression, irritability/aggression, vegetative symptoms, and apathy) reflect the known categories of noncognitive features that are seen in Alzheimer's disease samples. The other two factors namely psychotic features and behavioural dysregulation show a less robust relationship but reflect conditions that are attributable to dementia of the Alzheimer's type. In a comparative study, Patterson et al. (1997) found that Alzheimer's disease patients differ significantly from normal elderly control subjects on BRSD ratings.

A follow-up study by Tractenberg et al. (2000) confirms a higher prevalence rate of noncognitive symptoms for Alzheimer's disease patients when compared to the endorsement rates of normal elderly controls. At baseline the Alzheimer's disease subjects mean score on the BRSD was 29.9 (20.0) with a range of 0-117, whereas the control group had low total scores with a mean of 4.7 (8.3) and a range of 0-53. Tariot et al (1995) also shows that patients who are described as having undergone personality changes have an increased average number of items rated as present. They suggest that this also provides a basic validity estimate of the instrument. Tariot (1996) concludes that the instrument has satisfactory content, construct, discriminant, predictive, and convergent validity as demonstrated by numerous studies.

A caveat on the reliability estimates derives from the notion that pathological behaviours are not stable and therefore, reliability of scores may be influenced by this. According to Mack et al. (1999) shorter retesting intervals reduces the impact of behavioural instability, but enhances the odds that a respondent may recall a previous answer and this influences

reliability estimates. Nevertheless, the availability of scale scores for specific clusters of noncognitive symptoms makes this instrument relevant to the investigation of possible correlates of specific noncognitive symptoms

5.3.1.2 Formal Characteristics of Behaviour-Temperament Inventory

The choice of an appropriate temperament inventory proved challenging. Most inventories are designed in self-report formats, and Alzheimer's patients do not have the capacity to report on their own behaviours thus, necessitating the use of collateral sources of information. After a lengthy correspondence with Strelau, Newberry, and Zawadzki (personal communication, July 31, 2000; August 13, 2000; August 29, 2000; August 30, 2000; September 11, 2000; October 2, 2000; December 17, 2000) it was decided that the Formal Characteristics of Behaviour- Temperament Inventory would be used instead of the Pavlovian Temperament Inventory (Strelau & Zawadzki, 1993).

This decision is based on the knowledge that the instrument is constructed on the assumption that temperament refers not to content but to formal aspects of behaviour. Moreover, in addition to the Eysenck Personality Questionnaire, for example, the Formal Characteristics of Behaviour-Temperament Inventory includes measures of perseverance traits that are not included in other inventories, and has scales that tap into a wider content. The activity scale, for example, refers not only to motor actions but to goal directed behaviours as well and this appears to have relevance for the chosen Alzheimer's sample.

Drawing on the theoretical literature one can hypothesise that due to the involvement of frontal circuits in Alzheimer's disease, assessment of goal directed behaviour is integral to

this study. Moreover, this inventory was developed using the postulations of the Regulatory Theory of Temperament and identifies temperament according to its primary traits thus, allowing the measurement of its functional importance and distinctiveness. This corroborates the goal of the study, which attempts to elucidate the relationship between functional deterioration during the course of Alzheimer's disease with distinct biological premorbid traits. The robustness of the scale is evident because of its significant correlations with other biologically based temperament inventories (Strelau & Zawadzki, 1995).

The Formal Characteristics of Behaviour-Temperament Inventory was constructed as a self-report questionnaire. On the advice of Strelau and Zawadzki (personal communication, 13 August 2001) it was decided that the questions would be changed to reflect the third person singular so that informants could rate patient behaviours. According to Strelau (personal communication, 13 August 2001) questions on the Pavlovian Temperament Inventory were changed to the third person and administered to caregivers of patients with bipolar affective disorders and the results corresponded with the temperament dimensions as measured by the Formal Characteristics of Behaviour-Temperament Inventory and are in accordance with the hypotheses on which this inventory was developed.

Hofstee (1991) is in agreement with the translating of these instruments into the third person and suggests that this is a more satisfactory manner than asking informants to rate persons directly on traits using an unchanged self-report format. He contends further that because of the different social roles ascribed to people different views of temperament traits may arise. These discrepancies can be addressed through the use of many raters, whereas a self-report cannot be validated in this manner. He suggests that self-reports

should only be used if observer ratings are not available and only as an "auxiliary variable, boosting the reliability and validity of the observer ratings as a prime measure " (Hofstee, 1991, p. 187). Nonetheless in this study, the methodological consequence of self and informant bias is benign, because Alzheimer's patients have limited capacity to make judgments on their temperamental dispositions, especially the premorbid approximations. However, it should be pointed out that some of the items on the scale refer to traits that are more readily evaluated by introspection and self-awareness and these scale items are most likely to show greater interrater disagreement.

5.3.1.2.1 Item composition

The Formal Characteristics of Behaviour-Temperament Inventory consists of six subscales constructed on the hypothesis that temperament encompasses formal aspects of behaviour that emerge as energetic and temporal attributes (Strelau & Zawadzki, 1993). Each of these subscales represents a robust temperament dimension with four traits (sensory sensitivity, endurance, emotional reactivity, and activity) reflecting the energetic characteristics, and two traits (briskness and perseverance) alluding to the temporal dimension of behaviour.

Informants are asked to make a general assessment of what the patient was usually like without contemplating their previous answers. There are many versions of this inventory and the international version was used in this study. The following six subscales, with 20 items each comprise this international version:

- *Perseverance* (PE) - penchant for continuous and repetitive actions after cessation of the stimuli responsible for these actions.

- *Emotional Reactivity* (ER) - penchant for intense reactions to emotion - generating stimuli, manifested as high emotional sensitivity and low emotional endurance.
- *Endurance* (EN) - the capacity for appropriate and adequate reactions in situations of long-lasting or high stimulative activity and situations of intensive external stimulation.
- *Activity* (AC) - penchant for actions of a high stimulative value.
- *Sensory sensitivity* - response to low stimulation in all sensory modalities.
- *Briskness* – the behavioural capacity for mobility, speed and tempo in response to stimuli.

5.3.1.2.2 Reliability and validity

According to Strelau and Zawadzki (1993) alpha coefficients of the subscales range from .77 to .85, and intercorrelations are satisfactory across five different samples (n=2023) providing support for the replicability of results, and the reliability of this instrument as a measure of primary temperament traits. With reference to the psychometric properties of the scale, Strelau and Zawadzki (1993) conclude that the scores on the six subscales follow a normal distribution with skewness and kurtosis indices in an acceptable range.

The Formal Characteristics of Behaviour-Temperament Inventory has demonstrated acceptable construct validity in a large study. In a study utilising samples of 1500 people, Strelau and Zawadzki (1995) correlated the subscale scores with 27 other temperament dimensions measured by seven different temperament inventories. They found that the construct emotional reactivity correlated highly with emotion-oriented scales, activity was associated with extraversion and strength of excitation, perseverance was negatively linked with strength of excitation and positively with emotional dimensions and neuroticism, and endurance had positive association with strength of inhibition. Furthermore, they

found no significant association between traits of temperament and most of the personality traits as measured by the NEO-FFI (e.g., openness, agreeableness, and conscientiousness), and the 16PF.

This supports the theoretical assumptions on which the scale was constructed, namely that nontemperamental measures of personality characteristics should not be linked to temperament because the Regulative Theory of Temperament proposes that temperament and personality are separate constructs. The discriminant validity was also indicated by the lack of association between the subscales and the 16PF measures of intelligence, shrewdness, and self-sufficiency.

5.3.1.3 Blessed Dementia Scale

This scale, which was originally developed by Blessed et al. (1968) is widely cited in literature as a quantitative measure of the severity of deterioration in Alzheimer's disease. It is commonly used in cross-sectional studies because of its high reliability and validity in short term evaluations and its "brevity and ease of administration " during the assessment (Harwood et al., 2000, p. 397).

For the purposes of this study, a modified version of Part A of the scale was used (Mack & Patterson, 1993). Caregivers are asked to rate on a 3- or 4- point scale the patient's premorbid cognitive ability in comparison with the preceding six months and the patient's ability to perform everyday tasks. The scores range from 0 to 17, with higher scores reflecting greater incapacity. Researchers often use the BDS as a measure of disease severity, cognitive impairment, or functional incapacity (Gauthier, Gelinas, & Gauthier, 2002; Teri et al., 1988).

Studies show that the Blessed Dementia Scale correlates highly with post-mortem changes and level of cortical involvement (Hesdorffer, Sano, & Mayeux, 1990; Teri et al., 1988), and this confirms the earlier results of Blessed et al. (1968) who found that there is a significant association between biological markers (plaque counts) and incapacity among patients with senile dementia. Chen et al. (1998) also demonstrate the association between BDS and cortical deterioration in their study, which shows significant positive relationship between specific cognitive disabilities such as executive deficits and BDS scores. When compared to the Mini Mental Status Exam, scores on the Blessed Dementia Scale show high correlations with this measure of cognitive impairment, and positive significant associations with noncognitive problems reported by caregivers (Harwood et al., 2000; Swearer et al., 1996; Teri et al., 1988).

To reiterate, the aim of this study was to elucidate the relationship between noncognitive functional deterioration and distinct biological premorbid temperament traits in a group of Alzheimer's patients. The data were analysed using both descriptive and multivariate analyses.

5.4 Data analyses

The data were analysed using both descriptive and inferential statistics. The descriptive analysis was used to summarise the frequency of noncognitive aspects thereby aiding the description of a large quantity of data (Welkowitz, Ewen, & Cohen, 2000). This was followed by the calculation of alpha coefficients, which indicate consistency among scales, skewness, kurtosis and standard error scores, and other psychometric measures. A description of the method for collating the primary and secondary informant data from the

Formal Characteristics of Behaviour-Temperament Inventory into one composite score follows. Finally, this section describes the multivariate method of canonical analysis that was used to explore the relationship between premorbid temperament and noncognitive symptoms in Alzheimer's disease.

5.4.1 Descriptive statistics

Biographical data such as mean and standard deviations for age, education levels, gender, scale means, and frequency of occurrence of noncognitive symptoms were calculated. This provides a description of the sample characteristics and average ratings obtained on the scales.

Concordance between primary and secondary informant's descriptions of premorbid temperament along all dimensions was analysed using intraclass correlations with Bonferroni corrections. An alternative technique (Cohen's Kappa) was considered, but with this technique it is not possible to determine statistical significance (Bordens & Abbott (2002). Furthermore, according to Strauss, Pasupathi, and Chatterjee (1993) the correlational technique takes into account the difference in mean scores and variances and is a useful measure of interrater reliability. The mean differences between raters in the domain scores were calculated and the combined mean was used in the analysis. In order to minimise errors of interpretation the means and standard deviations of the two sets of scores were compared. In this way the researcher can determine if the correlation is a true reflection of agreement or an anomaly that arises when the magnitude of scores from the two sets increase and decrease similarly, but differ in absolute value (Bordens & Abbott, 2002).

5.4.2 Canonical analysis

This technique was used because it serves as an apt tool to answer the questions about the relationship between premorbid temperament and noncognitive symptoms of Alzheimer's disease. Two sets of variables (with many scale scores) were analysed in order to determine the number of dimensions that one set (noncognitive symptoms) shares with the other set (premorbid temperament). The canonical analysis was performed using the SAS computer package (CANCORR procedure).

This technique has a number of limitations. According to Tabachnick and Fidell (1983) the associations between linear variable composites do not necessarily lead to the interpretability of principal dimensions. Moreover, unlike other techniques, canonical analysis restricts interpretation to orthogonal factors, and intercorrelations within the sets are not identified. However, to answer the research question posed in this study, the researcher considered this technique because of its complexity and its incorporation of multiple relationship dimensions. The use of linear regression was considered, however this empirical study is explanatory and the following advice was heeded:

> We take a dim view of regression in explanatory research for various reasons…but mostly because we feel that more orderly advance in behavioural sciences is likely when researchers, armed with theories, provide apriori theoretical ordering that reflects causal hypothesis rather than when computers order IVs post and ad hoc for a given sample … Probably the most serious problem with the use of regression is when a relatively large number of IVs is used…and the ad hoc order produced from the set of IVs is likely not to be found in other samples from the same population (Cohen & Cohen, 1983, p. 124).

Prior to the use of canonical analysis the following norms were considered:

- The skewness and kurtosis values and associated standard errors were carefully assessed to ensure that the variables were normally distributed. This was of particular importance because of the small sample size.
- Outliers or extreme datum were determined and controlled for. In the event of nonnormality (skewed distributions) and outliers transformations and other methods for multivariate outliers were used to transform the data and fulfil the prerequisite of normality.
- Aspects of multicolinearity, singularity, and linearity were identified and eliminated or corrected using various techniques (Miles & Shevlin, 2001; Tabachnick & Fidell, 1983).

Steps 1 to 10 of the analysis process are outlined below.

1. A correlation matrix is generated. This matrix can be subdivided into four sections: correlations between dependent variables, correlations between independent variables, and two matrices between independent and dependent variables.
2. The canonical correlations obtained from the four elements provide a coefficient that is interpreted as a Pearson product-moment coefficient (*r*).
3. When *r* is squared it reflects the overlapping variance between pairs of canonical variates.
4. Eigenvalues are calculated to denote overlapping variance. They are considered equal to the squared *r* (Tabachnick & Fidell, 1983).
5. Significance tests (Chi-squared or F distributions) are conducted to determine the significance of the canonical correlations. Only variates that are significant are considered for interpretation.

6. The two matrices of independent and dependent canonical coefficients are used to ascertain the scores on canonical variates. This establishes a matrix of canonical structure that shows the correlation of the original variables with the canonical variates.
7. In order to estimate the direct contribution of each variable to the composite variate, a matrix of canonical coefficients is calculated.
8. Assessment of variance from the significant variates is determined by calculating the amount of variance that a canonical variate extracts from its own set of variables *(pv).*
9. Finally, a redundancy analysis is done to determine variance obtained by a canonical variate multiplied by the canonical correlation of the pair.
10. Interpretation of variates involves the assessment of correlations for all variates found to be significant. In most cases loadings between variables and variates below .30 are disregarded.

5.5 Conclusion

The power of neuropsychological research is reliant on the knowledge of basic organization of functional systems, its adaptability to atrophy, and its threshold of resilience or vulnerability to disease states. In this study information on premorbid temperament and current noncognitive symptoms of Alzheimer's disease patients was elicited from a carefully chosen cohort of Alzheimer's disease caregivers.

Various statistical techniques were used to derive results on the occurrence of noncognitive symptoms, concordance of ratings among informants, and relationship between dimensions of temperament and disease symptoms. The choice of instrumentation fulfils the purpose of distinguishing between dimensions of noncognitive

symptoms and eliciting primary functional temperament traits. In this manner the researcher ensures both the measurement of temperament on a continuum and the assessment of nominal neuropsychiatric and neurobehavioural signs, and seeks to explain the relationship between the two. In addition, this study provides the implicit benefit of providing insight about how functional states emerge from the structural substrates of the brain, relative to the imposition of a neurological disease. The latter premise is explored in the following chapters.